Red Hat JBoss Fuse 6.3

Fuse Integration Services 2.0 for OpenShift

Installing and developing with Red Hat JBoss Fuse Integration Services 2.0 for OpenShift

Last Updated: 2018-10-11

Red Hat JBoss Fuse 6.3 Fuse Integration Services 2.0 for OpenShift

Installing and developing with Red Hat JBoss Fuse Integration Services 2.0 for OpenShift

Abstract

Guide to using Fuse Integration Services 2.0 for OpenShift

Table of Contents

CHAPTER 1. BEFORE YOU BEGIN

1.1. RELEASE NOTES

See the Fuse Integration Services 2.0 for OpenShift Release Notes for important information about this release.

1.2. VERSION COMPATIBILITY AND SUPPORT

See the Red Hat JBoss Fuse Supported Configurations page for details of version compatibility and support.

1.3. SUPPORT FOR WINDOWS O/S

The developer tooling (**oc** client and Container Development Kit) for FIS is fully supported on the Windows O/S. The examples shown in Linux command-line syntax can also work on the Windows O/S, provided they are modified appropriately to obey Windows command-line syntax.

1.4. GETTING STARTED FOR ADMINISTRATORS

If you are an administrator, we recommend you read the instructions in the OpenShift Primer to get started with installing and administering a small OpenShift cluster.

1.5. COMPARISON: FUSE STANDALONE AND FUSE INTEGRATION SERVICES

There are several major functionality differences:

- An application deployment with Fuse Integration Services consists of an application and all required runtime components packaged inside a Docker image. Applications are not deployed to a runtime as with Fuse Standalone, the application image itself is a complete runtime environment deployed and managed through OpenShift.

- Patching in an OpenShift environment is different from Fuse Standalone, as each application image is a complete runtime environment. To apply a patch, the application image is rebuilt and redeployed within OpenShift. Core OpenShift management capabilities allow for rolling upgrades and side-by-side deployment to maintain availability of your application during upgrade.

- Provisioning and clustering capabilities provided by Fabric in Fuse have been replaced with equivalent functionality in Kubernetes and OpenShift. There is no need to create or configure individual child containers as OpenShift automatically does this for you as part of deploying and scaling your application.

- Fabric endpoints are not used within an OpenShift environment. Kubernetes services must be used instead.

- Messaging services are created and managed using the A-MQ for OpenShift image and *not* included directly within a Karaf container. Fuse Integration Services provides an enhanced version of the camel-amq component to allow for seamless connectivity to messaging services in OpenShift through Kubernetes.

- Live updates to running Karaf instances using the Karaf shell is strongly discouraged as updates will not be preserved if an application container is restarted or scaled up. This is a fundamental tenet of immutable architecture and essential to achieving scalability and flexibility within OpenShift.

- Maven dependencies directly linked to Red Hat Fuse components are supported by Red Hat. Third-party Maven dependencies introduced by users are not supported.
- The SSH Agent is not included in the Apache Karaf micro-container, so you cannot connect to it using the bin/client console client.
- Protocol compatibility and Camel components within a Fuse Integration Services application: non-HTTP based communications must use TLS and SNI to be routable from outside OpenShift into a Fuse service (Camel consumer endpoint).

CHAPTER 2. GET STARTED FOR ADMINISTRATORS

If you are an OpenShift administrator, you can set up Fuse Integration Services (FIS) for other users by installing the FIS images streams and templates as described here.

2.1. PREPARE THE OPENSHIFT SERVER

1. Start the OpenShift Server.
2. Log in to the OpenShift Server as an administrator, as follows:

   ```
   oc login -u adminUser -p adminPassword
   ```

3. Install the FIS image streams. Enter the following commands at a command prompt:

   ```
   BASEURL=https://raw.githubusercontent.com/jboss-fuse/application-
   templates/6.3-GA
   oc replace --force -n openshift -f ${BASEURL}/fis-image-streams.json
   ```

4. Install the FIS templates. Enter the following commands at a command prompt:

   ```
   BASEURL=https://raw.githubusercontent.com/jboss-fuse/application-
   templates/6.3-GA
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/karaf2-
   camel-amq-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/karaf2-
   camel-log-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/karaf2-
   camel-rest-sql-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/karaf2-
   cxf-rest-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-amq-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-config-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-drools-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-infinispan-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-rest-sql-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-teiid-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-xml-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-cxf-jaxrs-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-cxf-jaxws-template.json
   ```

CHAPTER 3. GET STARTED FOR DEVELOPERS

You can start using Fuse Integration Services by creating an application and deploying it to OpenShift using one of the following OpenShift Source-to-Image (S2I) application development workflows:

S2I binary workflow

S2I with build input from a *binary source*. This workflow is characterised by the fact that the build is partly executed on the developer's own machine. After building a binary package locally, this workflow hands off the binary package to OpenShift. For more details, see Binary Source from the *OpenShift 3.5 Developer Guide*.

S2I source workflow

S2I with build input from a *Git source*. This workflow is characterised by the fact that the build is executed entirely on the OpenShift server. For more details, see Git Source from the *OpenShift 3.5 Developer Guide*.

3.1. PREREQUISITES

3.1.1. Access to an OpenShift Server

The fundamental requirement for developing and testing FIS projects is having access to an OpenShift Server. You have the following basic alternatives:

- Section 3.1.1.1, “Install Container Development Kit (CDK) on Your Local Machine”
- Section 3.1.1.2, “Get Remote Access to an Existing OpenShift Server”

3.1.1.1. Install Container Development Kit (CDK) on Your Local Machine

To get started quickly, the most practical alternative for a developer is to install Red Hat CDK on their local machine. Using CDK, you can boot a virtual machine (VM) instance that runs an image of OpenShift on Red Hat Enterprise Linux (RHEL) 7. An installation of CDK consists of the following key components:

- A virtual machine (libvirt, VirtualBox, or Hyper-V)
- Minishift to start and manage the Container Development Environment

For FIS 2.0, we recommend you install version 3.1 of CDK. Detailed instructions for installing and using CDK 3.1 are provided in the following guide:

- Red Hat CDK 3.1 Getting Started Guide

If you opt to use CDK, we recommend that you read and thoroughly understand the content of the preceding guides before proceeding with the examples in this chapter.

NOTE

If you are using a CDK version earlier than 3.1, you need to install the FIS image streams and templates manually. See Chapter 2, *Get Started for Administrators*.

IMPORTANT

Red Hat CDK is intended for *development purposes only*. It is not intended for other purposes, such as production environments, and may not address known security vulnerabilities. For full support of running mission-critical applications inside of docker-formatted containers, you need an active RHEL 7 or RHEL Atomic subscription. For more details, see Support for Red Hat Container Development Kit (CDK).

3.1.1.2. Get Remote Access to an Existing OpenShift Server

Your IT department might already have set up an OpenShift cluster on some server machines. In this case, the following requirements must be satisfied for getting started with FIS 2.0:

- The server machines must be running a supported version of OpenShift Container Platform (as documented in the Supported Configurations page). The examples in this guide have been tested against version 3.5.
- Ask the OpenShift administrator to install the latest FIS 2.0 container base images and the FIS templates on the OpenShift servers.
- Ask the OpenShift administrator to create a user account for you, having the usual developer permissions (enabling you to create, deploy, and run OpenShift projects).
- Ask the administrator for the URL of the OpenShift Server (which you can use either to browse to the OpenShift console or connect to OpenShift using the **oc** command-line client) and the login credentials for your account.

3.1.2. Java Version

On your developer machine, make sure you have installed a Java version that is supported by JBoss Fuse 6.3. For details of the supported Java versions, see Supported Configurations.

3.1.3. Install the Requisite Client-Side Tools

We recommend that you have the following tools installed on your developer machine:

Apache Maven 3.3.x

Required for local builds of OpenShift projects. Download the appropriate package from the Apache Maven download page. Make sure that you have at least version 3.3.x (or later) installed, otherwise Maven might have problems resolving dependencies when you build your project.

Git

Required for the OpenShift S2I source workflow and generally recommended for source control of your FIS projects. Download the appropriate package from the Git Downloads page.

OpenShift client

If you are using CDK, you can add the **oc** binary to your PATH using **`minishift oc-env`** which displays the command you need to type into your shell (the output of **`oc-env`** will differ depending on OS and shell type):

```
$ minishift oc-env
export PATH="/Users/john/.minishift/cache/oc/v1.5.0:$PATH"
# Run this command to configure your shell:
# eval $(minishift oc-env)
```

For more details, see Using the OpenShift Client Binary in CDK 3.1 *Getting Started Guide*.

If you are not using CDK, follow the instructions in the CLI Reference to install the **oc** client tool.

***(Optional)* Docker client**

Advanced users might find it convenient to have the Docker client tool installed (to communicate with the docker daemon running on an OpenShift server). For information about specific binary installations for your operating system, see the Docker installation site.
For more details, see Reusing the docker Daemon in CDK 3.1 *Getting Started Guide*.

IMPORTANT

Make sure that you install versions of the **oc** tool and the **docker** tool that are compatible with the version of OpenShift running on the OpenShift Server.

3.2. PREPARE YOUR DEVELOPMENT ENVIRONMENT

After installing the required software and tools, prepare your development environment as follows.

3.2.1. Configure Maven Repositories

Configure the Maven repositories, which hold the archetypes and artifacts you will need for building an FIS project on your local machine. Edit your Maven **settings.xml** file, which is usually located in **~/.m2/settings.xml** (on Linux or macOS) or **Documents and Settings\<USER_NAME>\.m2\settings.xml** (on Windows). The following Maven repositories are required:

- Maven central: **https://repo1.maven.org/maven2**
- Red Hat GA repository: **https://maven.repository.redhat.com/ga**
- Red Hat EA repository: **https://maven.repository.redhat.com/earlyaccess/all**

You must add the preceding repositories both to the dependency repositories section as well as the plug-in repositories section of your **settings.xml** file.

3.2.2. *(Optional)* Install Developer Studio

Red Hat JBoss Developer Studio is an Eclipse-based development environment, which includes support for developing Fuse Integration Services applications. For details of how to install this development environment, see Install Red Hat JBoss Developer Studio.

3.3. CREATE AND DEPLOY A PROJECT USING THE S2I BINARY WORKFLOW

In this section, you will use the OpenShift S2I binary workflow to create, build, and deploy an FIS project.

1. Create a new FIS project using a Maven archetype. For this example, we use an archetype that creates a sample Spring Boot Camel project. Open a new shell prompt and enter the following Maven command:

```
mvn org.apache.maven.plugins:maven-archetype-plugin:2.4:generate \
  -
```

```
DarchetypeCatalog=https://maven.repository.redhat.com/ga/io/fabric8/
archetypes/archetypes-catalog/2.2.195.redhat-000017/archetypes-
catalog-2.2.195.redhat-000017-archetype-catalog.xml \
  -DarchetypeGroupId=org.jboss.fuse.fis.archetypes \
  -DarchetypeArtifactId=spring-boot-camel-xml-archetype \
  -DarchetypeVersion=2.2.195.redhat-000017
```

The archetype plug-in switches to interactive mode to prompt you for the remaining fields:

```
Define value for property 'groupId': : org.example.fis
Define value for property 'artifactId': : fis-spring-boot
Define value for property 'version':  1.0-SNAPSHOT: :
Define value for property 'package':  org.example.fis: :
[INFO] Using property: spring-boot-version = 1.4.1.RELEASE
Confirm properties configuration:
groupId: org.example.fis
artifactId: fis-spring-boot
version: 1.0-SNAPSHOT
package: org.example.fis
spring-boot-version: 1.4.1.RELEASE
 Y: :
```

When prompted, enter **org.example.fis** for the **groupId** value and **fis-spring-boot** for the **artifactId** value. Accept the defaults for the remaining fields.

2. If the previous command exited with the **BUILD SUCCESS** status, you should now have a new FIS project under the **fis-spring-boot** subdirectory. You can inspect the XML DSL code in the **fis-spring-boot/src/main/resources/spring/camel-context.xml** file. The demonstration code defines a simple Camel route that continuously sends message containing a random number to the log.

3. In preparation for building and deploying the FIS project, log in to the OpenShift Server as follows:

```
oc login -u developer -p developer https://OPENSHIFT_IP_ADDR:8443
```

Where, **OPENSHIFT_IP_ADDR** is a placeholder for the OpenShift server's IP address as this IP address is not always the same.

NOTE

The **developer** user (with **developer** password) is a standard account that is automatically created on the virtual OpenShift Server by CDK. If you are accessing a remote server, use the URL and credentials provided by your OpenShift administrator.

4. Create a new project namespace called **test** (assuming it does not already exist), as follows:

```
oc new-project test
```

If the **test** project namespace already exists, you can switch to it using the following command:

```
oc project test
```

5. You are now ready to build and deploy the **`fis-spring-boot`** project. Assuming you are still logged into OpenShift, change to the directory of the **`fis-spring-boot`** project, and then build and deploy the project, as follows:

   ```
   cd fis-spring-boot
   mvn fabric8:deploy
   ```

   At the end of a successful build, you should see some output like the following:

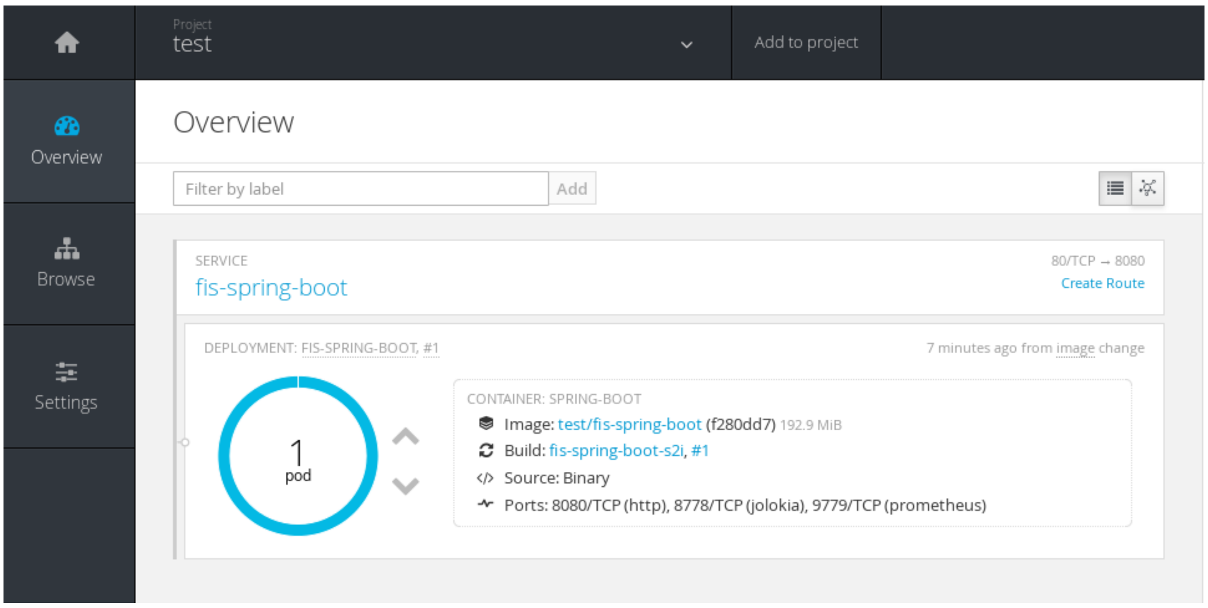
   ```
   ...
   [INFO] OpenShift platform detected
   [INFO] Using project: test
   [INFO] Creating a Service from openshift.yml namespace test name
   fis-spring-boot
   [INFO] Created Service: target/fabric8/applyJson/test/service-fis-
   spring-boot.json
   [INFO] Updating ImageStream fis-spring-boot from openshift.yml
   [INFO] Creating a DeploymentConfig from openshift.yml namespace test
   name fis-spring-boot
   [INFO] Created DeploymentConfig:
   target/fabric8/applyJson/test/deploymentconfig-fis-spring-boot.json
   [INFO] F8: HINT: Use the command `oc get pods -w` to watch your pods
   start up
   [INFO] -----------------------------------------------------------
   --------------
   [INFO] BUILD SUCCESS
   [INFO] -----------------------------------------------------------
   --------------
   [INFO] Total time: 01:23 min
   [INFO] Finished at: 2016-11-10T17:46:05+01:00
   [INFO] Final Memory: 66M/666M
   [INFO] -----------------------------------------------------------
   --------------
   ```

   NOTE

   The first time you run this command, Maven has to download a lot of dependencies, which takes several minutes. Subsequent builds will be faster.

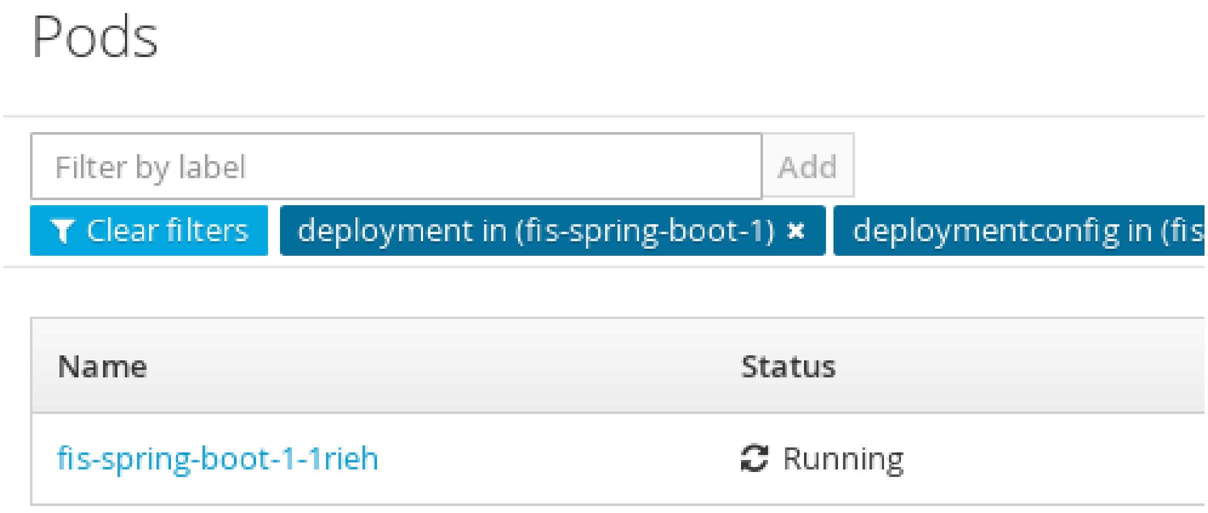
6. Navigate to the OpenShift console in your browser and log in to the console with your credentials (for example, with username **`developer`** and password, **`developer`**).

7. In the OpenShift console, scroll down to find the **test** project namespace. Click the **test** project and an overview of the **fis-spring-boot** service opens, as shown.



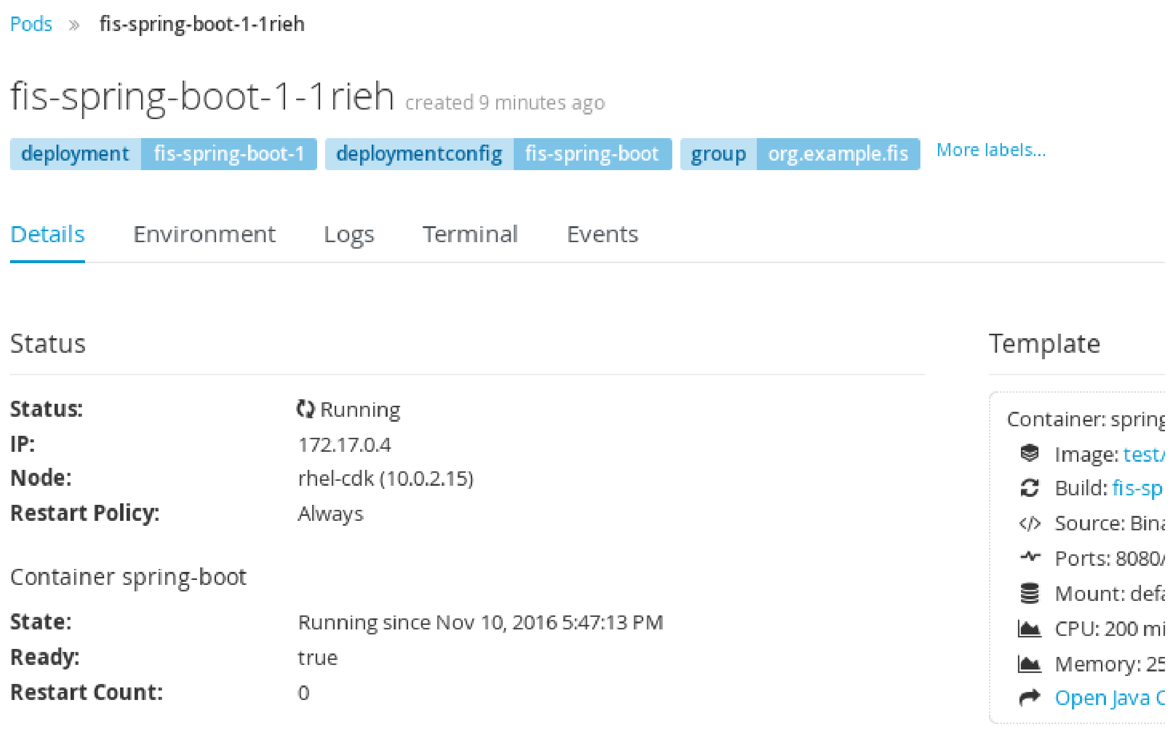
CONTAINER: SPRING-BOOT
Image: test/fis-spring-boot (f280dd7) 192.9 MiB
Build: fis-spring-boot-s2i, #1
Source: Binary
Ports: 8080/TCP (http), 8778/TCP (jolokia), 9779/TCP (prometheus)

8. Click in the centre of the pod icon (blue circle) to view the list of pods for **fis-spring-boot**.



Name	Status
fis-spring-boot-1-1rieh	Running

9. Click on the pod **Name** (in this example, `fis-spring-boot-1-1rieh`) to view the details of the running pod.


Pods » fis-spring-boot-1-1rieh

fis-spring-boot-1-1rieh created 9 minutes ago

deployment fis-spring-boot-1 deploymentconfig fis-spring-boot group org.example.fis More labels...

