



# Red Hat Fuse 7.12

## Tooling User Guide

Use Fuse Tooling in CodeReady Studio to develop and deploy Fuse applications



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## Abstract

This guide describes how to use the Red Hat Fuse Tooling, which provides developer tools designed to increase your productivity when designing, developing, testing, and debugging your integration applications.

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## PREFACE

Red Hat Fuse Tooling is an Eclipse-based IDE that simplifies and streamlines the process of developing integration applications within Red Hat CodeReady Studio. Fuse Tooling provides a set of developer tools that are specifically designed to work with:

- Red Hat Fuse
- Red Hat JBoss EAP
- Apache Camel
- Apache CXF
- Apache Karaf
- Spring Boot

This guide provides information about how to use Fuse Tooling to:

- Create a project for your application, including Maven dependencies
- Connect and configure Enterprise Integration Patterns to build routes
- Browse endpoints and routes
- Drag and drop messages onto running routes
- Browse and visualize runtime processes via JMX
- Debug locally running Camel contexts and routes
- Test your application by:
  - Creating and using JUnit test cases on Apache Camel routes
  - Using JMX to analyze running components
  - Tracing messages through Apache Camel routes
- Deploy your application

For new users, the [Tooling Tutorials](#) provide step-by-step instructions on how to create, debug, test, and deploy a sample Camel application.

## MAKING OPEN SOURCE MORE INCLUSIVE

Red Hat is committed to replacing problematic language in our code, documentation, and web properties. We are beginning with these four terms: master, slave, blacklist, and whitelist. Because of the enormity of this endeavor, these changes will be implemented gradually over several upcoming releases. For more details, see our [CTO Chris Wright's message](#).

## PART I. DEVELOPING APPLICATIONS

# CHAPTER 1. CREATING A NEW FUSE INTEGRATION PROJECT

## OVERVIEW

Creating a new Fuse Integration project involves these main steps:

- [Specifying the project name and workspace](#)
- [Configuring the project deployment environment](#)
- [Selecting a project template](#)
- If necessary, [resolving Maven dependency errors](#)

After you configure the project, the tooling downloads all of the required Maven dependencies and creates the POM file needed to run and publish the project.

## BEFORE YOU BEGIN


Before you create a new Fuse Integration project, you should have the following information:

- Your target runtime environment: Fuse on OpenShift or Fuse standalone (Spring Boot, Fuse on Karaf, or Fuse on EAP)
- The Camel version (if other than the default used by the tooling)

## SPECIFYING THE PROJECT NAME AND WORKSPACE

To create a new Fuse Integration project, follow these steps:

1. Select **New** → **Project** → **Red Hat Fuse** → **Fuse Integration Project** to open the **New Fuse Integration Project** wizard.  
The wizard opens with the **Use default workspace location** option selected in the **Location** pane.

2. In **Project Name**, type a name for the new project, for example **MySampleProject**.
3. Specify the workspace location in which you want to store the data for the project.
  - To use the default workspace, leave the **Use default workspace location** option enabled.
  - To use an alternative location clear the **Use default workspace location** option and specify a location in the **Path** field.
 Click  to quickly find and select an alternate workspace.
4. Click **Next** to open the **Select a Target Environment** page.

## CONFIGURING THE PROJECT DEPLOYMENT ENVIRONMENT

When you create a new project, you specify the project's target deployment environment so that your project has the resources it needs at runtime. You must select a deployment platform and a Camel version. Optionally, you can specify a runtime configuration.

With the **Select a Target Environment** page open:

1. Select whether you want to deploy the project on **Kubernetes/OpenShift** or on a **Standalone** platform.




If you select **Kubernetes/OpenShift** for the deployment platform, the **Spring Boot** runtime is automatically selected and you can skip to Step 3.

2. If you select **Standalone** for the deployment platform:
  - a. Choose a target runtime environment:
    - **Spring Boot**
    - **Karaf/Fuse on Karaf**
    - **Wildfly/Fuse on EAP**
  - b. For the Karaf and EAP standalone runtime environments, choose one of the following options for the runtime configuration:
    - Accept the **None selected** option (you can define the runtime configuration later).
    - Select an existing runtime configuration from the drop-down menu.
    - Create a new runtime configuration as described in [the section called "Creating a new target runtime \(optional\)"](#).
3. In the **Select the Camel version for your new project** pane, accept the default Camel version associated with the runtime or change the default by:
  - Selecting a Camel version from the drop-down list. Fuse Tooling supports the listed productized versions.

- Typing a different Camel version if you want to experiment with non-productized versions (that are not supported).  
You can click the **Verify** button to check whether the tooling can access the specified version. If not, a notification similar to the following example appears in the **Select a Target Runtime** page header:

#### Select a Target Runtime

 The selected Apache Camel version 2.12 seems to be unavailable. Please choose a different version.