Details Environment Logs Terminal Events

Status

Status: Running
IP: 172.17.0.4
Node: rhel-cdk (10.0.2.15)
Restart Policy: Always

Container spring-boot

State: Running since Nov 10, 2016 5:47:13 PM
Ready: true
Restart Count: 0

Template

Container: spring
Image: test/
Build: fis-sp
Source: Bina
Ports: 8080/
Mount: defa
CPU: 200 mi
Memory: 25
Open Java C

10. Click on the **Logs** tab to view the application log and scroll down the log to find the random number log messages generated by the Camel application.

```
...
07:30:32.406 [Camel (camel) thread #0 - timer://foo] INFO  simple-
route - >>> 985
07:30:34.405 [Camel (camel) thread #0 - timer://foo] INFO  simple-
route - >>> 741
07:30:36.409 [Camel (camel) thread #0 - timer://foo] INFO  simple-
route - >>> 796
07:30:38.409 [Camel (camel) thread #0 - timer://foo] INFO  simple-
route - >>> 211
07:30:40.411 [Camel (camel) thread #0 - timer://foo] INFO  simple-
route - >>> 511
07:30:42.411 [Camel (camel) thread #0 - timer://foo] INFO simple-
route - >>> 942
```

11. Click **Overview** on the left-hand navigation bar to return to the overview of the services in the `test` namespace. To shut down the running pod, click the down arrow beside the pod icon. When a dialog prompts you with the question **Scale down deployment fis-spring-boot-1?**, click **Scale Down**.

12. *(Optional)* If you are using CDK, you can shut down the virtual OpenShift Server completely by returning to the shell prompt and entering the following command:

```
minishift stop
```

3.3.1. Redeploy and Undeploy the Project

To redeploy or undeploy your projects, you can use the following commands.

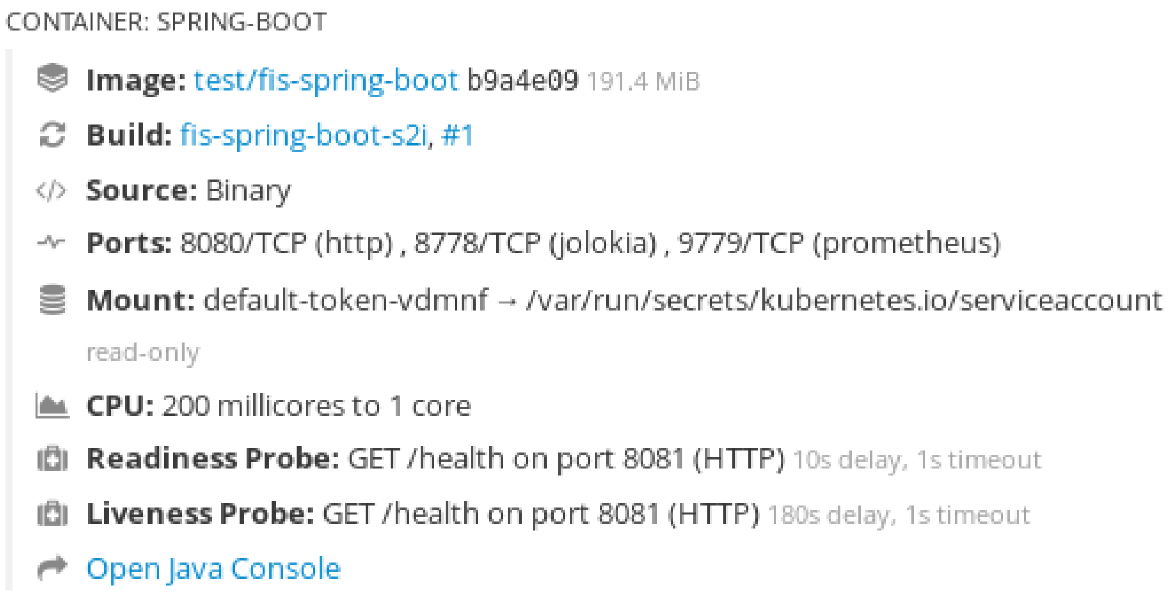
- To redeploy the project, rerun `mvn fabric8:deploy`.

- To undeploy the project, run `mvn fabric8:undeploy`.

3.3.2. Opening the HawtIO Console

To open the HawtIO console for a pod running the FIS Spring Boot example, proceed as follows:

1. From the **Applications** → **Pods** view in your OpenShift project, click on the pod name to view the details of the running FIS Spring Boot pod. On the right-hand side of this page, you see a summary of the container template:



CONTAINER: SPRING-BOOT

Image: test/fis-spring-boot b9a4e09 191.4 MiB

Build: fis-spring-boot-s2i, #1

Source: Binary

Ports: 8080/TCP (http) , 8778/TCP (jolokia) , 9779/TCP (prometheus)

Mount: default-token-vdmnf → /var/run/secrets/kubernetes.io/serviceaccount read-only

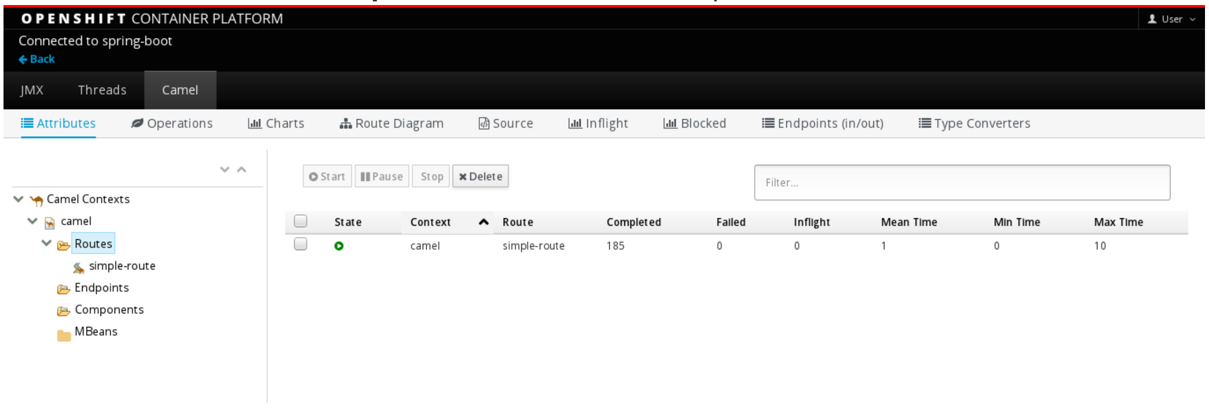
CPU: 200 millicores to 1 core

Readiness Probe: GET /health on port 8081 (HTTP) 10s delay, 1s timeout

Liveness Probe: GET /health on port 8081 (HTTP) 180s delay, 1s timeout

Open Java Console

2. From this view, click on the **Open Java Console** link to open the **HawtIO** console.



State	Context	Route	Completed	Failed	Inflight	Mean Time	Min Time	Max Time
●	camel	simple-route	185	0	0	1	0	10

NOTE

In order to configure OpenShift to display a link to HawtIO console in the pod view, the pod running a FIS image must declare a tcp port within a name attribute set to `jolokia`:

```
{
  "kind": "Pod",
  [...]
  "spec": {
    "containers": [
      {
        [...]
        "ports": [
          {
            "name": "jolokia",
            "containerPort": 8778,
            "protocol": "TCP"
          }
```

3.4. CREATE AND DEPLOY A PROJECT USING THE S2I SOURCE WORKFLOW

In this section, you will use the OpenShift S2I source workflow to build and deploy an FIS project based on a template. The starting point for this demonstration is a quickstart project stored in a remote Git repository. Using the OpenShift console, you will download, build, and deploy this quickstart project in the OpenShift server.

1. Navigate to the OpenShift console in your browser (https://OPENSHIFT_IP_ADDR:8443, replace **`OPENSHIFT_IP_ADDR`** with the IP address that was displayed in the case of CDK) and log in to the console with your credentials (for example, with username **`developer`** and password, **`developer`**).

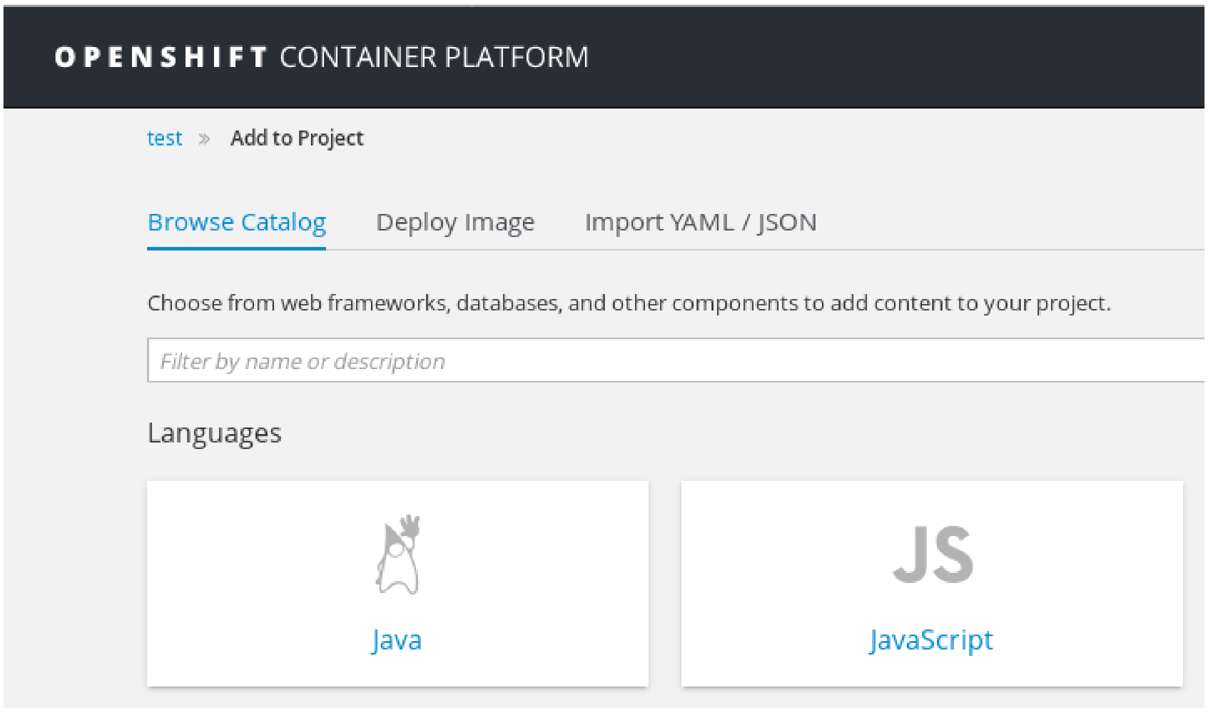
2. On the **Projects** screen of the OpenShift console, click **New Project**.

3. On the **New Project** screen, enter **`test`** in the **Name** field and click **Create**. The **Select Image or Template** screen now opens.

   NOTE

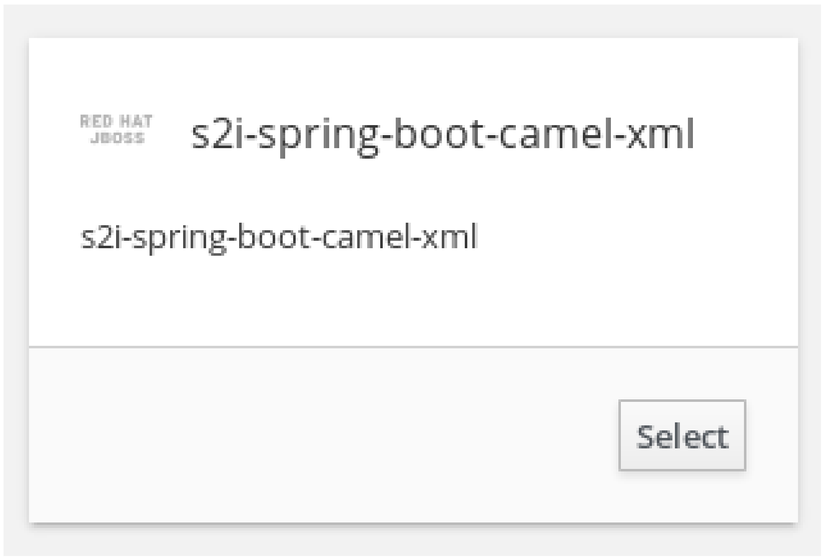
   If the **`test`** project already exists in OpenShift, click on the **`test`** project and then click **Add to Project** to open the **Add to Project** screen.

4. On the **Add to Project** screen, from the **Browse Catalog** tab, click **Java** to open the list of Java templates.

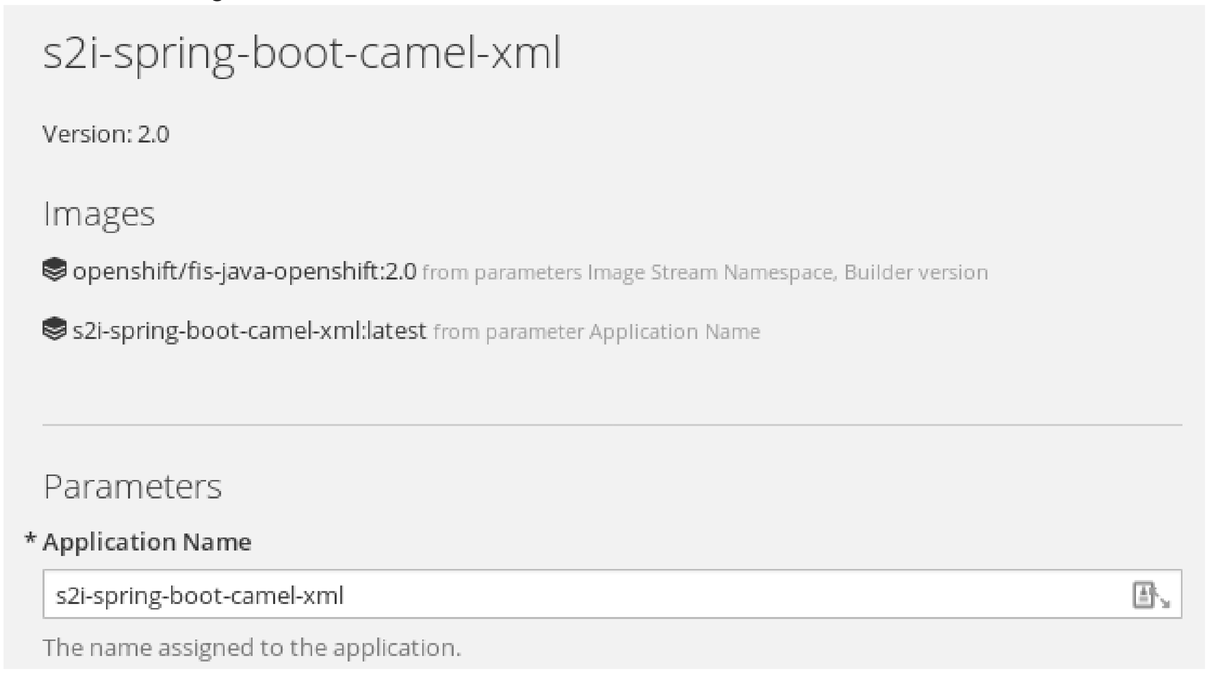


Choose from web frameworks, databases, and other components to add content to your project.

5. Scroll down to find the **s2i-spring-boot-camel-xml** template and click the **Select** button.



6. The **s2i-spring-boot-camel-xml** template form opens, as shown below. You can accept all of the default settings on this form. Scroll down to the bottom of the form and click **Create**.



s2i-spring-boot-camel-xml

Version: 2.0

Images

openshift/fis-java-openshift:2.0 from parameters Image Stream Namespace, Builder version

s2i-spring-boot-camel-xml:latest from parameter Application Name

Parameters

* Application Name

s2i-spring-boot-camel-xml

The name assigned to the application.

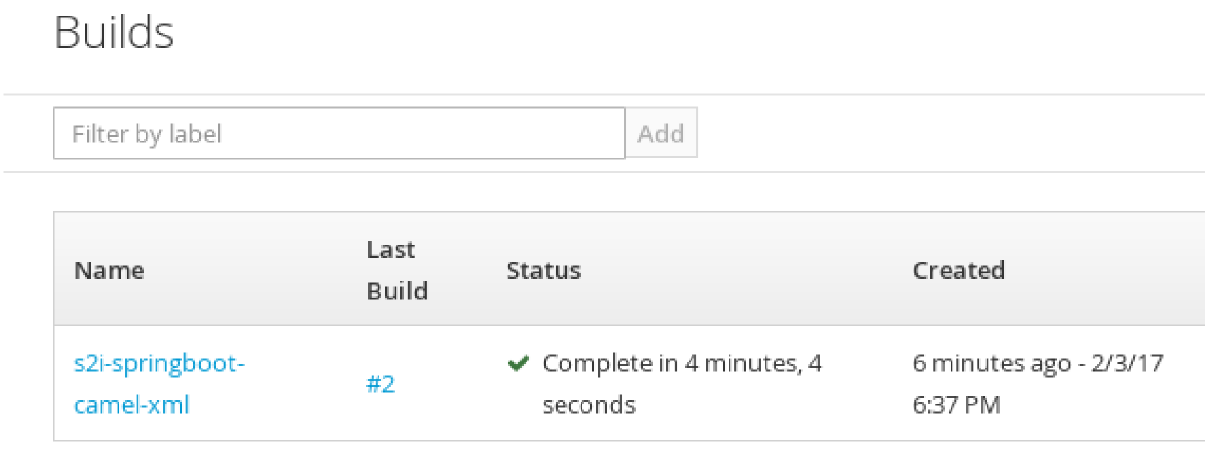
NOTE

If you want to modify the application code (instead of just running the quickstart as is), you would need to fork the original quickstart Git repository and fill in the appropriate values in the **Git repository URL** and **Git reference** fields.

7. The **Application created** screen now opens. Click **Continue to overview** to go to the **Overview** tab of the OpenShift console (which shows an overview of the available services and pods in the current project). If you have not previously created any application builds in this project, this screen will be empty.

8. In the navigation pane on the left-hand side, select **Builds→Builds** to open the **Builds** screen.

9. Click the **`s2i-spring-boot-camel-xml`** build name to open the **`s2i-spring-boot-camel-xml`** build page, as shown below.



Builds

Filter by label | Add

Name	Last Build	Status	Created
s2i-springboot-camel-xml	#2	✓ Complete in 4 minutes, 4 seconds	6 minutes ago - 2/3/17 6:37 PM

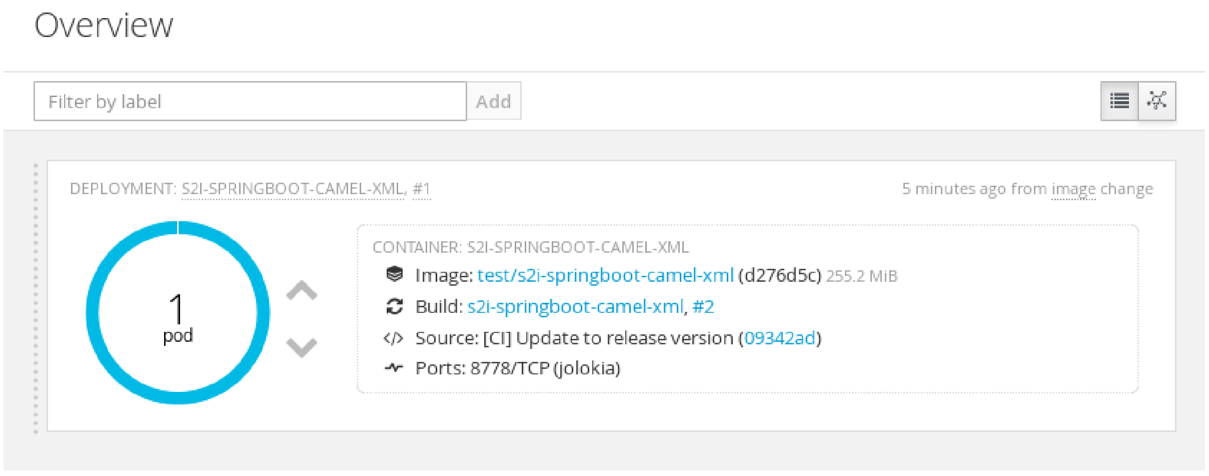
10. Click **View log** to view the log for the latest build — if the build should fail for any reason, the build log can help you to diagnose the problem.

NOTE

The build can take several minutes to complete, because a lot of dependencies must be downloaded from remote Maven repositories. To speed up build times, we recommend you deploy a Nexus server on your local network.

11. If the build completes successfully, click **Overview** in the left-hand navigation pane to view the running pod for this application.

12. Click in the centre of the pod icon (blue circle) to view the list of pods for **s2i-spring-boot-camel-xml**.



Overview

Filter by label | Add

DEPLOYMENT: S2I-SPRINGBOOT-CAMEL-XML, #1

5 minutes ago from image change

1 pod

CONTAINER: S2I-SPRINGBOOT-CAMEL-XML

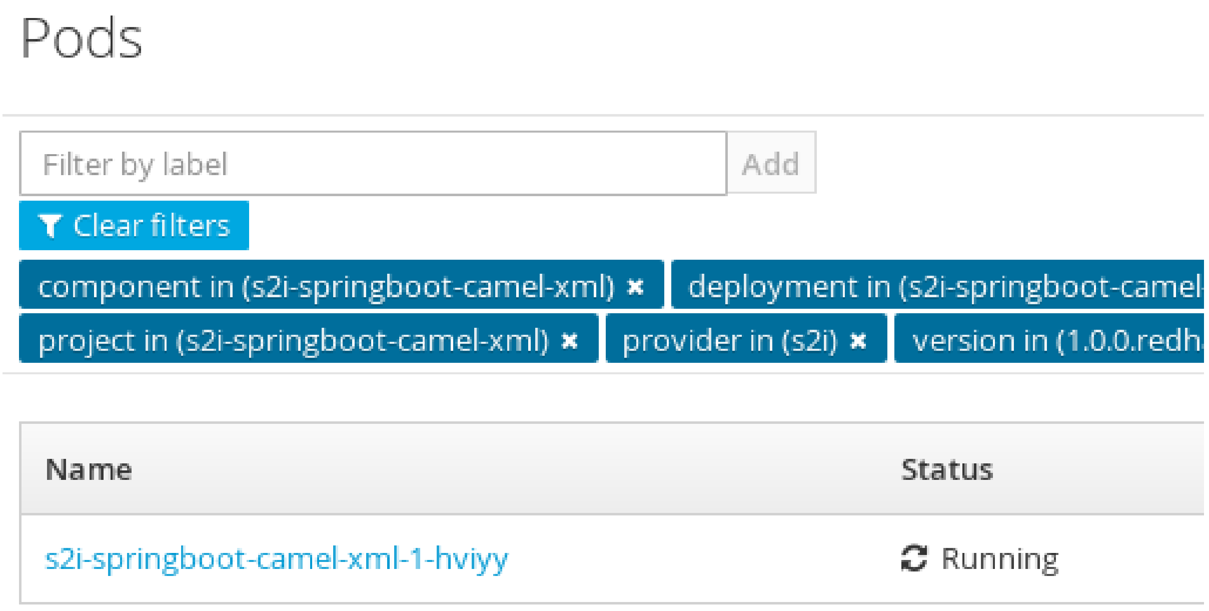
Image: test/s2i-springboot-camel-xml (d276d5c) 255.2 MiB

Build: s2i-springboot-camel-xml, #2

Source: [CI] Update to release version (09342ad)

Ports: 8778/TCP (jolokia)

13. Click on the pod **Name** (in this example, `s2i-spring-boot-camel-xml-1-hviyy`) to view the details of the running pod.



Pods

Filter by label

Add

Clear filters

component in (s2i-springboot-camel-xml) ✖

deployment in (s2i-springboot-camel

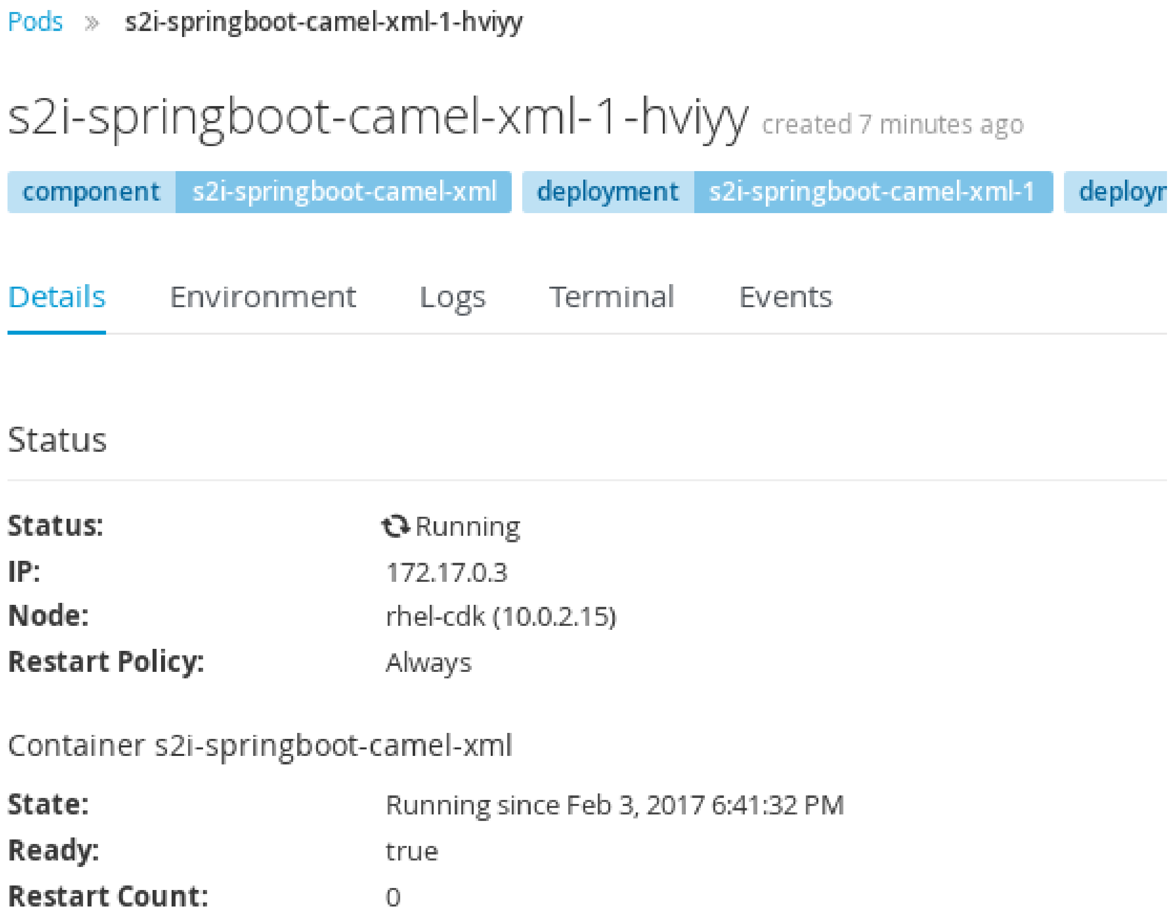
project in (s2i-springboot-camel-xml) ✖

provider in (s2i) ✖

version in (1.0.0.redh

Name	Status
s2i-springboot-camel-xml-1-hviyy	Running

14. Click on the **Logs** tab to view the application log and scroll down the log to find the log messages generated by the Camel application.



Pods » s2i-springboot-camel-xml-1-hviyy

s2i-springboot-camel-xml-1-hviyy created 7 minutes ago

component s2i-springboot-camel-xml deployment s2i-springboot-camel-xml-1 deployr

Details Environment Logs Terminal Events

Status

Status:	Running
IP:	172.17.0.3
Node:	rhel-cdk (10.0.2.15)
Restart Policy:	Always

Container s2i-springboot-camel-xml

State:	Running since Feb 3, 2017 6:41:32 PM
Ready:	true
Restart Count:	0

15. Click **Overview** on the left-hand navigation bar to return to the overview of the services in the `test` namespace. To shut down the running pod, click the down arrow beside the pod icon. When a dialog prompts you with the question **Scale down deployment s2i-spring-boot-camel-xml-1?**, click **Scale Down**.

16. *(Optional)* If you are using CDK, you can shut down the virtual OpenShift Server completely by returning to the shell prompt and entering the following command:

    ```
    minishift stop
    ```

CHAPTER 4. DEVELOP AN APPLICATION FOR THE SPRING BOOT IMAGE

4.1. OVERVIEW

This chapter explains how to develop applications for the Spring Boot image.

4.2. CREATE A SPRING BOOT PROJECT USING MAVEN ARCHETYPE

To create a Spring Boot project, follow these steps:

1. Go to the appropriate directory on your system.
2. Launch the **`mvn`** command to create Spring Boot project

```
mvn org.apache.maven.plugins:maven-archetype-plugin:2.4:generate \
  -
DarchetypeCatalog=https://maven.repository.redhat.com/ga/io/fabric8/
archetypes/archetypes-catalog/2.2.195.redhat-000017/archetypes-
catalog-2.2.195.redhat-000017-archetype-catalog.xml \
  -DarchetypeGroupId=org.jboss.fuse.fis.archetypes \
  -DarchetypeArtifactId=spring-boot-camel-xml-archetype \
  -DarchetypeVersion=2.2.195.redhat-000017
```

The archetype plug-in switches to interactive mode to prompt you for the remaining fields

```
Define value for property 'groupId': : org.example.fis
Define value for property 'artifactId': : fis-spring-boot
Define value for property 'version':  1.0-SNAPSHOT: :
Define value for property 'package':  org.example.fis: :

[INFO] Using property: spring-boot-version = 1.4.1.RELEASE
Confirm properties configuration:
groupId: org.example.fis
artifactId: fis-spring-boot
version: 1.0-SNAPSHOT
package: org.example.fis
spring-boot-version: 1.4.1.RELEASE
 Y: :
```

When prompted, enter **`org.example.fis`** for the **`groupId`** value and **`fis-spring-boot`** for the **`artifactId`** value. Accept the defaults for the remaining fields.

Then, follow the instructions in the quickstart on how to build and deploy the example.

NOTE

For the full list of available Spring Boot archetypes, see Section 4.4, “Spring Boot Archetype Catalog”.

4.3. STRUCTURE OF THE CAMEL SPRING BOOT APPLICATION

The directory structure of a Camel Spring Boot application is as follows:

```
├── LICENSE.md
├── pom.xml
├── README.md
└── src
    ├── main
    │   ├── fabric8
    │   │   └── deployment.yml
    │   ├── java
    │   │   └── org
    │   │       └── first1
    │   │           └── spring
    │   │               └── boot
    │   │                   └── project
    │   │                       ├── Application.java
    │   │                       └── MyTransformer.java
    │   └── resources
    │       ├── application.properties
    │       ├── logback.xml
    │       └── spring
    │           └── camel-context.xml
    └── test
        ├── java
        │   └── org
        │       └── first1
        │           └── spring
        │               └── boot
        │                   └── project
        │                       └── KubernetesIntegrationKT.java
        └── resources
```

Where the following files are important for developing an application:

pom.xml

Includes additional dependencies. Camel components that are compatible with Spring Boot are available in the starter version, for example **`camel-jdbc-starter`** or **`camel-infinispan-starter`**. Once the starters are included in the **`pom.xml`** they are automatically configured and registered with the Camel content at boot time. Users can configure the properties of the components using the **`application.properties`** file.

application.properties

It is an important file that allows you to externalize your configuration and work with the same application code in different environments. For details, see Externalized Configuration
For example, in this Camel application you can configure certain properties such as name of the application or the IP addresses, and so on.

application.properties

```
# the options from
org.apache.camel.spring.boot.CamelConfigurationProperties can be
configured here
camel.springboot.name=MyCamel
```

```
# lets listen on all ports to ensure we can be invoked from the pod IP
server.address=0.0.0.0
management.address=0.0.0.0
```

Application.java

It is an important file to run your application. As a user you will import here a file **`camel-context.xml`** to configure routes using the Spring DSL.
The **`Application.java file`** specifies the **`@SpringBootApplication`** annotation, which is equivalent to **`@Configuration`**, **`@EnableAutoConfiguration`** and **`@ComponentScan`** with their default attributes.

Application.java

```
@SpringBootApplication
// load regular Spring XML file from the classpath that contains the
Camel XML DSL
@ImportResource({"classpath:spring/camel-context.xml"})
```

It must have a **`main`** method to run the Spring Boot application.

Application.java

```
public class Application {
    /**
     * A main method to start this application.
     */
    public static void main(String[] args) {
        SpringApplication.run(Application.class, args);
    }
}
```

camel-context.xml

The **`src/main/resources/spring/camel-context.xml`** is an important file for developing application as it contains the Camel routes.

NOTE

You can find more information on developing Spring-Boot applications at Developing your first Spring Boot Application

src/main/fabric8/deployment.yml

Provides additional configuration that is merged with the default OpenShift configuration file generated by the fabric8-maven-plugin.

NOTE

This file is not used part of Spring Boot application but it is used in all quickstarts to limit the resources such as CPU and memory usage.

KubernetesIntegrationKT.java

An Arquillian based integration test that test deploying into OpenShift and making sure the container can boot correctly.

4.4. SPRING BOOT ARCHETYPE CATALOG

The Spring Boot Archetype catalog includes the following examples.

Table 4.1. Spring Boot Maven Archetypes

Name	Description
`spring-boot-camel-archetype`	Demonstrates how to use Apache Camel with Spring Boot based on a fabric8 Java base image.
`spring-boot-camel-amq-archetype`	Demonstrates how to connect a Spring-Boot application to an ActiveMQ broker and use JMS messaging between two Camel routes using Kubernetes or OpenShift.
`spring-boot-camel-config-archetype`	Demonstrates how to configure a Spring-Boot application using Kubernetes ConfigMaps and Secrets.
`spring-boot-camel-drools-archetype`	Demonstrates how to use Apache Camel to integrate a Spring-Boot application running on Kubernetes or OpenShift with a remote Kie Server.
`spring-boot-camel-infinispan-archetype`	Demonstrates how to connect a Spring-Boot application to a JBoss Data Grid or Infinispan server using the Hot Rod protocol.
`spring-boot-camel-rest-sql-archetype`	Demonstrates how to use SQL via JDBC along with Camel's REST DSL to expose a RESTful API.
`spring-boot-camel-teiid-archetype`	Demonstrates how to connect Apache Camel to a remote JBoss Data Virtualization (or Teiid) Server using the JDBC protocol.
`spring-boot-camel-xml-archetype`	Demonstrates how to configure Camel routes in Spring Boot via a Spring XML configuration file.
`spring-boot-cxf-jaxrs-archetype`	Demonstrates how to use Apache CXF with Spring Boot based on a fabric8 Java base image. The quickstart uses Spring Boot to configure an application that includes a CXF JAXRS endpoint with Swagger enabled.
`spring-boot-cxf-jaxws-archetype`	Demonstrates how to use Apache CXF with Spring Bootbased on a fabric8 Java base image. The quickstart uses Spring Boot to configure an application that includes a CXF JAXWS endpoint.

4.5. CAMEL STARTER MODULES

4.5.1. Overview

Starters are Apache Camel modules intended to be used in Spring Boot applications. There is a **`camel-xxx-starter`** module for each Camel component (with few exceptions listed below).

Starters meet the following requirements:

- Allow auto-configuration of the component using native Spring Boot configuration system which is compatible with IDE tooling.
- Allows auto-configuration of data formats and languages.
- Manage transitive logging dependencies to integrate with Spring Boot logging system.
- Include additional dependencies and align transitive dependencies to minimize the effort of creating a working Spring Boot application.

Each starter has its own integration test in **`tests/camel-itest-spring-boot`**, that verifies the compatibility with the current release of Spring Boot.

4.5.2. Using Camel Starter Modules

Apache Camel provides a starter module that allows you to develop Spring Boot applications using starters.

To use the Spring Boot starter:

1. Add the following to your Spring Boot pom.xml file:

```
<dependency>
    <groupId>org.apache.camel</groupId>
    <artifactId>camel-spring-boot-starter</artifactId>
</dependency>
```

2. Add classes with your Camel routes such as:

```
package com.example;

import org.apache.camel.builder.RouteBuilder;
import org.springframework.stereotype.Component;

@Component
public class MyRoute extends RouteBuilder {

    @Override
    public void configure() throws Exception {
        from("timer:foo")
          .to("log:bar");
    }
}
```

These routes will be started automatically.

NOTE

To keep the main thread blocked so that Camel stays up, either include the `spring-boot-starter-web` dependency, or add `camel.springboot.main-run-controller=true` to your `application.properties` or `application.yml` file.

You can customize the Camel application in the `application.properties` or `application.yml` file with `camel.springboot.* properties`.

4.6. UNSUPPORTED STARTER MODULES

The following components do not have a starter because of compatibility issues:

- **camel-blueprint** (intended for OSGi only)
- **camel-cdi** (intended for CDI only)
- **camel-core-osgi** (intended for OSGi only)
- **camel-ejb** (intended for JEE only)
- **camel-eventadmin** (intended for OSGi only)
- **camel-ibatis** (`camel-mybatis-starter` is included)
- **camel-jclouds**
- **camel-mina** (`camel-mina2-starter` is included)
- **camel-paxlogging** (intended for OSGi only)
- **camel-quartz** (`camel-quartz2-starter` is included)
- **camel-spark-rest**
- **camel-swagger** (`camel-swagger-java-starter` is included)

CHAPTER 5. DEVELOP CAMEL APPLICATIONS IN SPRING BOOT

5.1. INTRODUCTION TO CAMEL SPRING BOOT

Spring Boot component provides auto configuration for Apache Camel. Auto-configuration of the Camel context auto-detects Camel routes available in the Spring context and registers the key Camel utilities such as producer template, consumer template, and the type converter as beans.

Every Camel Spring Boot application should use **`dependencyManagement`** with productized versions, see quickstart pom. Versions that are tagged later can be omitted to not override the versions from BOM.

```
<dependencyManagement>
 <dependencies>
  <dependency>
   <groupId>io.fabric8</groupId>
   <artifactId>fabric8-project-bom-camel-spring-boot</artifactId>
   <version>${fabric8.version}</version>
   <type>pom</type>
   <scope>import</scope>
  </dependency>
</dependencyManagement>
```

NOTE

`camel-spring-boot` jar comes with the **`spring.factories`** file which allows you to add that dependency into your classpath and hence Spring Boot will automatically auto-configure Camel.

5.2. INTRODUCTION TO CAMEL SPRING BOOT STARTER

Apache Camel contains Spring Boot Starter module that allows you to develop Spring Boot applications using starters.

NOTE

For more details, see sample application in the source code.

To use the starter, add the following snippet to your Spring Boot **`pom.xml`** file:

```
<dependency>
    <groupId>org.apache.camel</groupId>
    <artifactId>camel-spring-boot-starter</artifactId>
</dependency>
```

The starter allows you to add classes with your Camel routes, as shown in the snippet below. Once these routes are added to the class path the routes are started automatically.

```
package com.example;

import org.apache.camel.builder.RouteBuilder;
import org.springframework.stereotype.Component;

@Component
public class MyRoute extends RouteBuilder {

    @Override
    public void configure() throws Exception {
        from("timer:foo").to("log:bar");
    }
}
```

NOTE

You can customize the Camel application in the **`application.properties`** or **`application.yml`** file.

5.3. AUTO-CONFIGURED CAMEL CONTEXT

Camel auto-configuration provides a **`CamelContext`** instance and creates a **`SpringCamelContext`**. It also initializes and performs shutdown of that context. This Camel context is registered in the Spring application context under **`camelContext`** bean name and you can access it like other Spring bean.

For example, you can access the **`camelContext`** as shown below:

```
@Configuration
public class MyAppConfig {

  @Autowired
  CamelContext camelContext;

  @Bean
  MyService myService() {
    return new DefaultMyService(camelContext);
  }

}
```

5.4. AUTO-DETECTING CAMEL ROUTES

Camel auto configuration collects all the **`RouteBuilder`** instances from the Spring context and automatically injects them into the **`CamelContext`**. It simplifies the process of creating new Camel route with the Spring Boot starter. You can create the routes by adding the **`@Component`** annotated class to your classpath.

```
@Component
public class MyRouter extends RouteBuilder {

  @Override
  public void configure() throws Exception {
    from("jms:invoices").to("file:/invoices");
  }

}
```

To create a new route **RouteBuilder** bean in your **@Configuration** class, see below:

```
@Configuration
public class MyRouterConfiguration {

  @Bean
  RoutesBuilder myRouter() {
    return new RouteBuilder() {

      @Override
      public void configure() throws Exception {
        from("jms:invoices").to("file:/invoices");
      }

    };
  }

}
```

5.5. CAMEL PROPERTIES

Spring Boot auto configuration automatically connects to Spring Boot external configuration such as properties placeholders, OS environment variables, or system properties with Camel properties support.

These properties are defined in **application.properties** file:

```
route.from = jms:invoices
```

Use as system property

```
java -Droute.to=jms:processed.invoices -jar mySpringApp.jar
```

Use as placeholders in Camel route:

```
@Component
public class MyRouter extends RouteBuilder {

  @Override
  public void configure() throws Exception {
    from("{{route.from}}").to("{{route.to}}");
  }

}
```

5.6. CUSTOM CAMEL CONTEXT CONFIGURATION

To perform operations on **CamelContext** bean created by Camel auto configuration, you need to register **CamelContextConfiguration** instance in your Spring context as shown below:

```
@Configuration
public class MyAppConfig {

  ...
  @Bean
  CamelContextConfiguration contextConfiguration() {
    return new CamelContextConfiguration() {
      @Override
      void beforeApplicationStart(CamelContext context) {
        // your custom configuration goes here
      }
    };
  }

}
```

NOTE

The method **`CamelContextConfiguration`** and **`beforeApplicationStart(CamelContext)`** will be called before the Spring context is started, so the **`CamelContext`** instance passed to this callback is fully auto-configured. You can add many instances of **`CamelContextConfiguration`** into your Spring context and all of them will be executed.