#### NOTE

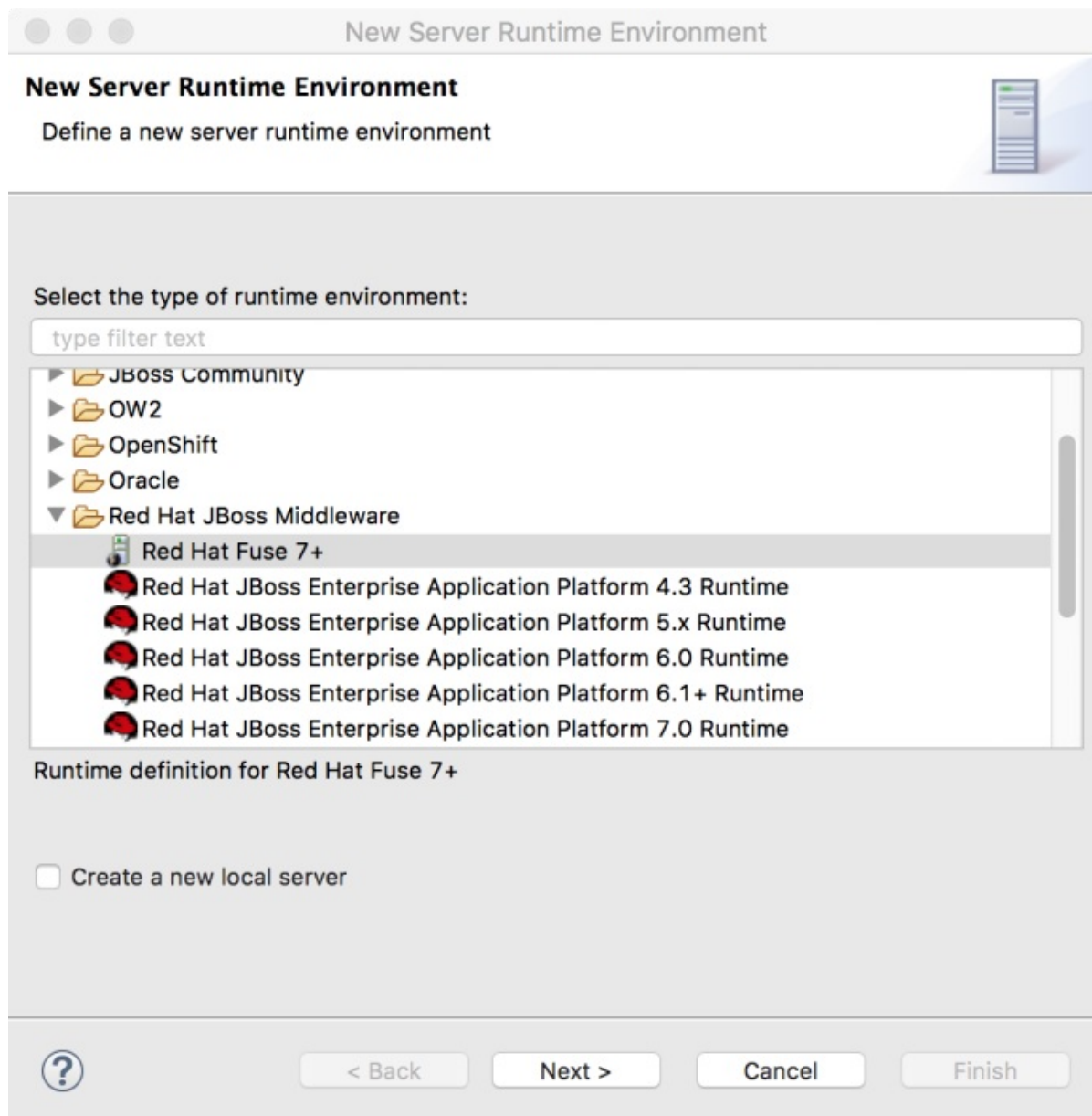
After you create, configure, and save a project, you can change the Camel version. See [Chapter 11, Changing the Camel version](#).

4. After you choose a runtime environment and a Camel version on which to base your new Fuse Integration project, click **Next** to open the wizard's **Advanced Project Setup** page and then follow the steps in [the section called "Selecting a project template"](#).

## CREATING A NEW TARGET RUNTIME (OPTIONAL)

For the Karaf and EAP standalone runtime environments, you can optionally create a new runtime configuration from the **New Fuse Integration Project** wizard.

1. From the wizard's the **Select a Target Runtime** page, click **New** to open the **New server runtime environment** page:



- Expand the **Red Hat JBoss Middleware** folder, and then select a Red Hat Fuse runtime environment.

Leave the **Create a new local server** option unchecked. You can create the local server later when you are ready to publish your project (see [Section 27.1, “Adding a Server”](#)).



#### NOTE

If you check the **Create a new local server** option, the **New Fuse Integration Project** wizard walks you through additional steps to define and configure the Fuse server runtime (as described in [Section 27.1, “Adding a Server”](#)). Then, when it builds the project, it also adds the server runtime to the **Servers** view in the **Fuse Integration** perspective.

- Click **Next** to open the server’s **New Server Runtime Environment** page:

4. Specify the **Name**, **Home Directory**, **Execution Environment** of the server runtime:

- **Name** – Accept the default or enter a new name for the runtime environment.
- **Home Directory** – Click the **Browse** button to locate and select the server runtime’s installation directory.