5.7. DISABLING JMX

To disable JMX of the auto-configured **`CamelContext`** use **`camel.springboot.jmxEnabled`** property as JMX is enabled by default.

For example, you could add the following property to your **`application.properties`** file:

```
camel.springboot.jmxEnabled = false
```

5.8. AUTO-CONFIGURED CONSUMER AND PRODUCER TEMPLATES

Camel auto configuration provides pre-configured **`ConsumerTemplate`** and **`ProducerTemplate`** instances. You can inject them into your Spring-managed beans:

```
@Component
public class InvoiceProcessor {

  @Autowired
  private ProducerTemplate producerTemplate;

  @Autowired
  private ConsumerTemplate consumerTemplate;
  public void processNextInvoice() {
    Invoice invoice = consumerTemplate.receiveBody("jms:invoices",
Invoice.class);
    ...
    producerTemplate.sendBody("netty-http:http://invoicing.com/received/"
+ invoice.id());
  }

}
```

By default consumer templates and producer templates come with the endpoint cache sizes set to 1000. You can change those values using the following Spring properties:

```
camel.springboot.consumerTemplateCacheSize = 100
camel.springboot.producerTemplateCacheSize = 200
```

5.9. AUTO-CONFIGURED TYPECONVERTER

Camel auto configuration registers a **`TypeConverter`** instance named **`typeConverter`** in the Spring context.

```
@Component
public class InvoiceProcessor {

  @Autowired
  private TypeConverter typeConverter;

  public long parseInvoiceValue(Invoice invoice) {
    String invoiceValue = invoice.grossValue();
    return typeConverter.convertTo(Long.class, invoiceValue);
  }

}
```

5.10. SPRING TYPE CONVERSION API BRIDGE

Spring consist of type conversion API. Spring API is similar to the Camel type converter API. Due to the similarities between the two APIs Camel Spring Boot automatically registers a bridge converter (**`SpringTypeConverter`**) that delegates to the Spring conversion API. That means that out-of-the-box Camel will treat Spring Converters similar to Camel.

This allows you to access both Camel and Spring converters using the Camel **`TypeConverter`** API, as shown below:

```
@Component
public class InvoiceProcessor {

  @Autowired
  private TypeConverter typeConverter;

  public UUID parseInvoiceId(Invoice invoice) {
    // Using Spring's StringToUUIDConverter
    UUID id = invoice.typeConverter.convertTo(UUID.class,
invoice.getId());
  }

}
```

Here, Spring Boot delegates conversion to the Spring's **`ConversionService`** instances available in the application context. If no **`ConversionService`** instance is available, Camel Spring Boot auto configuration creates an instance of **`ConversionService`**.

5.11. DISABLING TYPE CONVERSIONS FEATURES

To disable registering type conversion features of Camel Spring Boot such as **`TypeConverter`** instance or Spring bridge, set the **`camel.springboot.typeConversion`** property to **`false`** as shown below:

```
camel.springboot.typeConversion = false
```

5.12. ADDING XML ROUTES

By default, you can put Camel XML routes in the classpath under the directory camel, which **`camel-spring-boot`** will auto detect and include. From **Camel version 2.17** onwards you can configure the directory name or disable this feature using the configuration option, as shown below:

```
// turn off
camel.springboot.xmlRoutes = false
// scan in the com/foo/routes classpath
camel.springboot.xmlRoutes = classpath:com/foo/routes/*.xml
```

NOTE

The XML files should be Camel XML routes and not **`CamelContext`** such as:

```
   <routes xmlns="http://camel.apache.org/schema/spring">
        <route id="test">
            <from uri="timer://trigger"/>
            <transform>
                <simple>ref:myBean</simple>
            </transform>
            <to uri="log:out"/>
        </route>
    </routes>
```

5.13. ADDING XML REST-DSL

By default, you can put Camel Rest-DSL XML routes in the classpath under the directory **`camel-rest`**, which **`camel-spring-boot`** will auto detect and include. You can configure the directory name or disable this feature using the configuration option, as shown below:

```
// turn off
camel.springboot.xmlRests = false
// scan in the com/foo/routes classpath
camel.springboot.xmlRests = classpath:com/foo/rests/*.xml
```

NOTE

The Rest-DSL XML files should be Camel XML rests and not **`CamelContext`** such as:

```
   <rests xmlns="http://camel.apache.org/schema/spring">
      <rest>
```

```
          <post uri="/persons">
             <to uri="direct:postPersons"/>
          </post>
          <get uri="/persons">
             <to uri="direct:getPersons"/>
          </get>
          <get uri="/persons/{personId}">
              <to uri="direct:getPersionId"/>
          </get>
          <put uri="/persons/{personId}">
              <to uri="direct:putPersionId"/>
          </put>
          <delete uri="/persons/{personId}">
              <to uri="direct:deletePersionId"/>
          </delete>
       </rest>
     </rests>
```

5.14. SEE ALSO

- Configuring Camel
- Component
- Endpoint
- Getting Started

CHAPTER 6. INTEGRATE A CAMEL APPLICATION WITH THE AMQ BROKER

6.1. EXAMPLE HOW TO DEPLOY A SPRING BOOT CAMEL A-MQ QUICKSTART

This tutorial shows how to deploy a quickstart using the A-MQ image.

6.1.1. Prerequisites

1. Ensure that CDK is installed and OpenShift is running correctly. See Section 3.1, “Prerequisites”.
2. Ensure that Maven Repositories are configured for fuse, see Section 3.2.1, “Configure Maven Repositories”

6.1.2. Building and Deploying the Quickstart

This example requires a JBoss A-MQ 6 image and deployment template. If you are using CDK 3.1.1+, JBoss A-MQ 6 images and templates should be already installed in the **`openshift`** namespace by default.

To build and deploy the A-MQ quickstart, perform the following steps:

1. In your FIS environment, login as a developer, for example:

   ```
   oc login -u developer -p developer
   ```

2. Create a new project **amq-quickstart**

   ```
   oc new-project amq-quickstart
   ```

3. Determine the version of the A-MQ 6 images and templates installed:

   ```
   $ oc get template -n openshift
   ```

   You should be able to find a template named **`amqXX-basic`**, where **`XX`** is the version of A-MQ installed in Openshift.

4. Deploy the A-MQ 6 image in the **`amq-quickstart`** namespace (replace **`XX`** with the actual version of A-MQ found in previous step):

   ```
   $ oc process openshift//amqXX-basic -p APPLICATION_NAME=broker -p
   MQ_USERNAME=admin -p MQ_PASSWORD=admin -p MQ_QUEUES=test -n amq-
   quickstart | oc create -f -
   ```

   NOTE

   This **oc** command could fail, if you use an older version of**oc**. This syntax works with **oc** versions 3.5.x (based on Kubernetes 1.5.x).

5. Add role which is needed for discovery of mesh endpoints (through Kubernetes REST API agent).

   ```
   $ oc policy add-role-to-user view system:serviceaccount:amq-
   quickstart:default
   ```

6. Create the quickstart project using the Maven workflow:

   ```
   $ mvn org.apache.maven.plugins:maven-archetype-plugin:2.4:generate \
   -
   DarchetypeCatalog=https://maven.repository.redhat.com/ga/io/fabric8/
   archetypes/archetypes-catalog/2.2.195.redhat-000017/archetypes-
   catalog-2.2.195.redhat-000017-archetype-catalog.xml \
   -DarchetypeGroupId=org.jboss.fuse.fis.archetypes \
   -DarchetypeArtifactId=spring-boot-camel-amq-archetype \
   -DarchetypeVersion=2.2.195.redhat-000017
   ```

7. The archetype plug-in switches to interactive mode to prompt you for the remaining fields:

   ```
   $ Define value for property 'groupId': : org.example.fis
     Define value for property 'artifactId': : fis-spring-boot-camel-
   amq
     Define value for property 'version':  1.0-SNAPSHOT: :
     Define value for property 'package':  org.example.fis: :
     [INFO] Using property: spring-boot-version = 1.4.1.RELEASE
     Confirm properties configuration:
     groupId: org.example.fis
     artifactId: fis-spring-boot
     version: 1.0-SNAPSHOT
     package: org.example.fis
     spring-boot-version: 1.4.1.RELEASE
     Y: :
   ```

   When prompted, enter **`org.example.fis`** for the **`groupId`** value and **`fis-spring-boot-camel-amq`** for the **`artifactId`** value. Accept the defaults for the remaining fields.

8. Navigate to the quickstart directory **`fis-spring-boot-camel-amq`**:

   ```
   $ cd fis-spring-boot-camel-amq
   ```

9. Customize the client credentials for logging on to the broker, by setting the **`ACTIVEMQ_BROKER_USERNAME`** and **`ACTIVEMQ_BROKER_PASSWORD`** environment variables. In the **`fis-spring-boot-camel-amq`** project, edit the **`src/main/fabric8/deployment.yml`** file, as follows:

   ```
   spec:
     template:
       spec:
         containers:
           -
             resources:
               requests:
                 cpu: "0.2"
   #               memory: 256Mi
   ```

```
              limits:
                cpu: "1.0"
#                 memory: 256Mi
            env:
            - name: ACTIVEMQ_SERVICE_NAME
              value: broker-amq-tcp
            - name: ACTIVEMQ_BROKER_USERNAME
              value: admin
            - name: ACTIVEMQ_BROKER_PASSWORD
              value: admin
```

10. Run the **mvn** command to deploy the quickstart to OpenShift server.

```
mvn fabric8:deploy
```

11. To verify that the quickstart is running successfully, navigate to the OpenShift console, select the project **amq-quickstart**, click **Applications**, select **Pods**, click **fis-spring-boot-camel-am-1-xxxxx**, and click **Logs**.

12. The output shows the messages are sent successfully.

```
10:17:59.825 [Camel (camel) thread #10 - timer://order] INFO
generate-order-route - Generating order order1379.xml
10:17:59.829 [Camel (camel) thread #8 - JmsConsumer[incomingOrders]]
INFO  jms-cbr-route - Sending order order1379.xml to the UK
10:17:59.829 [Camel (camel) thread #8 - JmsConsumer[incomingOrders]]
INFO  jms-cbr-route - Done processing order1379.xml
10:18:02.825 [Camel (camel) thread #10 - timer://order] INFO
generate-order-route - Generating order order1380.xml
10:18:02.829 [Camel (camel) thread #7 - JmsConsumer[incomingOrders]]
INFO  jms-cbr-route - Sending order order1380.xml to another country
10:18:02.829 [Camel (camel) thread #7 - JmsConsumer[incomingOrders]]
INFO jms-cbr-route - Done processing order1380.xml
```

13. To view the routes on the web interface, click **Open Java Console** and check the messages in the A-MQ queue.

CHAPTER 7. INTEGRATE SPRING BOOT WITH KUBERNETES

7.1. INTRODUCTION TO SPRING BOOT WITH KUBERNETES INTEGRATION

7.1.1. What are we Integrating?

The Spring Cloud Kubernetes plug-in currently enables you to integrate the following features of Spring Boot and Kubernetes:

- Section 7.1.2, “Spring Boot Externalized Configuration” integrates with,
- Section 7.1.3, “Kubernetes ConfigMap” and,
- Section 7.1.4, “Kubernetes Secrets”

7.1.2. Spring Boot Externalized Configuration

In Spring Boot, externalized configuration is the mechanism that enables you to inject configuration values from external sources into Java code. In your Java code, injection is typically enabled by annotating with the **`@Value`** annotation (to inject into a single field) or the **`@ConfigurationProperties`** annotation (to inject into multiple properties on a Java bean class).

The configuration data can come from a wide variety of different sources (or *property sources*). In particular, configuration properties are often set in a project’s **`application.properties`** file (or **`application.yaml`** file, if you prefer).

7.1.3. Kubernetes ConfigMap

A Kubernetes ConfigMap is a mechanism that can provide configuration data to a deployed application. A ConfigMap object is typically defined in a YAML file, which is then uploaded to the Kubernetes cluster, making the configuration data available to deployed applications.

7.1.4. Kubernetes Secrets

A Kubernetes Secrets is a mechanism for providing sensitive data (such as passwords, certificates, and so on) to deployed applications.

7.1.5. Spring Cloud Kubernetes Plug-In

The Spring Cloud Kubernetes plug-in implements the integration between Kubernetes and Spring Boot. In principle, you could access the configuration data from a ConfigMap using the Kubernetes API. It is much more convenient, however, to integrate Kubernetes ConfigMap directly with the Spring Boot externalized configuration mechanism, so that Kubernetes ConfigMaps behave as an alternative property source for Spring Boot configuration. This is essentially what the Spring Cloud Kubernetes plug-in provides.

7.1.6. How to Enable Spring Boot with Kubernetes Integration

In a typical Spring Boot Maven project, you can enable the integration by adding the following Maven dependency to your project’s POM file:

```
<project ...>
  ...
  <dependencies>
    ...
    <dependency>
      <groupId>io.fabric8</groupId>
      <artifactId>spring-cloud-kubernetes-core</artifactId>
    </dependency>
    ...
  </dependencies>
  ...
</project>
```

To complete the integration, you need to add some annotations to your Java source code, create a Kubernetes ConfigMap object, and modify the OpenShift service account permissions to allow your application to read the ConfigMap object. These steps are described in detail in Section 7.2, “Tutorial for ConfigMap Property Source”.

7.2. TUTORIAL FOR CONFIGMAP PROPERTY SOURCE

The following tutorial is based on the **`spring-boot-camel-config-archetype`** Maven archetype, which enables you to experiment with setting Kubernetes Secrets and ConfigMaps. The Spring Cloud Kubernetes plug-in is also enabled, making it possible to integrate Kubernetes configuration objects with Spring Boot Externalized Configuration.

7.2.1. Build and run the spring-boot-camel-config quickstart

Perform the following steps to create a simple Camel Spring Boot project:

1. Open a new shell prompt and enter the following Maven command:

   ```
   mvn org.apache.maven.plugins:maven-archetype-plugin:2.4:generate \
     -
   DarchetypeCatalog=https://maven.repository.redhat.com/ga/io/fabric8/
   archetypes/archetypes-catalog/2.2.195.redhat-000017/archetypes-
   catalog-2.2.195.redhat-000017-archetype-catalog.xml \
     -DarchetypeGroupId=org.jboss.fuse.fis.archetypes \
     -DarchetypeArtifactId=spring-boot-camel-config-archetype \
     -DarchetypeVersion=2.2.195.redhat-000017
   ```

   The archetype plug-in switches to interactive mode to prompt you for the remaining fields:

   ```
   Define value for property 'groupId': : org.example.fis
   Define value for property 'artifactId': : fis-configmap
   Define value for property 'version':  1.0-SNAPSHOT: :
   Define value for property 'package':  org.example.fis: :
   [INFO] Using property: spring-boot-version = 1.4.1.RELEASE
   Confirm properties configuration:
   groupId: org.example.fis
   artifactId: fis-configmap
   version: 1.0-SNAPSHOT
   package: org.example.fis
   spring-boot-version: 1.4.1.RELEASE
    Y: :
   ```

When prompted, enter **`org.example.fis`** for the **`groupId`** value and **`fis-configmap`** for the **`artifactId`** value. Accept the defaults for the remaining fields.

2. Log in to OpenShift and switch to the OpenShift project where you will deploy your application. For example, to log in as the **`developer`** user and deploy to the **`test`** project, enter the following commands:

```
oc login -u developer -p developer https://OPENSHIFT_IP_ADDR:8443
oc project test
```

Where, **`OPENSHIFT_IP_ADDR`** is a placeholder for the OpenShift server's IP address.

3. At the command line, change to the directory of the new **`fis-configmap`** project and create the Secret object for this application:

```
oc create -f sample-secret.yml
```

NOTE

It is necessary to create the Secret object *before* you deploy the application, otherwise the deployed container enters a wait state until the Secret becomes available. If you subsequently create the Secret, the container will come out of the wait state.

4. Build and deploy the quickstart application. From the top level of the **`fis-configmap`** project, enter:

```
mvn fabric8:deploy
```

5. View the application log as follows. Open the OpenShift console in your browser and select the relevant project namespace (for example, **`test`**). Click in the center of the circular pod icon for the **`fis-configmap`** service and then — in the **Pods** view — click on the pod **Name** to view the details of the running pod (alternatively, you will get straight through to the details page, if there is only one pod running). Now click on the **Logs** tag to view the application log and scroll down to find the log messages generated by the Camel application.

6. The default recipient list, which is configured in **`src/main/resources/application.properties`**, sends the generated messages to two dummy endpoints: **`direct:async-queue`** and **`direct:file`**. This causes messages like the following to be written to the application log:

```
5:44:57.376 [Camel (camel) thread #0 - timer://order] INFO
generate-order-route - Generating message message-44, sending to the
recipient list
15:44:57.378 [Camel (camel) thread #0 - timer://order] INFO  target-
route-queue - ----> message-44 pushed to an async queue (simulation)
15:44:57.379 [Camel (camel) thread #0 - timer://order] INFO  target-
route-queue - ----> Using username 'myuser' for the async queue
15:44:57.380 [Camel (camel) thread #0 - timer://order] INFO  target-
route--file - ----> message-44 written to a file
```

7. Before you can update the configuration of the **`fis-configmap`** application using a ConfigMap object, you must give the **`fis-configmap`** application permission to view data from the

OpenShift ApiServer. Enter the following command to give the **`view`** permission to the **`fis-configmap`** application's service account:

```
oc policy add-role-to-user view system:serviceaccount:test:qs-camel-
config
```

NOTE

A service account is specified using the syntax **`system:serviceaccount:PROJECT_NAME:SERVICE_ACCOUNT_NAME`**. The **`fis-config`** deployment descriptor defines the **`SERVICE_ACCOUNT_NAME`** to be **`qs-camel-config`**.

8. To see the live reload feature in action, create a ConfigMap object as follows:

```
oc create -f sample-configmap.yml
```

The new ConfigMap overrides the recipient list of the Camel route in the running application, configuring it to send the generated messages to *three* dummy endpoints: **`direct:async-queue`**, **`direct:file`**, and **`direct:mail`**. This causes messages like the following to be written to the application log:

```
16:25:24.121 [Camel (camel) thread #0 - timer://order] INFO
generate-order-route - Generating message message-9, sending to the
recipient list
16:25:24.124 [Camel (camel) thread #0 - timer://order] INFO  target-
route-queue - ----> message-9 pushed to an async queue (simulation)
16:25:24.125 [Camel (camel) thread #0 - timer://order] INFO  target-
route-queue - ----> Using username 'myuser' for the async queue
16:25:24.125 [Camel (camel) thread #0 - timer://order] INFO  target-
route--file - ----> message-9 written to a file (simulation)
16:25:24.126 [Camel (camel) thread #0 - timer://order] INFO  target-
route--mail - ----> message-9 sent via mail
```

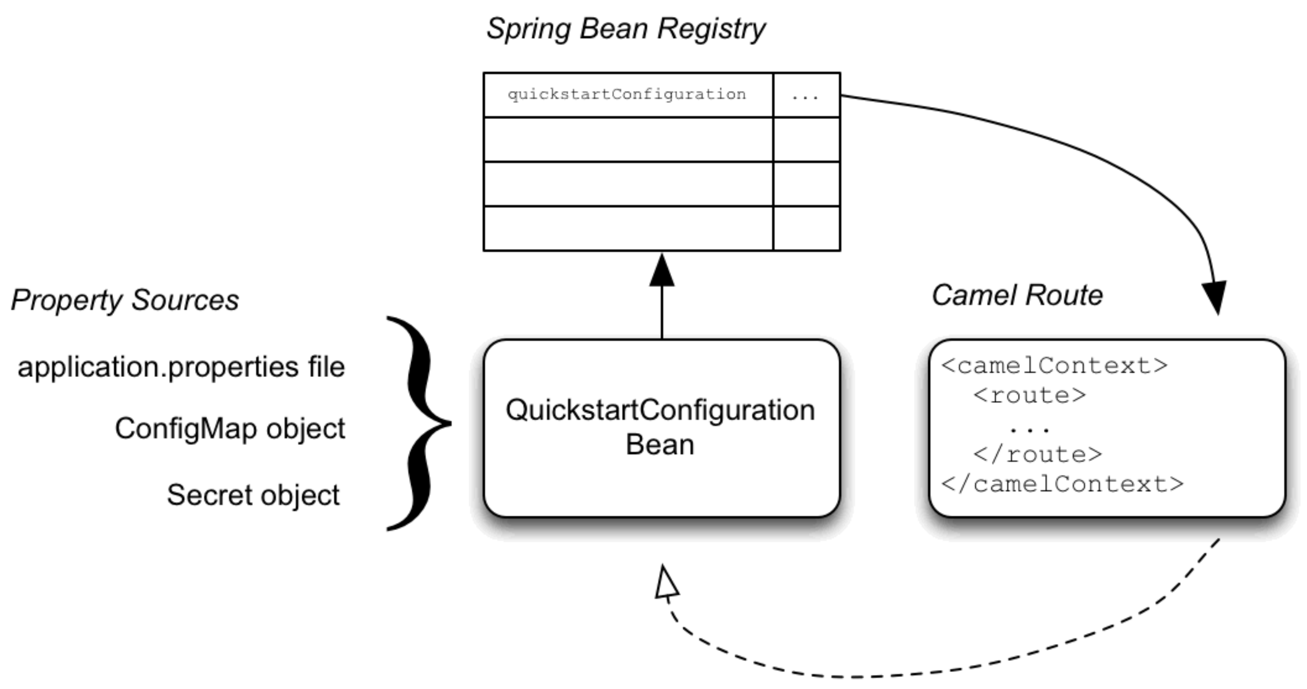
7.2.2. Configuration Properties bean

A configuration properties bean is a regular Java bean that can receive configuration settings by injection. It provides the basic interface between your Java code and the external configuration mechanisms.