**NOTE**

If the server is not already installed on your machine, you can install it now by clicking the **Download and install runtime** link and then following the site’s download instructions. Depending on the site, you might be required to provide valid credentials before you can continue the download process.

- **Runtime JRE: Execution Environment**– Accept the default or select another JavaSE version from the drop-down list.  
If the version that you want does not appear on the list, click the **Environments** button and select the version from that list. The JRE version that you select must be installed on your machine.



**NOTE**

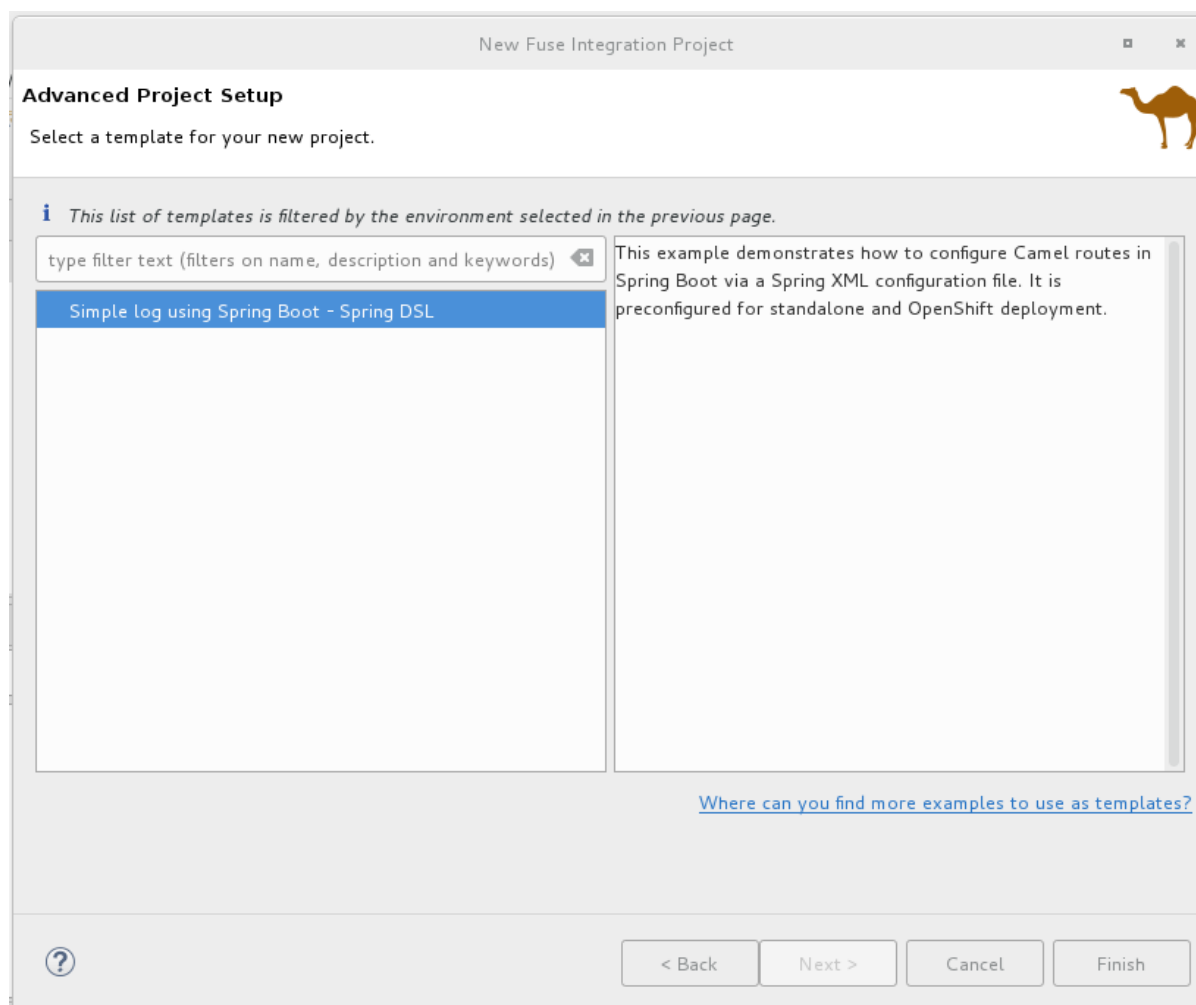
Fuse 7.x requires JRE version 1.8.

- **Runtime JRE: Alternate JRE**- If your project requires a different version of Java, you can use this option.
5. Click **Finish** to return to the **New Fuse Integration Project** wizard's **Select a Target Runtime** page:  
The newly configured target runtime appears in the **Target Runtime** pane's drop-down menu, and the Camel version supported by the runtime appears in the **Camel Version** pane, grayed out.
- After you create a Fuse Integration project, it is possible to change the Camel version. See [Chapter 11, \*Changing the Camel version\*](#).
6. Click **Next** to specify a template for the project as described in [the section called "Selecting a project template"](#).

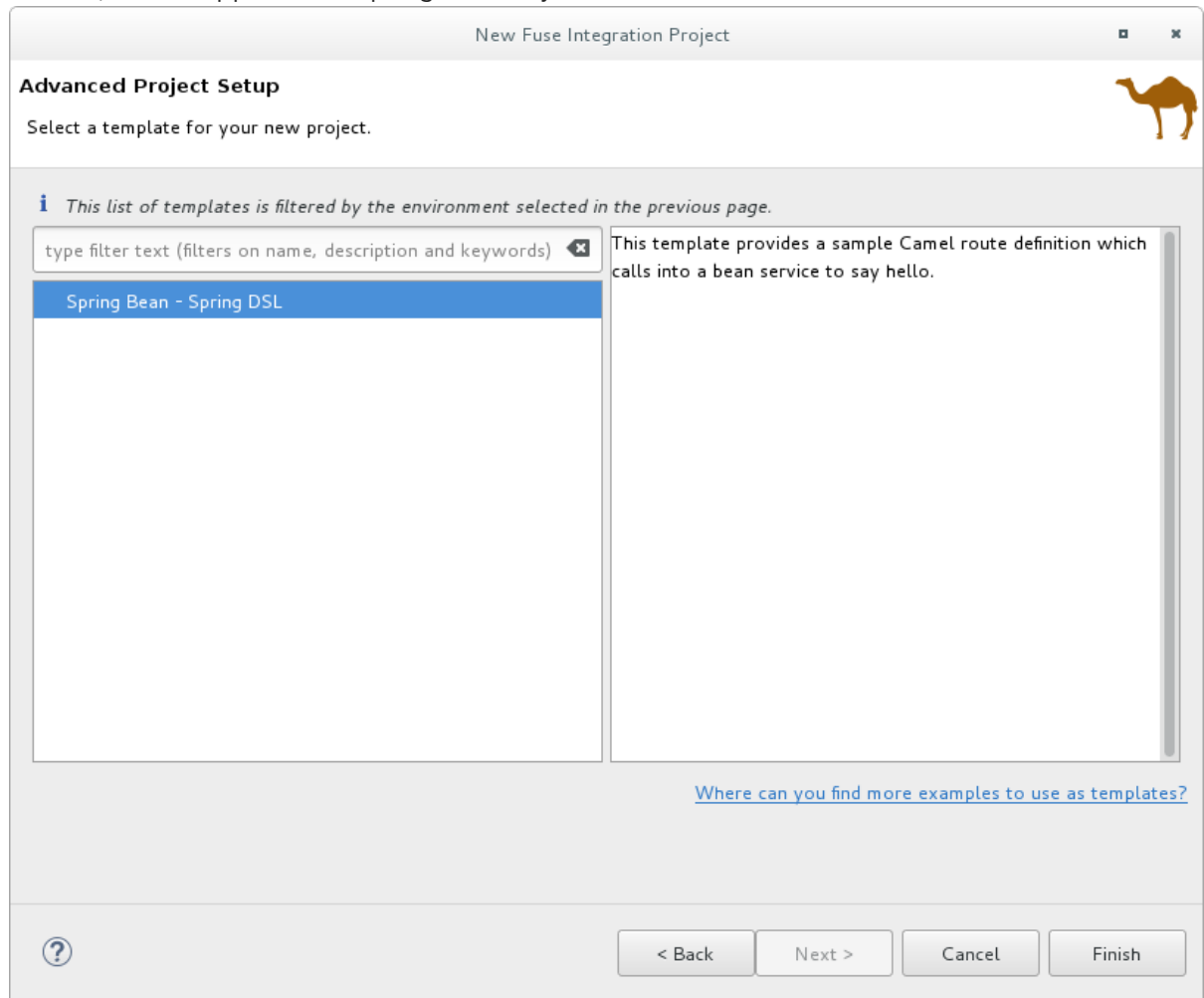
## SELECTING A PROJECT TEMPLATE

The **Advanced Project Setup** page provides a list of templates that you can use as a starting point for your new project. The templates, based on common use cases, provide sample code and data to get you started quickly. The list of available templates depends on the runtime environment that you selected on the previous page. Select a template to view its description in the right pane.

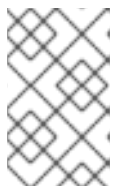
- For **Fuse on OpenShift** there is a single template that demonstrates how to configure Camel routes in Spring Boot using a Spring XML configuration file. This template creates a Fuse Integration project and requires a Camel version newer than `2.18.1.redhat-000012`. This template creates a project that runs on OpenShift servers, and it supports the Spring DSL only. For details on using this template, see [Chapter 6, \*Getting Started with Fuse on OpenShift\*](#).



- For **Wildfly** or **Fuse on EAP** there is a single template that provides a sample Camel route that calls into a bean service to say "Hello". This template creates a project that runs on Red Hat EAP servers, and it supports the Spring DSL only.