7.2.2.1. Overview

Externalized Configuration and Bean Registry shows how Spring Boot Externalized Configuration works in the **`spring-boot-camel-config`** quickstart.

Externalized Configuration and Bean Registry



The configuration mechanism has the following main parts:

Property Sources

Provides property settings for injection into configuration. The default property source is the application’s **`application.properties`** file, and this can optionally be overridden by a ConfigMap object or a Secret object.

Configuration Properties bean

Receives configuraton updates from the property sources. A configuration properties bean is a Java bean decorated by the **`@Configuration`** and **`@ConfigurationProperties`** annotations.

Spring bean registry

With the requisite annotations, a configuration properties bean is registered in the Spring bean registry.

Integration with Camel bean registry

The Camel bean registry is automatically integrated with the Spring bean registry, so that registered Spring beans can be referenced in your Camel routes.

7.2.2.2. QuickstartConfiguration class

The configuration properties bean for the **`fis-configmap`** project is defined as the **`QuickstartConfiguration`** Java class (under the **`src/main/java/org/example/fis/`** directory), as follows:

```
package org.example.fis;

import
org.springframework.boot.context.properties.ConfigurationProperties;
import org.springframework.context.annotation.Configuration;

@Configuration  1
@ConfigurationProperties(prefix = "quickstart")  2
public class QuickstartConfiguration {

    /**
```

```
     * A comma-separated list of routes to use as recipients for messages.
     */
    private String recipients; (3)

    /**
     * The username to use when connecting to the async queue (simulation)
     */
    private String queueUsername; (4)

    /**
     * The password to use when connecting to the async queue (simulation)
     */
    private String queuePassword; (5)

    // Setters and Getters for Bean properties
    // NOT SHOWN
    ...
}
```

1. The `@Configuration` annotation causes the **`QuickstartConfiguration`** class to be instantiated and registered in Spring as the bean with ID, **`quickstartConfiguration`**. This automatically makes the bean accessible from Camel. For example, the **`target-route-queue`** route is able to access the **`queueUserName`** property using the Camel syntax **`${bean:quickstartConfiguration?method=getQueueUsername}`**.

2. The `@ConfigurationProperties` annotation defines a prefix, **`quickstart`**, that must be used when defining property values in a property source. For example, a properties file would reference the **`recipients`** property as **`quickstart.recipients`**.

3. The **`recipient`** property is injectable from property sources.

4. The **`queueUsername`** property is injectable from property sources.

5. The **`queuePassword`** property is injectable from property sources.

7.2.3. How to set up the Secret

The Kubernetes Secret in this quickstart is set up in the standard way, apart from one additional required step: the Spring Cloud Kubernetes plug-in must be configured with the mount paths of the Secrets, so that it can read the Secrets at run time.

For more details, see the chapter on Secrets in the Kubernetes reference documentation.

7.2.3.1. Sample Secret object

The quickstart project provides a sample Secret, **`sample-secret.yml`**, as follows:

```
apiVersion: v1
kind: Secret
metadata:
  name: camel-config
type: Opaque
data:
  # The username is 'myuser'
```

```
quickstart.queue-username: bXl1c2VyCg==
quickstart.queue-password: MWYyZDFlMmU2N2Rm
```

Note the following settings:

metadata.name

Identifies the Secret. Other parts of the OpenShift system use this identifier to reference the Secret.

quickstart.queue-username

Is meant to be injected into the **`queueUsername`** property of the **`quickstartConfiguration`** bean. The value *must* be base64 encoded.

quickstart.queue-password

Is meant to be injected into the **`queuePassword`** property of the **`quickstartConfiguration`** bean. The value *must* be base64 encoded.

Property values in Secret objects are always base64 encoded (use the **`base64`** command-line utility). When the Secret is mounted in a pod's filesystem, the values are automatically decoded back into plain text.

NOTE

Kubernetes does not allow you to define property names in CamelCase (it requires property names to be all lowercase). To work around this limitation, use the hyphenated form **`queue-username`**, which Spring Boot matches with **`queueUsername`**. This takes advantage of Spring Boot's relaxed binding rules for externalized configuration.

7.2.3.2. Configure volume mount for the Secret

The application must be configured to load the Secret at run time, by configuring the Secret as a volume mount. After the application starts, the Secret properties then become available at the specified location in the filesystem.

The Example 7.1, "deployment.yml file" listing shows the application's **`deployment.yml`** file (located under **`src/main/fabric8/`**), which defines the volume mount for the Secret.

Example 7.1. deployment.yml file

```
spec:
  template:
    spec:
      serviceAccountName: "qs-camel-config"
      volumes: 1
        - name: "camel-config"
          secret:
            # The secret must be created before deploying this
application
            secretName: "camel-config"
      containers:
        -
          volumeMounts: 2
            - name: "camel-config"
              readOnly: true
              # Mount the secret where spring-cloud-kubernetes is
configured to read it
```

```
                # see src/main/resources/bootstrap.yml
                mountPath: "/etc/secrets/camel-config"
            resources:
#              requests:
#                cpu: "0.2"
#                memory: 256Mi
#              limits:
#                cpu: "1.0"
#                memory: 256Mi
```

1. In the **volumes** section, the deployment declares a new volume named **camel-config**, which references the Secret named **camel-config**.

2. In the **volumeMounts** section, the deployment declares a new volume mount, which references the **camel-config** volume and specifies that the Secret volume should be mounted to the path **/etc/secrets/camel-config** in the pod's filesystem.

7.2.3.3. Configure spring-cloud-kubernetes to read Secret properties

To integrate secrets with Spring Boot externalized configuration, the Spring Cloud Kubernetes plug-in must be configured with the secret's mount path. Spring Cloud Kubernetes reads the secrets from the specified location and makes them available to Spring Boot as property sources.

The Spring Cloud Kubernetes plug-in is configured by settings in the **bootstrap.yml** file, located under **src/main/resources** in the quickstart project, as shown in the Example 7.2, "bootstrap.yml file" listing.

Example 7.2. bootstrap.yml file

```
# Startup configuration of Spring-cloud-kubernetes
spring:
  application:
    name: camel-config
  cloud:
    kubernetes:
      reload:
        # Enable live reload on ConfigMap change (disabled for Secrets
by default)
        enabled: true
      secrets:
        paths: /etc/secrets/camel-config
```

The **spring.cloud.kubernetes.secrets.paths** property specifies the list of paths of secrets volume mounts in the pod.

NOTE

A **bootstrap.properties** file (or **bootstrap.yml** file) behaves similarly to an **application.properties** file, but it is loaded at an earlier phase of application start-up. It is more reliable to set the properties relating to the Spring Cloud Kubernetes plug-in in the **bootstrap.properties** file.

7.2.4. How to set up the ConfigMap

In addition to creating a ConfigMap object and setting the view permission appropriately, the integration with Spring Cloud Kubernetes requires you to match the ConfigMap's **`metadata.name`** with the value of the **`spring.application.name`** property configured in the project's **`bootstrap.yml`** file.

7.2.4.1. Sample ConfigMap object

The quickstart project provides a sample ConfigMap, **`sample-configmap.yml`**, as follows:

```
kind: ConfigMap
apiVersion: v1
metadata:
  # Must match the 'spring.application.name' property of the application
  name: camel-config
data:
  application.properties: |
    # Override the configuration properties here
    quickstart.recipients=direct:async-queue,direct:file,direct:mail
```

Note the following settings:

metadata.name

Identifies the ConfigMap. Other parts of the OpenShift system use this identifier to reference the ConfigMap.

data.application.properties

This section lists property settings that can override settings from the original **`application.properties`** file that was deployed with the application.

quickstart.recipients

Is meant to be injected into the **`recipients`** property of the **`quickstartConfiguration`** bean.

For more details about the format of this file, see Section 7.3, "ConfigMap PropertySource".

7.2.4.2. Setting the view permission

As shown in the Example 7.1, "deployment.yml file" listing, the **`serviceAccountName`** is set to **`qs-camel-config`** in the project's **`deployment.yml`** file. Hence, you need to enter the following command to enable the **`view`** permission on the quickstart application (assuming that it deploys into the **`test`** project namespace):

```
oc policy add-role-to-user view system:serviceaccount:test:qs-camel-config
```

7.2.4.3. Configuring the Spring Cloud Kubernetes plug-in

The Spring Cloud Kubernetes plug-in is configured by the following settings in the **`bootstrap.yml`** file, as shown in the Example 7.2, "bootstrap.yml file" listing:

spring.application.name

This value must match the **`metadata.name`** of the ConfigMap object (for example, as defined in **`sample-configmap.yml`** in the quickstart project). It defaults to **`application`**.

spring.cloud.kubernetes.reload.enabled

Setting this to **true** enables dynamic reloading of ConfigMap objects.

For more details about the supported properties, see Section 7.5, “PropertySource Reload”.

7.3. CONFIGMAP PROPERTYSOURCE

Kubernetes has the notion of ConfigMap for passing configuration to the application. The Spring cloud Kubernetes plug-in provides integration with **ConfigMap** to make config maps accessible by Spring Boot.

The **ConfigMap PropertySource** when enabled will look up Kubernetes for a **ConfigMap** named after the application (see **spring.application.name**). If the map is found it will read its data and do the following:

- Section 7.3.1, “Apply Individual Properties”
- Section 7.3.2, “Apply Property Named application.yaml”
- Section 7.3.3, “Apply Property Named application.properties”

7.3.1. Apply Individual Properties

Let’s assume that we have a Spring Boot application named **demo** that uses properties to read its thread pool configuration.

- **pool.size.core**
- **pool.size.maximum**

This can be externalized to config map in YAML format:

```
kind: ConfigMap
apiVersion: v1
metadata:
  name: demo
data:
  pool.size.core: 1
  pool.size.max: 16
```

7.3.2. Apply Property Named application.yaml

Individual properties work fine for most cases but sometimes we find YAML is more convenient. In this case we use a single property named **application.yaml** and embed our YAML inside it:

```
kind: ConfigMap
apiVersion: v1
metadata:
  name: demo
data:
  application.yaml: |-
    pool:
      size:
        core: 1
        max:16
```

7.3.3. Apply Property Named application.properties

You can also define the ConfigMap properties in the style of a Spring Boot **`application.properties`** file. In this case we use a single property named **`application.properties`** and list the property settings inside it:

```
kind: ConfigMap
apiVersion: v1
metadata:
  name: demo
data:
  application.properties: |-
    pool.size.core: 1
    pool.size.max: 16
```

7.3.4. Deploying a ConfigMap

To deploy a ConfigMap and make it accessible to a Spring Boot application, perform the following steps:

1. In your Spring Boot application, use the externalized configuration mechanism to access the ConfigMap property source. For example, by annotating a Java bean with the **`@Configuration`** annotation, it becomes possible for the bean's property values to be injected by a ConfigMap.

2. In your project's **`bootstrap.properties`** file (or **`bootstrap.yaml`** file), set the **`spring.application.name`** property to match the name of the ConfigMap.

3. Enable the **`view`** permission on the service account that is associated with your application (by default, this would be the service account called **`default`**). For example, to add the **`view`** permission to the **`default`** service account:

```
oc policy add-role-to-user view system:serviceaccount:$(oc project -
q):default -n $(oc project -q)
```

7.4. SECRETS PROPERTYSOURCE

Kubernetes has the notion of Secrets for storing sensitive data such as password, OAuth tokens, etc. The Spring cloud Kubernetes plug-in provides integration with **`Secrets`** to make secrets accessible by Spring Boot.

The **`Secrets`** property source when enabled will look up Kubernetes for **`Secrets`** from the following sources:

1. Reading recursively from secrets mounts

2. Named after the application (see **`spring.application.name`**)

3. Matching some labels

Please note that, by default, consuming Secrets via API (points 2 and 3 above) **is not enabled**.

If the secrets are found, their data is made available to the application.

7.4.1. Example of Setting Secrets

Let’s assume that we have a Spring Boot application named **`demo`** that uses properties to read its ActiveMQ and PostreSQL configuration.

```
amq.username
amq.password
pg.username
pg.password
```

These secrets can be externalized to **`Secrets`** in YAML format:

ActiveMQ Secrets

```
apiVersion: v1
kind: Secret
metadata:
  name: activemq-secrets
  labels:
    broker: activemq
type: Opaque
data:
  amq.username: bXl1c2VyCg==
  amq.password: MWYyZDFlMmU2N2Rm
```

PostreSQL Secrets

```
apiVersion: v1
kind: Secret
metadata:
  name: postgres-secrets
  labels:
    db: postgres
type: Opaque
data:
  amq.username: dXNlcgo=
  amq.password: cGdhZG1pbgo=
```

7.4.2. Consuming the Secrets

You can select the Secrets to consume in a number of ways:

1. By listing the directories where the secrets are mapped:

   ```
   -
   Dspring.cloud.kubernetes.secrets.paths=/etc/secrets/activemq,etc/sec
   rets/postgres
   ```

   If you have all the secrets mapped to a common root, you can set them like this:

   ```
   -Dspring.cloud.kubernetes.secrets.paths=/etc/secrets
   ```

2. By setting a named secret:

```
-Dspring.cloud.kubernetes.secrets.name=postgres-secrets
```

3. By defining a list of labels:

```
-Dspring.cloud.kubernetes.secrets.labels.broker=activemq
-Dspring.cloud.kubernetes.secrets.labels.db=postgres
```

7.4.3. Secrets Configuration Properties

You can use the following properties to configure the Secrets property source:

spring.cloud.kubernetes.secrets.enabled

Enable the Secrets property source. Type is **`Boolean`** and default is **`true`**.

spring.cloud.kubernetes.secrets.name

Sets the name of the secret to look up. Type is **`String`** and default is **`${spring.application.name}`**.

spring.cloud.kubernetes.secrets.labels

Sets the labels used to lookup secrets. This property behaves as defined by Map-based binding. Type is **`java.util.Map`** and default is **`null`**.

spring.cloud.kubernetes.secrets.paths

Sets the paths where secrets are mounted. This property behaves as defined by Collection-based binding. Type is **`java.util.List`** and default is **`null`**.

spring.cloud.kubernetes.secrets.enableApi

Enable/disable consuming secrets via APIs. Type is **`Boolean`** and default is **`false`**.

NOTE

Access to secrets via API may be restricted for security reasons — the preferred way is to mount a secret to the POD.

7.5. PROPERTYSOURCE RELOAD

Some applications may need to detect changes on external property sources and update their internal status to reflect the new configuration. The reload feature of Spring Cloud Kubernetes is able to trigger an application reload when a related ConfigMap or Secret change.

This feature is disabled by default and can be enabled using the configuration property **`spring.cloud.kubernetes.reload.enabled=true`** (for example, in the **`bootstrap.properties`** file).

The following levels of reload are supported (property **`spring.cloud.kubernetes.reload.strategy`**):

refresh

(default) only configuration beans annotated with **`@ConfigurationProperties`** or **`@RefreshScope`** are reloaded. This reload level leverages the refresh feature of Spring Cloud Context.

NOTE

The PropertySource reload feature can only be used for *simple* properties (that is, not collections) when the reload strategy is set to **`refresh`**. Properties backed by collections must not be changed at runtime.

restart_context

the whole Spring *ApplicationContext* is gracefully restarted. Beans are recreated with the new configuration.

shutdown

the Spring *ApplicationContext* is shut down to activate a restart of the container. When using this level, make sure that the lifecycle of all non-daemon threads is bound to the ApplicationContext and that a replication controller or replica set is configured to restart the pod.

7.5.1. Example

Assuming that the reload feature is enabled with default settings (**refresh** mode), the following bean will be refreshed when the config map changes:

```
@Configuration
@ConfigurationProperties(prefix = "bean")
public class MyConfig {

    private String message = "a message that can be changed live";

    // getter and setters

}
```

A way to see that changes effectively happen is creating another bean that prints the message periodically.

```
@Component
public class MyBean {

    @Autowired
    private MyConfig config;

    @Scheduled(fixedDelay = 5000)
    public void hello() {
        System.out.println("The message is: " + config.getMessage());
    }
}
```

The message printed by the application can be changed using a ConfigMap like the following one:

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: reload-example
data:
  application.properties: |-
    bean.message=Hello World!
```

Any change to the property named **`bean.message`** in the Config Map associated with the pod will be reflected in the output of the program.

The reload feature supports two operating modes:

event

(default) watches for changes in ConfigMaps or secrets using the Kubernetes API (web socket). Any event will produce a re-check on the configuration and a reload in case of changes. The **`view`** role on the service account is required in order to listen for config map changes. A higher level role (eg. **`edit`**) is required for secrets (secrets are not monitored by default).

polling

re-creates the configuration periodically from config maps and secrets to see if it has changed. The polling period can be configured using the property **`spring.cloud.kubernetes.reload.period`** and defaults to **15 seconds**. It requires the same role as the monitored property source. This means, for example, that using polling on file mounted secret sources does not require particular privileges.

The following properties can be used to configure the reloading feature:

spring.cloud.kubernetes.reload.enabled

Enables monitoring of property sources and configuration reload. Type is **`Boolean`** and default is **`false`**.

spring.cloud.kubernetes.reload.monitoring-config-maps

Allow monitoring changes in config maps. Type is **`Boolean`** and default is **`true`**.

spring.cloud.kubernetes.reload.monitoring-secrets

Allow monitoring changes in secrets. Type is **`Boolean`** and default is **`false`**.

spring.cloud.kubernetes.reload.strategy

The strategy to use when firing a reload (**`refresh`**, **`restart_context`**, **`shutdown`**). Type is **`Enum`** and default is **`refresh`**.

spring.cloud.kubernetes.reload.mode

Specifies how to listen for changes in property sources (**`event`**, **`polling`**). Type is **`Enum`** and default is **`event`**.

spring.cloud.kubernetes.reload.period

The period in milliseconds for verifying changes when using the **`polling`** strategy. Type is **`Long`** and default is **`15000`**.

Note the following points:

- The **`spring.cloud.kubernetes.reload.*`** properties should not be used in ConfigMaps or Secrets. Changing such properties at run time may lead to unexpected results;
- Deleting a property or the whole config map does not restore the original state of the beans when using the **`refresh`** level.

CHAPTER 8. DEVELOP AN APPLICATION FOR THE KARAF IMAGE

8.1. CREATE A KARAF PROJECT USING MAVEN ARCHETYPE

To create a Karaf project using a Maven archetype, follow these steps:

1. Go to the appropriate directory on your system.
2. Launch the Maven command to create a Karaf project

```
mvn org.apache.maven.plugins:maven-archetype-plugin:2.4:generate \
  -
DarchetypeCatalog=https://maven.repository.redhat.com/ga/io/fabric8/
archetypes/archetypes-catalog/2.2.195.redhat-000017/archetypes-
catalog-2.2.195.redhat-000017-archetype-catalog.xml \
  -DarchetypeGroupId=org.jboss.fuse.fis.archetypes \
  -DarchetypeArtifactId=karaf2-camel-amq-archetype \
  -DarchetypeVersion=2.2.195.redhat-000017
```

3. The archetype plug-in switches to interactive mode to prompt you for the remaining fields

```
Define value for property 'groupId': : org.example.fis
Define value for property 'artifactId': : fis-karaf2
Define value for property 'version':  1.0-SNAPSHOT: :
Define value for property 'package':  org.example.fis: :
```

When prompted, enter **`org.example.fis`** for the **`groupId`** value and **`fis-karaf2`** for the **`artifactId`** value. Accept the defaults for the remaining fields.

Then, follow the instructions in the quickstart on how to build and deploy the example.

NOTE

For the full list of available Karaf archetypes, see Section 8.3, “Karaf Archetype Catalog”.

8.2. STRUCTURE OF THE CAMEL KARAF APPLICATION

The directory structure of a Camel Karaf application is as follows:

```
├── pom.xml
├── README.md
└── src
    ├── main
    │   ├── fabric8
    │   │   └── deployment.yml
    │   ├── java
    │   │   └── org
    │   │       └── first
    │   │           └── karaf
    │   │               └── project
    │   └── resources
    │       ├── assembly
```

```
        │         │    └── etc
        │         │         └── org.ops4j.pax.logging.cfg
        │         └── OSGI-INF
        │              └── blueprint
        │                   └── camel-log.xml
        └── test
             ├── java
             │    └── org
             │         └── first
             │              └── karaf
             │                   └── project
             └── resources
```

Where the following files are important for developing a Karaf application:

pom.xml

Includes additional dependencies.
You can add dependencies in the **pom.xml** file, for example for logging you can use SLF4J.