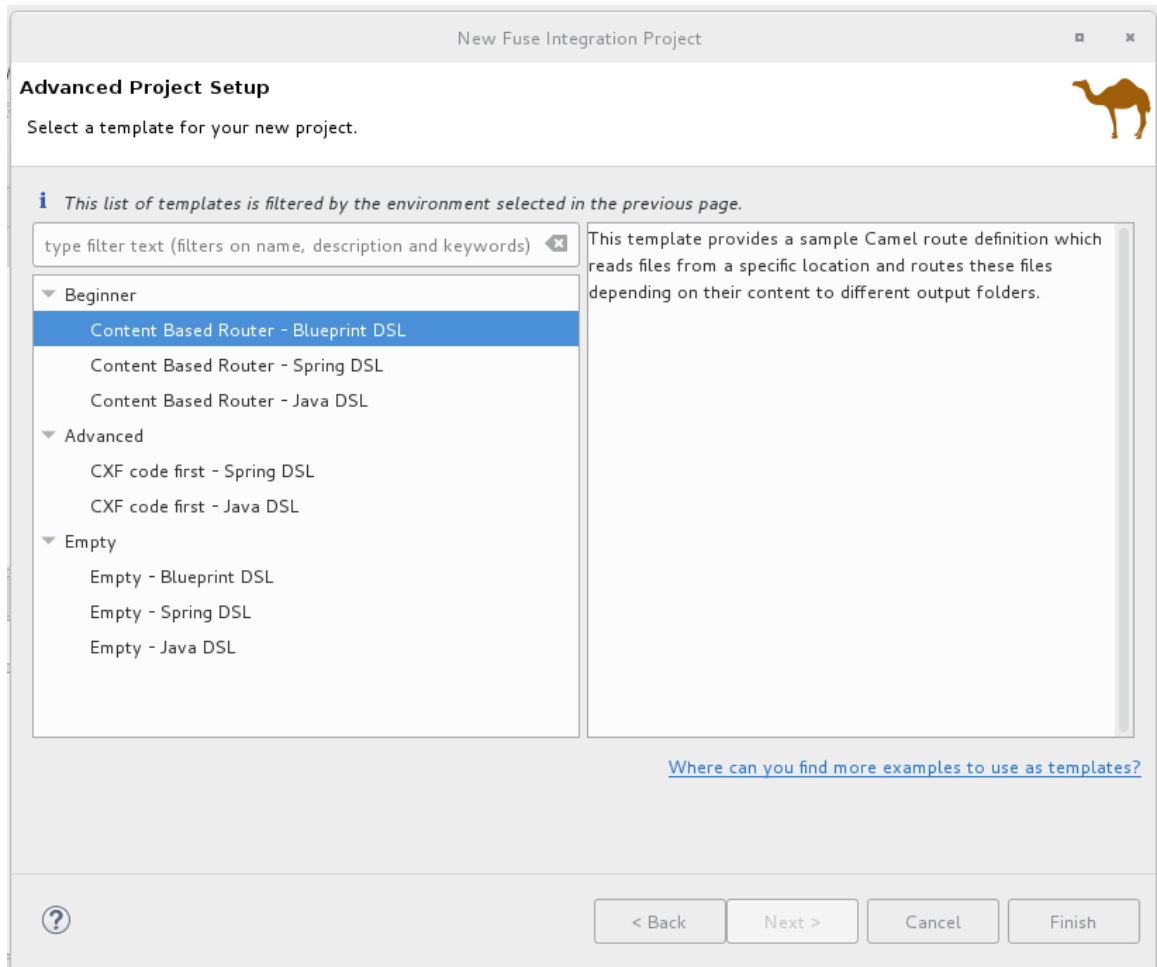
- For **Karaf** or **Fuse on Karaf**, you have a choice of templates. You can create an empty project, which creates a skeleton Camel context routing file based on one of the three supported Domain Specific Languages (DSLs), or you can use a predefined template, each of which is based on a common use case. Individual templates might not support all DSL options.



#### NOTE

For Java DSL, the tooling generates a **CamelRoute.java** file that you can edit in the tooling's Java editor, but it does not generate a graphical diagram representation of it.

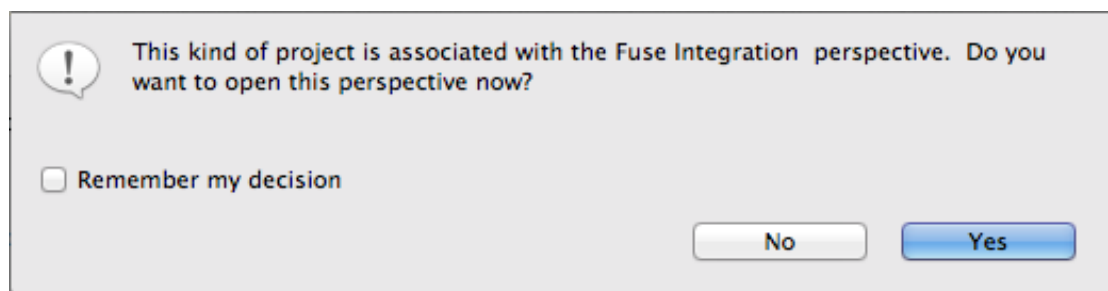
- **Content Based Router** – Provides a sample Camel route that reads files from a specific location and routes them to different output folders according to message content. This template creates a project that runs on Red Hat Fuse servers, and it supports all three of the DSLs.
- **CXF code first** – Provides a sample Camel route that is started by a CXF web service call. This template creates a project that runs on Red Hat Fuse servers, and it supports the Spring and Java DSLs only.



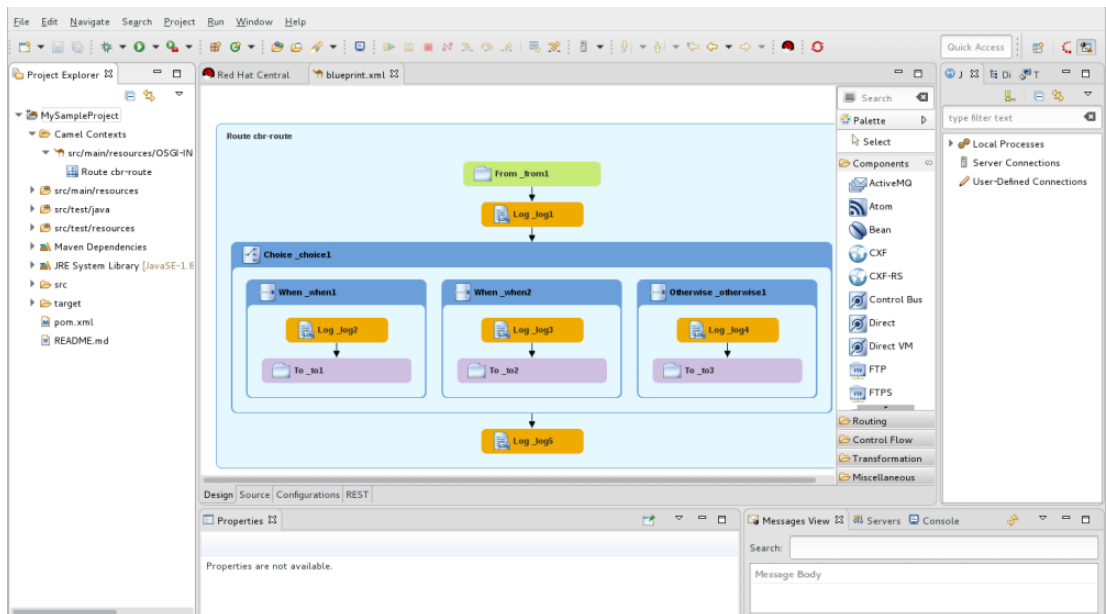
1. Select a template from the list.
2. Click **Finish**.

The tooling starts building the project and adds it to the **Project Explorer** view.

If the **Fuse Integration** perspective is not already open, the tooling asks whether you want to switch to it now:

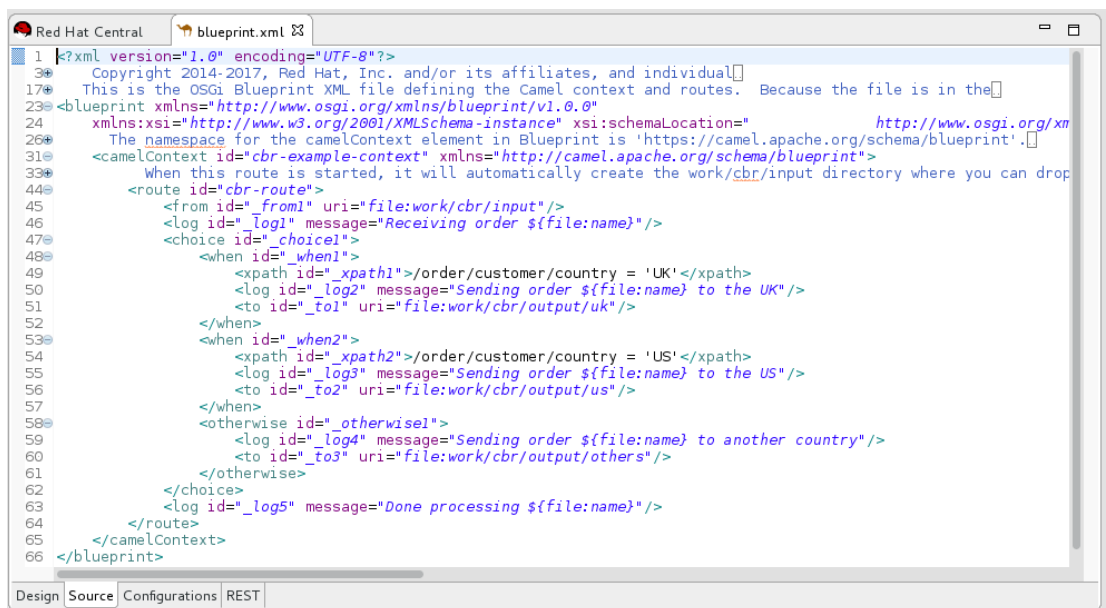


3. Click **Yes** to open the new project in the **Fuse Integration** perspective:



The project appears in the **Project Explorer** view. By default, the project includes an Apache Camel context (XML) file.

4. Click the **Source** tab at the bottom of the canvas to see the generated Camel context file:



## NOTE

If you want to add another new Camel context file to the project, see [Chapter 10, Creating a New Camel XML file](#).

When you build a project that uses CXF you might want the build process to automatically operate on the Java files to generate WSDL files. To do this, configure the **java2ws** Maven plug-in in the project's **.pom** file. See: [Apache CXF Development Guide, Maven Tooling Reference, java2ws](#).