```
        <dependency>
          <groupId>org.slf4j</groupId>
          <artifactId>slf4j-api</artifactId>
        </dependency>
```

org.ops4j.pax.logging.cfg

Demonstrates how to customize log levels, sets logging level to DEBUG instead of the default INFO.

camel-log.xml

Contains the source code of the application.

src/main/fabric8/deployment.yml

Provides additional configuration that is merged with the default OpenShift configuration file generated by the fabric8-maven-plugin.

NOTE

This file is not used as part of the Karaf application, but it is used in all quickstarts to limit the resources such as CPU and memory usage.

8.3. KARAF ARCHETYPE CATALOG

The Karaf archetype catalog includes the following examples.

Table 8.1. Karaf Maven Archetypes

Name	Description
`karaf2-camel-log-archetype`	Demonstrates a simple Apache Camel application that logs a message to the server log every 5th second.

Name	Description
`karaf2-camel-amq-archetype`	Demonstrates how to use Camel in a Karaf Container using Blueprint to connect to the AMQ xPaaS message broker on OpenShift.
`karaf2-camel-rest-sql-archetype`	Demonstrates how to use SQL via JDBC along with Camel's REST DSL to expose a RESTful API.
`karaf2-cxf-rest-archetype`	Demonstrates how to create a RESTful(JAX-RS) web service using CXF and expose it through the OSGi HTTP Service.

8.4. FABRIC8 KARAF FEATURES

Fabric8 provides support for Apache Karaf making it easier to develop OSGi apps for Kubernetes.

The important features of Fabric8 are as listed below:

- Different strategies to resolve placeholders in Blueprint XML files.
- Environment variables
- System properties
- Services
- Kubernetes ConfigMap
- Kubernetes Secrets
- Using Kubernetes configuration maps to dynamically update the OSGi configuration administration.
- Provides Kubernetes heath checks for OSGi services.

8.4.1. Adding Fabric8 Karaf Features

To use the features, add **`fabric8-karaf-features`** dependency to the project pom file.

```
<dependency>
  <groupId>io.fabric8</groupId>
  <artifactId>fabric8-karaf-features</artifactId>
  <version>${fabric8.version}</version>
  <classifier>features</classifier>
  <type>xml</type>
</dependency>
```

These features will be installed into the Karaf server.

8.4.2. Fabric8 Karaf Core Bundle functionalities

The bundle **`fabric8-karaf-core`** provides functionalities used by Blueprint and ConfigAdmin extensions.

To add the feature in a custom Karaf distribution, add it to **`startupFeatures`** in the project **`pom.xml`**

```
<startupFeatures>
  ...
  <feature>fabric8-karaf-core</feature>
  ...
</startupFeatures>
```

8.4.2.1. Property placeholders resolvers

The bundle **`fabric8-karaf-core`** exports a service **`PlaceholderResolver`** with the following interface:

```
public interface PlaceholderResolver {
    /**
     * Resolve a placeholder using the strategy indicated by the prefix
     *
     * @param value the placeholder to resolve
     * @return the resolved value or null if not resolved
     */
    String resolve(String value);

    /**
     * Replaces all the occurrences of variables with their matching
values from the resolver using the given source string as a template.
     *
     * @param source the string to replace in
     * @return the result of the replace operation
     */
    String replace(String value);

    /**
     * Replaces all the occurrences of variables within the given source
builder with their matching values from the resolver.
     *
     * @param value the builder to replace in
     * @rerurn true if altered
     */
    boolean replaceIn(StringBuilder value);

    /**
     * Replaces all the occurrences of variables within the given
dictionary
     *
     * @param dictionary the dictionary to replace in
     * @rerurn true if altered
     */
    boolean replaceAll(Dictionary<String, Object> dictionary);

    /**
     * Replaces all the occurrences of variables within the given
dictionary
```

```
     *
     * @param dictionary the dictionary to replace in
     * @rerurn true if altered
     */
    boolean replaceAll(Map<String, Object> dictionary);
}
```

The **`PlaceholderResolver`** service acts as a collector for different property placeholder resolution strategies. The resolution strategies it provides by default are listed in the table.

1. List of resolution strategies

Prefix	Example	Description
env	env:JAVA_HOME	lookup the property from OS environment variables.
sys	sys:java.version	lookup the property from Java JVM system properties.
service	service:amq	lookup the property from OS environment variables using the service naming idiom.
service.host	service.host:amq	lookup the property from OS environment variables using the service naming idiom returning the hostname part only.
service.port	service.port:amq	lookup the property from OS environment variables using the service naming idiom returning the port part only.
k8s:map	k8s:map:myMap/myKey	lookup the property from a Kubernetes ConfigMap (via API)
k8s:secret	k8s:secret:amq/password	lookup the property from a Kubernetes Secrets (via API or volume mounts)

The property placeholder service supports the following options:

1. List of property placeholder service options

Name	Default	Description
fabric8.placeholder.prefix	$[	The prefix for the placeholder
fabric8.placeholder.suffix	]	The suffix for the placeholder

Name	Default	Description
fabric8.k8s.secrets.path	null	A comma delimited list of paths were secrets are mapped
fabric8.k8s.secrets.api.enabled	false	Enable/Disable consuming secrets via APIs

To set the property placeholder service options you can use system properties or environment variables or both.

1. To access ConfigMaps on OpenShift the service account needs view permissions

   ```
   oc policy add-role-to-user view system:serviceaccount:$(oc project -
   q):default -n $(oc project -q)
   ```

2. Mount secret to the POD as access to secrets through API might be restricted.

3. Secrets available on the POD as volume mounts are mapped to a directory named as the secret, as shown below

```
containers:
  -
    env:
    - name: FABRIC8_K8S_SECRETS_PATH
      value: /etc/secrets
    volumeMounts:
    - name: activemq-secret-volume
      mountPath: /etc/secrets/activemq
      readOnly: true
    - name: postgres-secret-volume
      mountPath: /etc/secrets/postgres
      readOnly: true
volumes:
  - name: activemq-secret-volume
    secret:
      secretName: activemq
  - name: postgres-secret-volume
    secret:
      secretName: postgres
```

8.4.2.2. Adding a custom property placeholders resolvers

You can add a custom placeholder resolver to support a specific need, such as custom encryption. You can also use the **`PlaceholderResolver`** service to make the resolvers available to Blueprint and ConfigAdmin.

To add a custom property placeholders resolvers, follow these steps:

1. Add the following mvn dependency to the project **`pom.xml`**.

   pom.xml

```
---
<dependency>
  <groupId>io.fabric8</groupId>
  <artifactId>fabric8-karaf-core</artifactId>
</dependency>
---
```

2. Implement the PropertiesFunction interface and register it as OSGi service using SCR.

```
import io.fabric8.karaf.core.properties.function.PropertiesFunction;
import org.apache.felix.scr.annotations.Component;
import org.apache.felix.scr.annotations.ConfigurationPolicy;
import org.apache.felix.scr.annotations.Service;

@Component(
    immediate = true,
    policy = ConfigurationPolicy.IGNORE,
    createPid = false
)
@Service(PropertiesFunction.class)
public class MyPropertiesFunction implements PropertiesFunction {
    @Override
    public String getName() {
        return "myResolver";
    }

    @Override
    public String apply(String remainder) {
        // Parse and resolve remainder
        return remainder;
    }
}
```

3. You can reference the resolver in Configuration management as follows.

properties

```
my.property = $[myResolver:value-to-resolve]
```

8.4.3. Adding Fabric8 Karaf Config Admin Support

To include Config Admin Support feature in your custom Karaf distribution, add **`fabric8-karaf-cm`** to **`startupFeatures`** in your project **`pom.xml`**

pom.xml

```
<startupFeatures>
  ...
  <feature>fabric8-karaf-cm</feature>
  ...
</startupFeatures>
```

8.4.3.1. Adding ConfigMap injection

The **`fabric8-karaf-cm`** provides a **`ConfigAdmin`** bridge that inject **`ConfigMap`** values in Karaf’s **`ConfigAdmin`**.

To be added by the ConfigAdmin bridge, a ConfigMap has to be labeled with **karaf.pid**, where its values corresponds to the pid of your component.

```
kind: ConfigMap
apiVersion: v1
metadata:
  name: myconfig
  labels:
    karaf.pid: com.mycompany.bundle
data:
  example.property.1: my property one
  example.property.2: my property two
```

Individual properties work for most cases. But to define your configuration, you can use a single property names. It is same as the pid file in **`karaf/etc`**. For example,

```
kind: ConfigMap
apiVersion: v1
metadata:
  name: myconfig
  labels:
    karaf.pid: com.mycompany.bundle
data:
  com.mycompany.bundle.cfg: |
    example.property.1: my property one
    example.property.2: my property two
```

8.4.3.2. Configuration plugin

The **`fabric8-karaf-cm`** provides a **`ConfigurationPlugin`** which resolves configuration property placeholders.

To enable property substitution with the **`fabric8-karaf-cm`** plug-in, you must set the Java property, **`fabric8.config.plugin.enabled`** to **`true`**. For example, you can set this property using the **`JAVA_OPTIONS`** environment variable in the Karaf image, as follows:

```
JAVA_OPTIONS=-Dfabric8.config.plugin.enabled=true
```

An example of configuration property placeholders is shown below.

my.service.cfg

```
    amq.usr = $[k8s:secret:$[env:ACTIVEMQ_SERVICE_NAME]/username]
    amq.pwd = $[k8s:secret:$[env:ACTIVEMQ_SERVICE_NAME]/password]
    amq.url = tcp://$[env+service:ACTIVEMQ_SERVICE_NAME]
```

my-service.xml

```
    <?xml version="1.0" encoding="UTF-8"?>
    <blueprint xmlns="http://www.osgi.org/xmlns/blueprint/v1.0.0"
               xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xmlns:cm="http://aries.apache.org/blueprint/xmlns/blueprint-cm/v1.1.0"
               xsi:schemaLocation="
                 http://www.osgi.org/xmlns/blueprint/v1.0.0

https://www.osgi.org/xmlns/blueprint/v1.0.0/blueprint.xsd
                 http://camel.apache.org/schema/blueprint
                 http://camel.apache.org/schema/blueprint/camel-
blueprint.xsd">

      <cm:property-placeholder persistent-id="my.service" id="my.service"
update-strategy="reload"/>

      <bean id="activemq"
class="org.apache.activemq.camel.component.ActiveMQComponent">
         <property name="userName"  value="${amq.usr}"/>
         <property name="password"  value="${amq.pwd}"/>
         <property name="brokerURL" value="${amq.url}"/>
      </bean>
    </blueprint>
```

Fabric8 Karaf Config Admin supports the following options.

Name	Default	Description
fabric8.config.plugin.enabled	false	Enable ConfigurationPlugin
fabric8.cm.bridge.enabled	true	Enable ConfigAdmin bridge
fabric8.config.watch	true	Enable watching for ConfigMap changes
fabric8.config.merge	false	Enable merge ConfigMap values in ConfigAdmin
fabric8.config.meta	true	Enable injecting ConfigMap meta in ConfigAdmin bridge
fabric8.pid.label	karaf.pid	Define the label the ConfigAdmin bridge looks for

IMPORTANT

`ConfigurationPlugin` requires **`Aries Blueprint CM 1.0.9`** or above.

8.4.4. Fabric8 Karaf Blueprint Support

The **`fabric8-karaf-blueprint`** uses Aries PropertyEvaluator and property placeholders resolvers from **`fabric8-karaf-core`** to resolve placeholders in your Blueprint XML file.

To include the feature for blueprint support in your custom Karaf distribution, add **`fabric8-karaf-blueprint`** to **`startupFeatures`** in your project **`pom.xml`**.

```
<startupFeatures>
  ...
  <feature>fabric8-karaf-blueprint</feature>
  ...
</startupFeatures>
```

The fabric8 evaluator supports chained evaluators, such as **`${env+service:MY_ENV_VAR}`**. You need to resolve **`MY_ENV_VAR`** variable against environment variables. The result is then resolved using service function. For example,

```
<?xml version="1.0" encoding="UTF-8"?>

<blueprint xmlns="http://www.osgi.org/xmlns/blueprint/v1.0.0"
           xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
           xmlns:ext="http://aries.apache.org/blueprint/xmlns/blueprint-
ext/v1.2.0"
           xsi:schemaLocation="
             http://www.osgi.org/xmlns/blueprint/v1.0.0
             https://www.osgi.org/xmlns/blueprint/v1.0.0/blueprint.xsd
             http://camel.apache.org/schema/blueprint
             http://camel.apache.org/schema/blueprint/camel-blueprint.xsd
             http://aries.apache.org/blueprint/xmlns/blueprint-ext/v1.3.0
             http://aries.apache.org/schemas/blueprint-ext/blueprint-ext-
1.3.xsd">

  <ext:property-placeholder evaluator="fabric8" placeholder-prefix="$["
placeholder-suffix="]"/>

  <bean id="activemq"
class="org.apache.activemq.camel.component.ActiveMQComponent">
     <property name="userName"
value="$[k8s:secret:$[env:ACTIVEMQ_SERVICE_NAME]/username]"/>
     <property name="password"
value="$[k8s:secret:$[env:ACTIVEMQ_SERVICE_NAME]/password]"/>
     <property name="brokerURL"
value="tcp://$[env+service:ACTIVEMQ_SERVICE_NAME]"/>
  </bean>
</blueprint>
```

IMPORTANT

Nested property placeholder substitution requires **`Aries Blueprint Core 1.7.0`** or above.

8.4.5. Fabric8 Karaf Health Checks

It is recommended to install the **`fabric8-karaf-checks`** as a startup feature. Once enable, your Karaf server can expose **`http://0.0.0.0:8181/readiness-check`** and **`http://0.0.0.0:8181/health-check`** URLs which can be used by Kubernetes for readiness and liveness probes.

NOTE

These URLs will only respond with a HTTP 200 status code when the following is true:

- OSGi Framework is started.
- All OSGi bundles are started.
- All boot features are installed.
- All deployed BluePrint bundles are in the created state.
- All deployed SCR bundles are in the active, registered or factory state.
- All web bundles are deployed to the web server.
- All created Camel contexts are in the started state.

You can add the Karaf health checks feature to the project **`pom.xml`** using **`startupFeatures`**.

pom.xml

```
<startupFeatures>
  ...
  <feature>fabric8-karaf-checks</feature>
  ...
</startupFeatures>
```

The **`fabric8-maven-plugin:resources`** goal will detect if your using the **`fabric8-karaf-checks`** feature and automatically add the Kubernetes for readiness and liveness probes to your container’s configuration.

8.4.5.1. Adding Custom Heath Checks

You can provide additional custom heath checks to prevent the Karaf server from receiving user traffic before it is ready to process the requests. TO enable custom health checks you need to implement the **`io.fabric8.karaf.checks.HealthChecker`** or **`io.fabric8.karaf.checks.ReadinessChecker`** interfaces and register those objects in the OSGi registry.

Your project will need to add the following mvn dependency to the project **`pom.xml`** file.

pom.xml

```
<dependency>
  <groupId>io.fabric8</groupId>
  <artifactId>fabric8-karaf-checks</artifactId>
</dependency>
```

NOTE

The simplest way to create and registered an object in the OSGi registry is to use SCR.

An example that performs a health check to make sure you have some free disk space, is shown below:

```
import io.fabric8.karaf.checks.*;
import org.apache.felix.scr.annotations.*;
import org.apache.commons.io.FileSystemUtils;
import java.util.Collections;
import java.util.List;

@Component(
    name = "example.DiskChecker",
    immediate = true,
    enabled = true,
    policy = ConfigurationPolicy.IGNORE,
    createPid = false
)
@Service({HealthChecker.class, ReadinessChecker.class})
public class DiskChecker implements HealthChecker, ReadinessChecker {

    public List<Check> getFailingReadinessChecks() {
        // lets just use the same checks for both readiness and health
        return getFailingHeathChecks();
    }

    public List<Check> getFailingHealthChecks() {
        long free = FileSystemUtils.freeSpaceKb("/");
        if (free < 1024 * 500) {
            return Collections.singletonList(new Check("disk-space-low",
"Only " + free + "kb of disk space left."));
        }
        return Collections.emptyList();
    }
}
```

CHAPTER 9. USING PERSISTENT STORAGE IN FUSE INTEGRATION SERVICES

Fuse Integration Services (FIS) applications are based on OpenShift containers, which do not have a persistent filesystem. Every time you start an application it is started in a new container with an immutable Docker image. Hence any persisted data in the file systems is lost when the container stops. But applications need to store some state as data in a persistent store and sometimes applications share access to a common data store. OpenShift platform supports provisioning of external stores as Persistent Storage.

9.1. VOLUMES

OpenShift allows pods and containers to mount Volumes as file systems which are backed by multiple host-local or network attached storage endpoints. Volume types include:

- emptydir (empty directory): This is a default volume type. It is a directory which gets allocated when the pod is created on a local host. It is not copied across the servers and when you delete the pod the directory is removed.
- configmap: It is a directory with contents populated with key-value pairs from a named configmap.
- hostPath (host directory): It is a directory with specific path on any host and it requires elevated privileges.
- secret (mounted secret): Secret volumes mount a named secret to the provided directory.
- persistentvolumeclaim or pvc (persistent volume claim): This links the volume directory in the container to a persistent volume claim you have allocated by name. A persistent volume claim is a request to allocate storage. Note that if your claim is not bound, your pods will not start.

Volumes are configured at the Pod level and can only directly access an external storage using **hostPath**. Hence it is harder to mange the access to shared resources for multiple Pods as **hostPath** volumes.

9.2. PERSISTENTVOLUMES

PersistentVolumes allow cluster administrators to provision cluster wide storage which is backed by various types of network storage like NFS, Ceph RBD, AWS Elastic Block Store (EBS), etc. **PersistentVolumes** also specify capacity, access modes, and recycling policies. This allows pods from multiple Projects to access persistent storage without worrying about the nature of the underlying resource.

See the Configuring Persistent Storage for creating various types of PersistentVolumes.

9.3. SAMPLE PERSISTENTVOLUME CONFIGURATION

The sample configuration below provisions a path on the host machine as a PersistentVolume named pv001:

```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: pv0001
```

```
spec:
  accessModes:
    - ReadWriteOnce
  capacity:
    storage: 2Mi
  hostPath:
    path: /data/pv0001/
```

Here the host path is /**data**/**pv0001** and storage capacity is limited to 2MB. For example, when using OpenShift CDK it will provision the directory /**data**/**pv0001** from the virtual machine hosting the OpenShift Cluster. To create this **PersistentVolume**, add the above configuration in a file **pv.yaml** and use the command:

```
oc create -f pv.yaml
```

To verify the creation of **PersistentVolume**, use the following command, which will list all the **PersistentVolumes** configured in your OpenShift cluster:

```
oc get pv
```

9.4. PERSISTENTVOLUMECLAIMS

A **PersistentVolume** exposes a storage endpoint as a named entity in an OpenShift cluster. To access this storage from Projects, **PersistentVolumeClaims** must be created that can access the **PersistentVolume**. **PersistentVolumeClaims** are created for each Project with customized claims for a certain amount of storage with certain access modes.

The sample configuration below creates a claim named pvc0001 for 1MB of storage with read-write-once access against a **PersistentVolume** named pv0001.

```
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: pvc0001
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 1Mi
```

9.5. VOLUMES IN PODS

Pods use Volume Mounts to define the filesystem mount location and Volumes to define reference **PersistentVolumeClaims**. The sample container configuration below mounts **PersistentVolumeClaim** pvc0001 at /**usr**/**share**/**data** in its filesystem.

```
spec:
  template:
    spec:
      containers:
        - volumeMounts:
          - name: vol0001
```

```
              mountPath: /usr/share/data
        volumes:
          - name: vol0001
            persistentVolumeClaim:
              claimName: pvc0001
```

Any data written by the application to the directory **/usr/share/data** is now persisted across container restarts. Add this configuration in the file **src/main/fabric8/deployment.yml** in a FIS application and create OpenShift resources using command:

```
mvn fabric8:resource-apply
```

To verify that the created **DeploymentConfiguration** has the volume mount and volume use the command:

```
oc describe deploymentconfig <application-dc-name>
```

For FIS quickstarts, the **<application-dc-name>** is the Maven project name, for example **spring-boot-camel**.

CHAPTER 10. PATCHING FUSE INTEGRATION SERVICES

10.1. PATCHING OVERVIEW

You might need to perform one or more of the following tasks to bring the Fuse Integration Services (FIS) product up to the latest patch level:

Section 10.2, "Patch Application Dependencies"

Update the dependencies in your project POM file, so that your application uses patched versions of the Maven artifacts.

Section 10.3, "Patch the FIS Templates"

Update the FIS templates on your OpenShift server, so that new projects created with the FIS templates use patched versions of the Maven artifacts.

Section 10.4, "Patch the FIS Images"

Update the FIS images on your OpenShift server, so that new application builds are based on patched versions of the Fuse base images.

10.2. PATCH APPLICATION DEPENDENCIES

In the context of Fuse Integration Services (FIS), applications are built entirely using Maven artifacts downloaded from the Red Hat Maven repositories. Hence, to patch your application, all that you need to do is to edit your project's POM file, changing the Maven dependencies to use the appropriate FIS patch version.

It is important to upgrade all of the Maven dependencies for FIS together, so that your project uses dependencies that are all from the same patch version. The FIS project consists of a carefully curated set of Maven artifacts that are built and tested together. If you try to mix and match Maven artifacts from *different* FIS patch levels, you could end up with a configuration that is untested and unsupported by Red Hat. The easiest way to avoid this scenario is to use a Bill of Materials (BOM) file in Maven, which defines the versions of all the Maven artifacts supported by FIS. When you update the version of a BOM file, you automatically update the versions for all the FIS Maven artifacts in your project's POM.

The POM file that is generated by a FIS Maven archetype or by a FIS template in OpenShift has a standard layout that uses a BOM file and defines the versions of certain required plug-ins. It is recommended that you stick to this standard layout in your own applications, because this makes it much easier to patch and upgrade your application's dependencies.

10.2.1. Update Dependencies in a Spring Boot Application

The following code fragment shows the standard layout of a POM file for a Spring Boot application in FIS, highlighting some important property settings:

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<project ...>
  ...
  <properties>
    <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>

    <!-- maven plugin versions -->
    <fabric8.maven.plugin.version>3.1.80.redhat-
000004</fabric8.maven.plugin.version>
```

```
      <!-- configure the versions you want to use here -->
      <fabric8.version>2.2.170.redhat-000004</fabric8.version>
      <spring-boot.version>1.4.1.RELEASE</spring-boot.version>

      <maven-compiler-plugin.version>3.3</maven-compiler-plugin.version>
      <maven-surefire-plugin.version>2.18.1</maven-surefire-plugin.version>
    </properties>

    <dependencyManagement>
      <dependencies>
        <dependency>
          <groupId>io.fabric8</groupId>
          <artifactId>fabric8-project-bom-camel-spring-boot</artifactId>
          <version>${fabric8.version}</version>
          <type>pom</type>
          <scope>import</scope>
        </dependency>
      </dependencies>
    </dependencyManagement>
    ...
  </project>
```

Notice how the **dependencyManagement** section of the POM references the **fabric8-project-bom-camel-spring-boot** BOM file, which defines the versions for all of the Spring Boot Maven artifacts in FIS. When it comes to patching or upgrading the application, the following version settings are important:

fabric8.version

Defines the version of the **fabric8-project-bom-camel-spring-boot** BOM file. By updating the BOM version to a particular patch version, you are effectively updating all of the FIS Maven dependencies as well.

fabric8.maven.plugin.version

Defines the version of the **fabric8-maven-plugin** plug-in. The **fabric8-maven-plugin** plug-in is tightly integrated with each version of FIS. Hence, whenever you patch or upgrade FIS, it is essential to upgrade the **fabric8-maven-plugin** plug-in to the matching version.

10.2.2. Update Dependencies in a Karaf Application

The following code fragment shows the standard layout of a POM file for a Karaf application in FIS, highlighting some important property settings:

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<project ...>
  ...
  <properties>
    <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>

      <!-- configure the versions you want to use here -->
    <fabric8.version>2.2.170.redhat-000004</fabric8.version>
    <karaf.plugin.version>4.0.8.redhat-000017</karaf.plugin.version>

    <!-- maven plugin versions -->
    ...
    <fabric8.maven.plugin.version>3.1.80.redhat-
```

```
000004</fabric8.maven.plugin.version>
  </properties>

  <dependencyManagement>
    <dependencies>
      <!-- fabric8 bom must be before fabric8 bom -->
      <dependency>
        <groupId>io.fabric8</groupId>
        <artifactId>fabric8-project-bom-fuse-karaf</artifactId>
        <version>${fabric8.version}</version>
        <type>pom</type>
        <scope>import</scope>
      </dependency>
    </dependencies>
  </dependencyManagement>
  ...
</project>
```

Notice how the **dependencyManagement** section of the POM references the **fabric8-project-bom-fuse-karaf** BOM file, which defines the versions for all of the Karaf Maven artifacts in FIS. When it comes to patching or upgrading the application, the following version settings are important:

fabric8.version

Defines the version of the **fabric8-project-bom-fuse-karaf** BOM file. By updating the BOM version to a particular patch version, you are effectively updating all of the FIS Maven dependencies as well.

fabric8.maven.plugin.version

Defines the version of the **fabric8-maven-plugin** plug-in. The **fabric8-maven-plugin** plug-in is tightly integrated with each version of FIS. Hence, whenever you patch or upgrade FIS, it is essential to upgrade the **fabric8-maven-plugin** plug-in to the matching version.

10.2.3. Available BOM Versions

The following table shows the BOM versions corresponding to different patch releases of JBoss Fuse.

Table 10.1. JBoss Fuse Releases and Corresponding BOM Version

JBoss Fuse Release	BOM Version	Fabric8 Maven Plug-In Version
JBoss Fuse 6.3.0 GA	2.2.170.redhat-000004	3.1.80.redhat-000004
JBoss Fuse 6.3.0 Roll Up 1	2.2.170.redhat-000010	3.1.80.redhat-000010
JBoss Fuse 6.3.0 Roll Up 2	2.2.170.redhat-000013	3.1.80.redhat-000013
JBoss Fuse 6.3.0 Roll Up 4	2.2.170.redhat-000019	3.1.80.redhat-000019
JBoss Fuse 6.3.0 Roll Up 5	2.2.170.redhat-000022	3.1.80.redhat-000022
JBoss Fuse 6.3.0 Roll Up 6	2.2.170.redhat-000023	3.1.80.redhat-000023

JBoss Fuse Release	BOM Version	Fabric8 Maven Plug-In Version
JBoss Fuse 6.3.0 Roll Up 7	2.2.170.redhat-000024	3.1.80.redhat-000024
JBoss Fuse 6.3.0 Roll Up 8	2.2.170.redhat-000030	3.1.80.redhat-000030

To upgrade your application POM to a specific JBoss Fuse patch release, set the **`fabric8.version`** property to the corresponding BOM version, and the **`fabric8.maven.plugin.version`** property to the corresponding Fabric8 Maven plug-in version.

To discover the latest available versions, you can check the Red Hat Maven repository directly:

- fabric8-project-bom-camel-spring-boot BOM versions
- fabric8-project-bom-fuse-karaf BOM versions
- fabric8-maven-plugin versions

10.3. PATCH THE FIS TEMPLATES

You must update the FIS templates to the latest patch level, to ensure that new template-based projects are built using the correct patched dependencies. Patch the FIS templates as follows:

1. You need administrator privileges to update the FIS templates in OpenShift. Log in to the OpenShift Server as an administrator, as follows:

   ```
   oc login URL -u ADMIN_USER -p ADMIN_PASS
   ```

   Where **`URL`** is the URL of the OpenShift server and **`ADMIN_USER`**, **`ADMIN_PASS`** are the credentials of an administrator account on the OpenShift server.

2. Install the patched FIS templates. Enter the following commands at a command prompt:

   ```
   BASEURL=https://raw.githubusercontent.com/jboss-fuse/application-
   templates/6.3-GA
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/karaf2-
   camel-amq-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/karaf2-
   camel-log-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/karaf2-
   camel-rest-sql-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/karaf2-
   cxf-rest-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-amq-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-config-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-drools-template.json
   oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
   boot-camel-infinispan-template.json
   ```

```
oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
boot-camel-rest-sql-template.json
oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
boot-camel-teiid-template.json
oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
boot-camel-xml-template.json
oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
boot-cxf-jaxrs-template.json
oc replace --force -n openshift -f ${BASEURL}/quickstarts/spring-
boot-cxf-jaxws-template.json
```

NOTE

The **BASEURL** points at the relevant branch of the Git repository that stores the quickstart templates and it will always have the latest templates at **HEAD**. So, any time you run the preceding commands, you will get the latest version of the templates.

10.4. PATCH THE FIS IMAGES

The FIS images are updated independently of the main Fuse product. If any patches are required for the FIS images, updated images will be made available on the standard FIS image streams and the updated images can be downloaded from the Red Hat image registry, **registry.access.redhat.com**. Fuse Integration Services provides the following image streams (identified by their OpenShift *image stream name*):

- **fis-java-openshift**
- **fis-karaf-openshift**

These image streams are normally installed on the **openshift** project on the OpenShift server. To check the status of the FIS images on OpenShift, login to OpenShift as an administrator and enter the following command:

```
$ oc get is -n openshift
NAME                                  DOCKER REPO
TAGS                                UPDATED
fis-java-openshift                    registry.access.redhat.com/jboss-
fuse-6/fis-java-openshift         2.0-2,2.0-3,latest + 1 more...     3 days
ago
fis-karaf-openshift                   registry.access.redhat.com/jboss-
fuse-6/fis-karaf-openshift        latest,2.0,2.0-2 + 1 more...       3
days ago
...
```

You can now update each image stream one at a time:

```
oc import-image -n openshift fis-java-openshift
oc import-image -n openshift fis-karaf-openshift
```

NOTE

You can also configure your Fuse applications so that a rebuild is automatically triggered whenever a new FIS image becomes available. For details, see the section Setting Deployment Triggers in the OpenShift Container Platform 3.5 *Developer Guide*.

APPENDIX A. SPRING BOOT MAVEN PLUG-IN

A.1. SPRING BOOT MAVEN PLUGIN OVERVIEW

This appendix describes the Spring Boot Maven Plugin. It provides the Spring Boot support in Maven and allows you to package the executable jar or war archives and run an application **`in-place`**.

A.2. GOALS

The Spring Boot Plugin includes the following goals:

1. **`spring-boot:run`** runs your Spring Boot application.
2. **`spring-boot:repackage`** repackages your **`.jar`** and **`.war`** files to be executable.
3. **`spring-boot:start`** and **`spring-boot:stop`** both are used to manage the lifecycle of your Spring Boot application.
4. **`spring-boot:build-info`** generates build information that can be used by the Actuator.

A.3. USAGE

You can find general instructions on how to use the Spring Boot Plugin at: **`http://docs.spring.io/spring-boot/docs/current/maven-plugin/usage.html`**. Following is an example that describes the usage of the `spring-boot-camel' plugin.

```
<project>
  <modelVersion>4.0.0</modelVersion>

  <groupId>io.fabric8.quickstarts</groupId>
  <artifactId>spring-boot-camel</artifactId>
  <version>1.0-SNAPSHOT</version>

  <name>Fabric8 :: Quickstarts :: Spring-Boot :: Camel</name>
  <description>Spring Boot example running a Camel route</description>

  <properties>
    <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>

    <!-- configure the versions you want to use here -->
    <fabric8.version>2.2.179</fabric8.version>
    <spring-boot.version>1.4.1.RELEASE</spring-boot.version>

    <!-- maven plugin versions -->
    <fabric8.maven.plugin.version>3.2.1</fabric8.maven.plugin.version>
    <maven-compiler-plugin.version>3.3</maven-compiler-plugin.version>
    <maven-surefire-plugin.version>2.18.1</maven-surefire-plugin.version>
  </properties>

  <dependencyManagement>
    <dependencies>
      <dependency>
        <groupId>io.fabric8</groupId>
        <artifactId>fabric8-project-bom-camel-spring-boot</artifactId>
        <version>${fabric8.version}</version>
        <type>pom</type>
        <scope>import</scope>
      </dependency>
    </dependencies>
  </dependencyManagement>

  <dependencies>

    <!-- Enabling health checks -->
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter-actuator</artifactId>
    </dependency>
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter-web</artifactId>
    </dependency>

    <dependency>
      <groupId>org.apache.camel</groupId>
      <artifactId>camel-spring-boot-starter</artifactId>
    </dependency>

    <!-- testing -->
    <dependency>
      <groupId>junit</groupId>
      <artifactId>junit</artifactId>
      <scope>test</scope>
    </dependency>
    <dependency>
      <groupId>org.springframework</groupId>
      <artifactId>spring-test</artifactId>
      <scope>test</scope>
    </dependency>
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter-test</artifactId>
      <scope>test</scope>
    </dependency>
    <dependency>
      <groupId>org.jboss.arquillian.junit</groupId>
      <artifactId>arquillian-junit-container</artifactId>
      <scope>test</scope>
    </dependency>
    <dependency>
      <groupId>io.fabric8</groupId>
      <artifactId>fabric8-arquillian</artifactId>
      <scope>test</scope>
    </dependency>
  </dependencies>

  <build>
    <defaultGoal>spring-boot:run</defaultGoal>

    <plugins>
```

```
      <plugin>
        <artifactId>maven-compiler-plugin</artifactId>
        <version>${maven-compiler-plugin.version}</version>
        <configuration>
          <source>1.8</source>
          <target>1.8</target>
        </configuration>
      </plugin>
      <plugin>
        <groupId>org.apache.maven.plugins</groupId>
        <artifactId>maven-surefire-plugin</artifactId>
        <version>${maven-surefire-plugin.version}</version>
        <inherited>true</inherited>
        <configuration>
          <excludes>
            <exclude>**/*KT.java</exclude>
          </excludes>
        </configuration>
      </plugin>

      <plugin>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-maven-plugin</artifactId>
        <version>${spring-boot.version}</version>
        <executions>
          <execution>
            <goals>
              <goal>repackage</goal>
            </goals>
          </execution>
        </executions>
      </plugin>

      <plugin>
        <groupId>io.fabric8</groupId>
        <artifactId>fabric8-maven-plugin</artifactId>
        <version>${fabric8.maven.plugin.version}</version>
        <executions>
          <execution>
            <goals>
              <goal>resource</goal>
              <goal>build</goal>
            </goals>
          </execution>
        </executions>
      </plugin>
    </plugins>
  </build>
</project>
```

For more information on Spring Boot Maven Plugin, refer the **`http://docs.spring.io/spring-boot/docs/current/maven-plugin`** link.

APPENDIX B. KARAF MAVEN PLUG-IN

B.1. USING THE KARAF-MAVEN-PLUGIN

The **karaf-maven-plugin** enables you to create a Karaf *server assembly*, which is a microservices style packaging of a Karaf container. That is, the finished assembly contains all of the essential components of a Karaf installation (for example, including the contents of the **etc/**, **data/**, **lib**, and **system** directories), but stripped down to the bare minimum required to run your application.

B.2. KARAF MAVEN PLUG-IN GOALS

The following Karaf Maven plug-in goals are relevant to building server assemblies in Fuse Integration Services (FIS):

- Section B.2.1, “karaf:assembly Goal”

B.2.1. karaf:assembly Goal

The recommended way to create a Karaf server assembly is to use the **karaf:assembly** goal provided by the **karaf-maven-plugin**. This assembles a server from the Maven dependencies in the project pom.

B.2.1.1. Example of a Maven Assembly

You can create a Karaf server assembly using the **karaf:assembly** goal provided by the **karaf-maven-plugin**. This goal assembles a microservices style server assembly from the Maven dependencies in the project POM. In a FIS project, it is recommended that you bind the **karaf:assembly** goal to the Maven **install** phase. The project uses **bundle** packaging and the project itself gets installed into the Karaf container by listing it inside the **startupBundles** element. The following example displays the typical Maven configuration in a FIS quickstart:

```
<plugin>
  <groupId>org.apache.karaf.tooling</groupId>
  <artifactId>karaf-maven-plugin</artifactId>
  <version>${karaf.plugin.version}</version>
  <extensions>true</extensions>
  <executions>
    <execution>
      <id>karaf-assembly</id>
      <goals>
        <goal>assembly</goal>
      </goals>
      <phase>install</phase>
    </execution>
  </executions>
  <configuration>
    <!-- we are using karaf 2.4.x -->
    <karafVersion>v24</karafVersion>
    <useReferenceUrls>true</useReferenceUrls>
    <archiveTarGz>false</archiveTarGz>
    <includeBuildOutputDirectory>false</includeBuildOutputDirectory>
    <startupFeatures>
      <feature>karaf-framework</feature>
```

```
        <feature>shell</feature>
        <feature>jaas</feature>
        <feature>aries-blueprint</feature>
        <feature>camel-blueprint</feature>
        <feature>fabric8-karaf-blueprint</feature>
        <feature>fabric8-karaf-checks</feature>
      </startupFeatures>
      <startupBundles>

<bundle>mvn:${project.groupId}/${project.artifactId}/${project.version}</b
undle>
      </startupBundles>
    </configuration>
</plugin>
```

B.2.1.2. Parameters

The **karaf:assembly** goal supports the following parameters:

startupFeature

This will result in the feature bundles being listed in **startup.properties** at the appropriate start level and the bundles being copied into the **system/** internal repository. You can use **<feature-name>** or **<feature-name>/<feature-version>** formats.

bootFeature

This will result in the feature name being added to **boot-features** in the features service configuration file and all the bundles in the feature copied into the **system/** internal repository. You can use **<feature-name>** or **<feature-name>/<feature-version>** formats.

installedFeature

This will result in all the bundles in the feature being installed in the **system/** internal repository. Therefore, at run time the feature may be installed without access to external repositories. You can use **<feature-name>** or **<feature-name>/<feature-version>** formats.

libraries

The plugin accepts the **libraries** element, which can have one or more **library** child elements that specify a library URL. For example:

```
<libraries>
    <library>mvn:org.postgresql/postgresql/9.3-1102-
jdbc41;type:=endorsed</library>
</libraries>
```

APPENDIX C. FABRIC8 MAVEN PLUG-IN

C.1. OVERVIEW

With the help of **`fabric8-maven-plugin`**, you can deploy your Java applications to OpenShift. It provides tight integration with Maven and benefits from the build configuration already provided. This plug-in focuses on the following tasks:

- Building Docker-formatted images and,
- Creating OpenShift resource descriptors

It can be configured very flexibly and supports multiple configuration models for creating:

- A *Zero-Config* setup, which allows for a quick ramp-up with some opinionated defaults. Or for more advanced requirements,
- An *XML configuration*, which provides additional configuration options that can be added to the **`pom.xml`** file.

C.1.1. Building Images

The **`fabric8:build`** goal is for creating Docker-formatted images containing an application. It is easy to include build artifacts and their dependencies in these images. This plugin uses the assembly descriptor format from the **`maven-assembly-plugin`** to specify the content which will be added to the image.

IMPORTANT

Fuse Integration Services supports only the OpenShift **`s2i`** build strategy, *not* the **`docker`** build strategy.

C.1.2. Kubernetes and OpenShift Resources

Kubernetes and OpenShift resource descriptors can be created with **`fabric8:resource`**. These files are packaged within the Maven artifacts and can be deployed to a running orchestration platform with **`fabric8:apply`**.

C.1.3. Configuration

There are three levels of configuration:

- Zero-Config mode helps to make some very useful decisions based on what is present in the **`pom.xml`** file like, what base image to use or which ports to expose. It is used for starting up things and for keeping quickstart applications small and tidy.
- XML plugin configuration mode is similar to what docker-maven-plugin provides. It allows for type safe configuration with IDE support, but only a subset of possible resource descriptor features is provided.
- Kubernetes and OpenShift resource fragments are user provided YAML files that can be enriched by the plugin. This allows expert users to use plain configuration file with all their capabilities, but also to add project specific build information and avoid boilerplate code.

For more information about the Configuration, see **https://maven.fabric8.io/#configuration**.

C.2. INSTALLING THE PLUGIN

The Fabric8 Maven plugin is available under the Maven central repository and can be connected to pre- and post-integration phases as shown below.