## RESOLVING MAVEN DEPENDENCY ERRORS

You might encounter Maven dependency errors after you create a new Fuse Integration project.



Though it can happen at other times, it more typically occurs when you cancel a project build before the process has finished. Interrupting the process in this way often prevents all of the project's dependencies from downloading from the Maven repositories, which can take some time.

You can often resolve these dependency errors by updating Maven dependencies as follows:

1. In the **Project Explorer** view, right-click the root project to open the context menu.
2. Select **Maven → Update Project**.
3. In the **Update Maven Project** wizard:
  - Select the project that you want to update, if more than one appears in the wizard's list.
  - Click the **Force Update of Snapshots/Releases** option to enable it.
4. Click **OK**.

In the bottom, right corner of the workbench, you can view the progress status bar churning as missing dependencies are downloaded from the Maven repositories.

## CHAPTER 2. EDITING A ROUTING CONTEXT IN THE ROUTE EDITOR

The following sections describe how to edit a routing context.

### 2.1. ADDING PATTERNS TO A ROUTE

Routes consist of a sequence of connected patterns, referred to as **nodes** once they are placed on the canvas inside a **Route** container node. A complete route typically consists of a starting endpoint, a string of processing nodes, and one or more destination endpoints.

When you add a pattern into a Route container on the canvas, the pattern takes on a color that indicates its type of node:

- Blue – Route containers, which correspond to route elements in the context file, and other container nodes, such as **when** and **otherwise** EIPs that contain other EIPs that complete their logic
- Green – Consumer endpoints that input data entering routes
- Orange – EIPs that route, transform, process, or control the flow of data transiting routes
- Purple – Producer endpoints that output the data exiting routes


#### Procedure

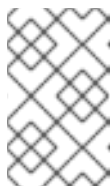
To add a pattern to a route:

1. In the **Palette**, locate the pattern that you want to add to the route.
2. Use one of the following methods:
  - Click the pattern in the **Palette** and then, in the canvas, click the route container.
  - Drag the pattern over the target **Route** container and drop it. Alternatively, you can add a pattern on an existing node that has no outgoing connection, or on a connection existing between two nodes, to have the tooling automatically wire the connections between all nodes involved.


The tooling checks whether the resulting connection is valid and then either allows or prevents you from adding the pattern on the target. For valid connections, the tooling behaves differently depending on whether the target is a node or a connection:

- For an **existing node**, the tooling adds the new node to the target node's outgoing side (beneath or to the right of it depending on [how the editor preferences are set](#)) and automatically wires the connection between them
  - For an **existing connection**, the tooling inserts the new node between the two connected nodes and automatically rewires the connections between the three nodes
3. Optionally, you can manually connect two nodes:
    - a. In the **Route** container on the canvas, select the source node to display its connector arrow.

- b. Drag the source node's connector arrow (  ) to the target node, and release the mouse button to drop the connector on it.



### NOTE

Not all nodes can be connected. When you try to connect a source node to an invalid target node, the tooling displays the  symbol attached to the mouse cursor, and the connector fails to stick to the target node.

4. After you add a pattern inside a Route container, you can drag it to different location inside the route container or to another route container on the canvas, as long as it can establish a valid connection. You can also relocate existing nodes that are already connected, as long as the move can establish another valid connection.

To view a short video that illustrates how to reposition endpoints, click [here](#).

5. Select **File** → **Save**. The tooling saves routes in the context file regardless of whether they are complete.

The new pattern appears on the canvas in the **Route** container and becomes the selected node. The **Properties** view displays a list of the new node's properties that you can edit.

## Changing the layout direction

When you connect one node to another, the tooling updates the layout according to the route editor's layout preference. The default is **Down**.

To access the route editor 's layout preference:

- On Linux and Windows machines, select **Windows** → **Preferences** → **Fuse Tooling** → **Editor** → **Choose the layout direction for the diagram editor**

## Related topics

- [Section 2.2, "Configuring a pattern"](#)
- [Section 2.3, "Removing patterns from a route"](#)

## 2.2. CONFIGURING A PATTERN

### Overview

Most patterns require some explicit configuration. For example, an endpoint requires an explicitly entered **URI**.

The tooling's **Properties** view provides a form that lists all of the configuration details a particular pattern supports. The **Properties** view also provides the following convenience features:

- validating that all required properties have values
- validating that supplied values are the correct data type for the property
- drop-down lists for properties that have a fixed set of values

- drop-down lists that are populated with the available bean references from the Apache Camel Spring configuration

## Procedure

To configure a pattern:


1. On the canvas, select the node you want to configure.  
The **Properties** view lists all of the selected node's properties for you to edit. For EIPs, the **Details** tab lists all of a pattern's properties. For components from the **Components** drawer, the **Details** tab lists the general properties and those that require a value, and the **Advanced** tab lists additional properties grouped according to function.

The **Documentation** tab describes the pattern and each of its properties.

2. Edit the fields in the **Properties** view to configure the node.
3. When done, save your work by selecting **File** → **Save** from the menu bar.

## 2.3. REMOVING PATTERNS FROM A ROUTE

### Overview

As you develop and update a route, you may need to remove one or more of the route's nodes. The node's  icon makes this easy to do. When you delete a node from the canvas, all of its connections with other nodes in the route are also deleted, and the node is removed from the corresponding route element in the context file.