```
<plugin>
  <groupId>io.fabric8</groupId>
  <artifactId>fabric8-maven-plugin</artifactId>
  <version>{version}</version>

  <configuration>
     ....
     <images>
        <!-- A single's image configuration -->
        <image>
          ...
          <build>
           ....
          </build>
        </image>
        ....
     </images>
  </configuration>

  <!-- Connect fabric8:resource and fabric8:build to lifecycle phases -->
  <executions>
    <execution>
       <id>fabric8</id>
       <goals>
         <goal>resource</goal>
         <goal>build</goal>
       </goals>
    </execution>
  </executions>
</plugin>
```

C.3. UNDERSTANDING THE GOALS

The Fabric8 Maven Plugin supports a rich set of goals for providing a smooth Java developer experience. You can categorize these goals as follows:

- Build goals are used to create and manage the Kubernetes and OpenShift build artifacts like Docker-formatted images or S2I builds.
- Development goals are used in deploying resource descriptors to the development cluster. Also, helps you to manage the lifecycle of the development cluster.

The following are the goals supported by the Fabric8 Maven plugin in the Red Hat Fabric Integration Services product:

Table C.1. Build Goals

Goal	Description
fabric8:build	Build images. Note that Fuse Integration Services supports only the OpenShift **`s2i`** build strategy, not the **`docker`** build strategy.
fabric8:resource	Create Kubernetes or OpenShift resource descriptors
fabric8:apply	Apply resources to a running cluster
fabric8:resource-apply	Run **`fabric8:resource`** → **`fabric8:apply`**

Table C.2. Development Goals

Goal	Description
fabric8:run	Run a complete development workflow cycle **`fabric8:resource`** → **`fabric8:build`** → **`fabric8:apply`** in the foreground.
fabric8:deploy	Deploy resources descriptors to a cluster after creating them and building the app. Same as **`fabric8:run`** except that it runs in the background.
fabric8:undeploy	Undeploy and remove resources descriptors from a cluster.
fabric8:start	Start the application which has been deployed previously
fabric8:stop	Stop the application which has been deployed previously
fabric8:log	Show the logs of the running application
fabric8:debug	Enable remote debugging

For more information about the Fabric8 Maven plugin goals, see https://maven.fabric8.io/#goals.

C.4. GENERATORS

The Fabric8 Maven plug-in provides *generator* components, which have the capability to build images automatically for specific kinds of application. In the case of Fuse Integration Services, the following generator types are supported:

- Section C.4.3, “Spring Boot”
- Section C.4.4, “Karaf”

Depending on certain characteristics of the application project, the generator framework auto-detects what type of build is required and invokes the appropriate generator component.

NOTE

The open source community version of the Fabric8 Maven plug-in provides additional generator types, but these are not supported in the Fuse Integration Services product.

C.4.1. Zero-Configuration

Generators do not *require* any configuration. They are enabled by default and run automatically with default settings when the Fabric8 Maven plug-in is invoked. But you can easily customize the configuration of the generators, if you need to.

C.4.2. Modes for Specifying the Base Image

In Fuse Integration Services, the base image for an application build can either be a Java image (for Spring Boot applications) or a Karaf image (for Karaf applications) The Fabric8 Maven plug-in supports the following modes for specifying the base image:

`istag`

(Default) The *image stream* mode works by selecting a tagged image from an OpenShift image stream. In this case, the base image is specified in the following format:

```
<namespace>/<image-stream-name>:<tag>
```

Where **`<namespace>`** is the name of the OpenShift project where the image streams are defined (normally, **`openshift`**), **`<image-stream-name>`** is the name of the image stream, and **`<tag>`** identifies a particular image in the stream (or tracks the *latest* image in the stream).

`docker`

The *docker* mode works by selecting a particular Docker-formatted image directly from an image registry. Because the base image is obtained directly from a remote registry, an image stream is not required. In this case, the base image is specified in the following format:

```
[<registry-location-url>/]<image-namespace>/<image-name>:<tag>
```

Where the image specifier *optionally* begins with the URL location of the remote image registry **`<registry-location-url>`**, followed by the image namespace **`<image-namespace>`**, the image name **`<image-name>`**, and the tag, **`<tag>`**.

NOTE

The default behaviour of the open source community version of **`fabric8-maven-plugin`** is different from the Red Hat productized version (for example, in the community version, the default mode is **`docker`**).

C.4.2.1. Default Values for istag Mode

When **`istag`** mode is selected (which is the default), the Fabric8 Maven plug-in uses the following default image specifiers to select the Fuse images (formatted as **`<namespace>/<image-stream-name>:<tag>`**):

```
openshift/fis-java-openshift:2.0
openshift/fis-karaf-openshift:2.0
```

NOTE

In the Fuse image streams, the individual images are tagged with build numbers — for example, **`2.0-1`**, **`2.0-2`**, and so on. The **`2.0`** tag is configured to always track the latest image.

C.4.2.2. Default Values for docker Mode

When **`docker`** mode is selected, and assuming that the OpenShift environment is configured to access **`registry.access.redhat.com`**, the Fabric8 Maven plug-in uses the following default image specifiers to select the Fuse images (formatted as **`<image-namespace>/<image-name>:<tag>`**):

```
jboss-fuse-6/fis-java-openshift:2.0
jboss-fuse-6/fis-karaf-openshift:2.0
```

C.4.2.3. Mode Configuration for Spring Boot Applications

To customize the mode configuration and base image location used for building Spring Boot applications, add a **`configuration`** element to the **`fabric8-maven-plugin`** configuration in your application's **`pom.xml`** file, in the following format:

```
<configuration>
  <generator>
    <config>
      <spring-boot>
        <fromMode>{istag|docker}</fromMode>
        <from>{image locations}</from>
      </spring-boot>
    </config>
  </generator>
</configuration>
```

C.4.2.4. Mode Configuration for Karaf Applications

To customize the mode configuration and base image location used for building Karaf applications, add a **`configuration`** element to the **`fabric8-maven-plugin`** configuration in your application's **`pom.xml`** file, in the following format:

```
<configuration>
  <generator>
    <config>
      <karaf>
        <fromMode>{istag|docker}</fromMode>
        <from>{image locations}</from>
      </karaf>
    </config>
  </generator>
</configuration>
```

C.4.2.5. Specifying the Mode on the Command Line

As an alternative to customizing the mode configuration directly in the **pom.xml** file, you can pass the mode settings directly to the **mvn** command, by adding the following property settings to the command line invocation:

```
//build from Docker-formatted image directly, registry location, image
name or tag are subject to change if desirable
-Dfabric8.generator.fromMode=docker
-Dfabric8.generator.from=<custom-registry-location-url>/<image-
namespace>/<image-name>:<tag>

//to use ImageStream from different namespace
-Dfabric8.generator.fromMode=istag //istag is default
-Dfabric8.generator.from=<namespace>/<image-stream-name>:<tag>
```

C.4.3. Spring Boot

The Spring Boot generator gets activated when it finds a **spring-boot-maven-plugin** plug-in in the **pom.xml** file. The generated container port is read from the **server.port** property **application.properties**, defaulting to **8080** if it is not found.

In addition to the common generator options, this generator can be configured with the following options:

Table C.3. Spring-Boot configuration options

Element	Description	Default
assemblyRef	If a reference to an assembly is given, then this is used without trying to detect the artifacts to include.	
targetDir	Directory within the generated image where the detected artefacts are put. Change this only if the base image is changed too.	**/deployments**
jolokiaPort	Port of the Jolokia agent exposed by the base image. Set this to 0 if you don't want to expose the Jolokia port.	8778
mainClass	Main class to call. If not specified, the generator searches for the main class as follows. First, a check is performed to detect a fat-jar. Next, the **target/classes** directory is scanned to look for a single class with a **main** method. If none is found or more than one is found, the generator does nothing.	
webPort	Port to expose as service, which is supposed to be the port of a web application. Set this to 0 if you don't want to expose a port.	8080
color	If set, force the use of color in the Spring Boot console output.	

The generator adds Kubernetes liveness and readiness probes pointing to either the management or server port as read from the **application.properties**. If the **server.ssl.key-store** property is set in **application.properties** then the probes are automatically set to use **https**.

C.4.4. Karaf

The Karaf generator gets activated when it finds a **`karaf-maven-plugin`** plug-in in the **`pom.xml`** file.

In addition to the common generator options, this generator can be configured with the following options:

Table C.4. Karaf configuration options

Element	Description	Default
baseDir	Directory within the generated image where the detected artifacts are put. Change this only if the base image is changed too.	**`/deployments`**
jolokiaPort	Port of the Jolokia agent exposed by the base image. Set this to 0 if you don’t want to expose the Jolokia port.	8778
mainClass	Main class to call. If not specified, the generator searches for the main class as follows. First, a check is performed to detect a fat-jar. Next, the **`target/classes`** directory is scanned to look for a single class with a **`main`** method. If none is found or more than one is found, the generator does nothing.	
user	User and/or group under which the files should be added. The user must already exist in the base image. It has the general format **`<user>[:<group>[:<run-user>]]`**`. The user and group can be given either as numeric user- and group-id or as names. The group id is optional.	**`jboss:jboss:jboss`**
webPort	Port to expose as service, which is supposed to be the port of a web application. Set this to 0 if you don’t want to expose a port.	8080

APPENDIX D. FABRIC8 CAMEL MAVEN PLUG-IN

D.1. GOALS

For validating Camel endpoints in the source code:

- **`fabric8-camel:validate`** validates the Maven project source code to identify invalid camel endpoint uris

D.2. ADDING THE PLUGIN TO YOUR PROJECT

To enable the Plugin, add the following to the **`pom.xml`** file:

```
<plugin>
  <groupId>io.fabric8.forge</groupId>
  <artifactId>fabric8-camel-maven-plugin</artifactId>
  <version>2.3.52</version>
</plugin>
```

`Note:` Check the current version number of the fabric8-forge release. You can find the latest release at the following location: **`https://github.com/fabric8io/fabric8-forge/releases`**.

However, you can run the validate goal from the command line or from your Java editor such as IDEA or Eclipse.

```
mvn fabric8-camel:validate
```

You can also enable the Plugin to run automatically as a part of the build to catch the errors.

```
<plugin>
  <groupId>io.fabric8.forge</groupId>
  <artifactId>fabric8-camel-maven-plugin</artifactId>
  <version>2.3.80</version>
  <executions>
    <execution>
      <phase>process-classes</phase>
    <goals>
      <goal>validate</goal>
    </goals>
    </execution>
  </executions>
</plugin>
```

The phase determines when the Plugin runs. In the above example, the phase is **`process-classes`** which runs after the compilation of the main source code.

You can also configure the maven plugin to validate the test source code. Change the phase as per the **`process-test-classes`** as shown below:

```
<plugin>
  <groupId>io.fabric8.forge</groupId>
  <artifactId>fabric8-camel-maven-plugin</artifactId>
  <version>2.3.80</version>
  <executions>
    <execution>
      <configuration>
        <includeTest>true</includeTest>
      </configuration>
      <phase>process-test-classes</phase>
      <goals>
        <goal>validate</goal>
      </goals>
    </execution>
  </executions>
</plugin>
```

D.3. RUNNING THE GOAL ON ANY MAVEN PROJECT

You can also run the validate goal on any Maven project, without adding the Plugin to the **`pom.xml`** file. You need to specify the Plugin, using its fully qualified name. For example, to run the goal on the camel-example-cdi plugin from Apache Camel, execute the following:

```
    $cd camel-example-cdi
    $mvn io.fabric8.forge:fabric8-camel-maven-plugin:2.3.52:validate
```

which then runs and displays the following output:

```
[INFO] ----------------------------------------------------------------
---------
[INFO] Building Camel :: Example :: CDI 2.16.2
[INFO] ----------------------------------------------------------------
---------
[INFO]
[INFO] --- fabric8-camel-maven-plugin:2.3.52:validate (default-cli) @
camel-example-cdi ---
[INFO] Endpoint validation success: (4 = passed, 0 = invalid, 0 =
incapable, 0 = unknown components)
[INFO] Simple validation success: (0 = passed, 0 = invalid)
[INFO] ----------------------------------------------------------------
---------
[INFO] BUILD SUCCESS
[INFO] ----------------------------------------------------------------
---------
```

After passing the validation successfully, you can validate the four endpoints. Let us assume that you made a typo in one of the Camel endpoint uris in the source code, such as:

```
  @Uri("timer:foo?period=5000")
```

You can make changes to include a typo error in the **`period`** option, such as:

```
  @Uri("timer:foo?perid=5000")
```

And when running the validate goal again, reports the following:

```
[INFO] ----------------------------------------------------------------
```

```
---------
[INFO] Building Camel :: Example :: CDI 2.16.2
[INFO] ----------------------------------------------------------------
---------
[INFO]
[INFO] --- fabric8-camel-maven-plugin:2.3.52:validate (default-cli) @
camel-example-cdi ---
[WARNING] Endpoint validation error at:
org.apache.camel.example.cdi.MyRoutes(MyRoutes.java:32)

 timer:foo?perid=5000

                    perid    Unknown option. Did you mean: [period]


[WARNING] Endpoint validation error: (3 = passed, 1 = invalid, 0 =
incapable, 0 = unknown components)
[INFO] Simple validation success: (0 = passed, 0 = invalid)
[INFO] ----------------------------------------------------------------
---------
[INFO] BUILD SUCCESS
[INFO] ----------------------------------------------------------------
---------
```

D.4. OPTIONS

The maven plugin supports the following options which you can configure from the command line (use **-D** syntax), or defined in the **pom.xml** file in the **<configuration>** tag.

D.4.1. Table

Parameter	Default Value	Description
downloadVersion	true	Whether to allow downloading Camel catalog version from the internet. This is needed, if the project uses a different Camel version than this plugin is using by default.
failOnError	false	Whether to fail if invalid Camel endpoints was found. By default the plugin logs the errors at **WARN** level
logUnparseable	false	Whether to log endpoint URIs which was un-parsable and therefore not possible to validate
includeJava	true	Whether to include Java files to be validated for invalid Camel endpoints
includeXML	true	Whether to include XML files to be validated for invalid Camel endpoints
includeTest	false	Whether to include test source code

Parameter	Default Value	Description
includes	-	To filter the names of java and xml files to only include files matching any of the given list of patterns (wildcard and regular expression). Multiple values can be separated by comma.
excludes	-	To filter the names of java and xml files to exclude files matching any of the given list of patterns (wildcard and regular expression). Multiple values can be separated by comma.
ignoreUnknownComponent	true	Whether to ignore unknown components
ignoreIncapable	true	Whether to ignore incapable of parsing the endpoint uri
ignoreLenientProperties	true	Whether to ignore components that uses lenient properties. When this is true, then the uri validation is stricter but would fail on properties that are not part of the component but in the uri because of using lenient properties. For example using the HTTP components to provide query parameters in the endpoint uri.
showAll	false	Whether to show all endpoints and simple expressions (both invalid and valid).

D.5. VALIDATING INCLUDE TEST

If you have a Maven project, then you can run the plugin to validate the endpoints in the unit test source code as well. You can pass in the options using **`-D`** style as shown:

```
    $cd myproject
    $mvn io.fabric8.forge:fabric8-camel-maven-plugin:2.3.52:validate -
DincludeTest=true
```

APPENDIX E. JVM ENVIRONMENT VARIABLES

E.1. S2I JAVA BUILDER IMAGE WITH OPENJDK 8

In this S2I builder image for Java builds, you can run results directly without using any other application server. It is suitable for microservices with a flat classpath (including **`fat jars`**).

You can configure java options when using the FIS images. All the options for the FIS images are set by using environment variables as given below. For the JVM options, you can use the environment variable **`JAVA_OPTIONS`**. Also, provide **`JAVA_ARGS`** for the arguments which are given through to the application.

E.2. S2I KARAF BUILDER IMAGE WITH OPENJDK 8

This image can be used with OpenShift's Source To Image in order to build Karaf4 custom assembly based maven projects.

Following is the command to use S2I:

```
s2i build <git repo url> registry.access.redhat.com/jboss-fuse-6/fis-karaf-
openshift:2.0 <target image name> docker run <target image name>
```

E.2.1. Configuring the Karaf4 Assembly

The location of the Karaf4 assembly built by the maven project can be provided in multiple ways.

- Default assembly file **`*.tar.gz`** in output directory
- By using the **`-e flag`** in sti or oc command
- By setting **`FUSE_ASSEMBLY`** property in **`.sti/environment`** under the project source

E.2.2. Customizing the Build

It is possible to customize the maven build. The **`MAVEN_ARGS`** environment variable can be set to change the behaviour.

By default, the **`MAVEN_ARGS`** is set as follows:

```
Karaf4: install karaf:assembly karaf:archive -DskipTests -e
```

E.3. ENVIRONMENT VARIABLES

Following are the environment variables that are used to influence the behaviour of S2I Java and Karaf builder images:

E.3.1. Build Time

During the build time, you can use the following environment variables:

- **`MAVEN_ARGS`**: Arguments to use when calling maven, replacing the default package.
- **`MAVEN_ARGS_APPEND`**: Additional Maven arguments, useful for adding temporary arguments like **`-X`** or **`-am -pl`**.

- **`ARTIFACT_DIR`**: Path to **`target/`** where the jar files are created for multi-module builds. These are added to **`${MAVEN_ARGS}`**.
- **`ARTIFACT_COPY_ARGS`**: Arguments to use when copying artifacts from the output directory to the application directory. Useful to specify which artifacts will be part of the image.
- **`MAVEN_CLEAR_REPO`**: If set, remove the Maven repository after you build the artifact. This is useful for keeping the application image small, however, It prevents the incremental builds. The default value is false.

E.3.2. Run Time

You can use the following environment variables to influence the run script:

- **`JAVA_APP_DIR`**: the directory where the application resides. All paths in your application are relative to the directory.
- **`JAVA_LIB_DIR`**: this directory contains the Java jar files as well an optional classpath file, which holds the classpath. Either as a single line classpath (colon separated) or with jar files listed line-by-line. However, If not set, then **`JAVA_LIB_DIR`** is the same as **`JAVA_APP_DIR`** directory.
- **`JAVA_OPTIONS`**: options to add when calling java.
- **`JAVA_MAX_MEM_RATIO`**: It is used when no **`-Xmx`** option is given in JAVA_OPTIONS. This is used to calculate a default maximal heap Memory based on a containers restriction. If used in a Docker container without any memory constraints for the container, then this option has no effect.
- **`JAVA_MAX_CORE`**: It restricts manually the number of cores available, which is used for calculating certain defaults like the number of garbage collector threads. If set to 0, you cannot perform the base JVM tuning based on the number of cores.
- **`JAVA_DIAGNOSTICS`**: Set this to fetch some diagnostics information, to standard out when things are happening.
- **`JAVA_MAIN_CLASS`**: A main class to use as an argument for java. When you give this environment variable, all jar files in **`$JAVA_APP_DIR`** directory are added to the classpath and in the **`$JAVA_LIB_DIR`** directory.
- **`JAVA_APP_JAR`**: A jar file with an appropriate manifest, so that you can start with **`java -jar`**. However, if it is not provided, then **`$JAVA_MAIN_CLASS`** is set. In all cases, this jar file is added to the classpath.
- **`JAVA_APP_NAME`**: Name to use for the process.
- **`JAVA_CLASSPATH`**: the classpath to use. If not given, the startup script checks for a file **`${JAVA_APP_DIR}/classpath`** and use its content as classpath. If this file doesn’t exists, then all jars in the application directory are added under **`(classes:${JAVA_APP_DIR}/*)`**.
- **`JAVA_DEBUG`**: If set, remote debugging will be switched on.
- **`JAVA_DEBUG_PORT`**: Port used for remote debugging. The default value is 5005.

E.3.3. Jolokia Configuration

You can use the following environment variables in Jolokia:

- **`AB_JOLOKIA_OFF`**: If set, disables the activation of Jolokia (echos an empty value). By default, Jolokia is enabled.
- **`AB_JOLOKIA_CONFIG`**: If set, uses the file (including path) as Jolokia JVM agent properties. However, If not set, the **`/opt/jolokia/etc/jolokia.properties`** will be created using the settings.
- **`AB_JOLOKIA_HOST`**: Host address to bind (Default value is 0.0.0.0)
- **`AB_JOLOKIA_PORT`**: Port to use (Default value is 8778)
- **`AB_JOLOKIA_USER`**: User for basic authentication. By default, it is **`jolokia`**
- **`AB_JOLOKIA_PASSWORD`**: Password for basic authentication. By default, authentication is switched off
- **`AB_JOLOKIA_PASSWORD_RANDOM`**: Generates a value and is written in **`/opt/jolokia/etc/jolokia.pw`** file
- **`AB_JOLOKIA_HTTPS`**: Switch on secure communication with **`HTTPS`**. By default, self-signed server certificates are generated, if no serverCert configuration is given in **`AB_JOLOKIA_OPTS`**
- **`AB_JOLOKIA_ID`**: Agent ID to use
- **`AB_JOLOKIA_DISCOVERY_ENABLED`**: Enables the Jolokia discovery. The default value is false.
- **`AB_JOLOKIA_OPTS`**: Additional options to be appended to the agent configuration. Options are given in the format **`key=value`**

Here is an option for integration with various environments:

- **`AB_JOLOKIA_AUTH_OPENSHIFT`**: Switch on client authentication for OpenShift TSL communication. Ensure that the value of this parameter must be present in a client certificate. If you enable this parameter, it will automatically switch Jolokia into **`HTTPS`** communication mode. The default CA cert is set to **`/var/run/secrets/kubernetes.io/serviceaccount/ca.crt`**

Application arguments can be provided by setting the variable **`JAVA_ARGS`** to the corresponding value.

APPENDIX F. TUNING JVMS TO RUN IN LINUX CONTAINERS

F.1. OVERVIEW

Java processes running inside the Linux container do not behave as expected when you allow JVM ergonomics to set the default values for the garbage collector, heap size, and runtime compiler. When you execute a Java application without any tuning parameters — for example, **`java -jar mypplication-fat.jar`** — the JVM automatically sets several parameters based on the host limits, *not* the container limits.

This section provides information about the packaging of Java applications inside a Linux container so that the container's limits are taken into consideration for calculating default values.

F.2. TUNING THE JVM

The current generation of Java JVMs are not container-aware, so they allocate resources based on the size of the physical host, not on the size of the container. For example, a JVM normally sets the *maximum heap size* to be 1/4 of the physical memory on a host. On a large host machine, this value can easily exceed the memory limit defined for a container and, if the container limit is exceeded at run time, OpenShift will kill the application.

To solve this issue, you can use the FIS base image that is capable of understanding that a Java JVM runs inside a restricted container and automatically adjusts the maximum heap size, if not done manually. It provides a solution of setting the maximum memory limit and the core limit on the JVM that runs your application.

F.3. DEFAULT BEHAVIOUR OF FIS IMAGES

In Fuse Integration Services, the base image for an application build can either be a Java image (for Spring Boot applications) or a Karaf image (for Karaf applications). FIS images execute a script that reads the container limits and uses these limits as the basis for allocating resources. By default, the script allocates the following resources to the JVM:

- 50% of the container memory limit,
- 50% of the container core limit.

F.4. CUSTOM TUNING OF FIS IMAGES

The script sets the **`CONTAINER_MAX_MEMORY`** and **`CONTAINER_CORE_LIMIT`** environment variables, which can be read by a custom application to tune its internal resources. Additionally, you can specify the following runtime environment variables that enable you to customize the settings on the JVM that runs your application:

- **`JAVA_OPTIONS`**
- **`JAVA_MAX_MEM_RATIO`**

To customize the limits explicitly, you can set the **`JAVA_MAX_MEM_RATIO`** environment variable by editing the **`deployment.yml`** file, in your Maven project. For example:

```
spec:
  template:
    spec:
      containers:
        -
          resources:
            requests:
              cpu: "0.2"
               memory: 256Mi
            limits:
              cpu: "1.0"
               memory: 256Mi
          env:
          - name: JAVA_MAX_MEM_RATIO
            value: 60
```

F.5. TUNING THIRD-PARTY LIBRARIES

Red Hat recommends you to customize limits for any third-party Java libraries such as Jetty. These libraries would use the given default limits, if you fail to customize limits manually.

The startup script exposes some environment variables describing container limits which can be used by applications:

`CONTAINER_CORE_LIMIT`

A calculated core limit

`CONTAINER_MAX_MEMORY`

Memory limit given to the container