#### NOTE

You can also remove a node by opening its context menu and selecting **Remove**.

### Procedure

To remove a node from a route:

1. Select the node you want to delete.
2. Click its  icon.
3. Click **Yes** when asked if you are sure you want to delete this element.

The node and all of its connections are deleted from the canvas, and the node is removed from its corresponding route element in the context file.

### Related topics

- [Section 2.1, "Adding patterns to a route"](#)

## 2.4. ADDING ROUTES TO THE ROUTING CONTEXT

### Overview

The camelContext element within an XML context file creates a routing context. The camelContext element can contain one or more routes, and each route, displayed on the canvas as a **Route** container node, maps to a route element in the generated camelContext element.

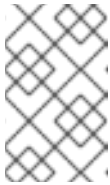
## Procedure

To add another route to the camelContext:

1. In the **Design** tab, do one of the following:
  - Click a **Route** pattern in the **Palette's Routing** drawer and then click in the canvas where you want to place the route.
  - Drag a **Route** pattern from the **Palette's Routing** drawer and drop it onto the canvas. The **Properties** view displays a list of the new route's properties that you can edit.

2. In the **Properties** view, enter:

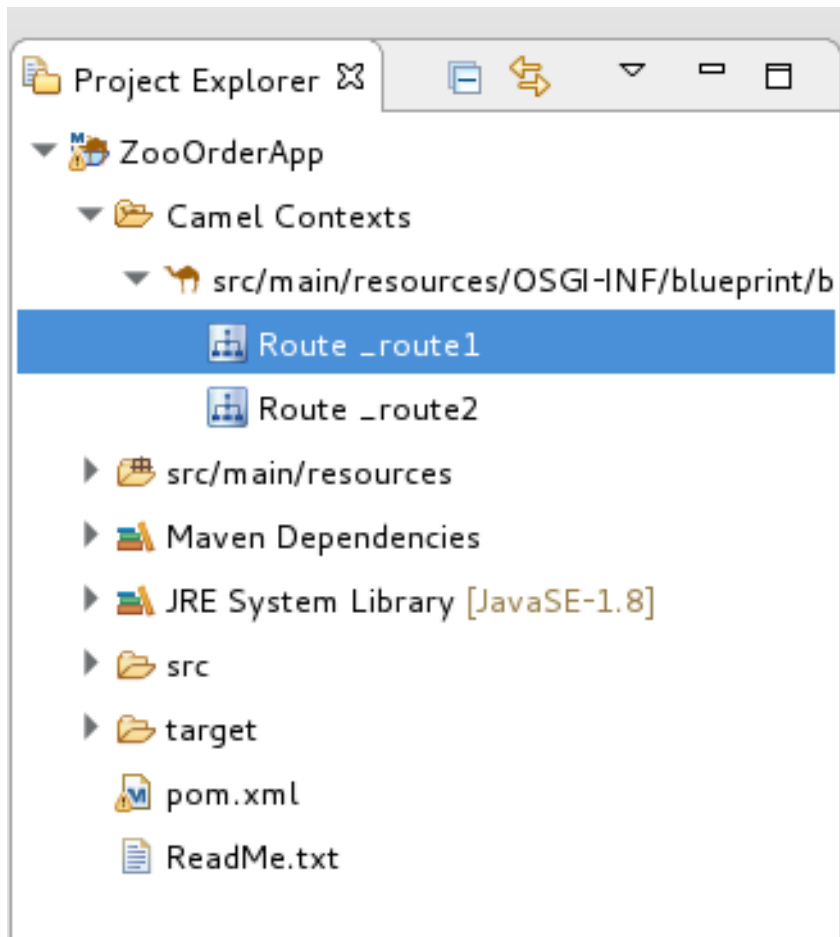
- An ID (for example, **Route2**) for the new route in the route's **Id** field



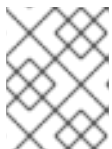
### NOTE

The tooling automatically assigns an ID to EIP and component patterns dropped on the canvas. You can replace these autogenerated IDs with your own to distinguish the routes in your project.

- A description of the route in the **Description** field
  - Values for any other properties, as needed. Required properties are indicated by an asterisk (\*).
3. On the menu bar, select **File → Save** to save the changes you made to the routing context file.
  4. To switch between multiple routes, select the route that you want to display on the canvas by clicking its entry under the project's **Camel Contexts** folder in the **Project Explorer** view.



5. To display all routes in the context, as space allows, click the context file entry in the **Project Explorer** view.
6. To view the code generated by the tooling when you add a route to the canvas, click the **Source** tab.




#### NOTE

You can alternately add a route in the **Source** tab, by adding a `<route/>` element to the existing list within the camelContext element.

## 2.5. DELETING A ROUTE

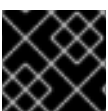
### Overview

In some cases you made need to delete an entire route from your routing context. The Route container's  icon makes this easy to do. When you delete a route, all of the nodes inside the Route container are also deleted, and the corresponding route element in the context file is removed.



#### NOTE

You can also remove a route using the Route container's context menu and selecting **Remove**.



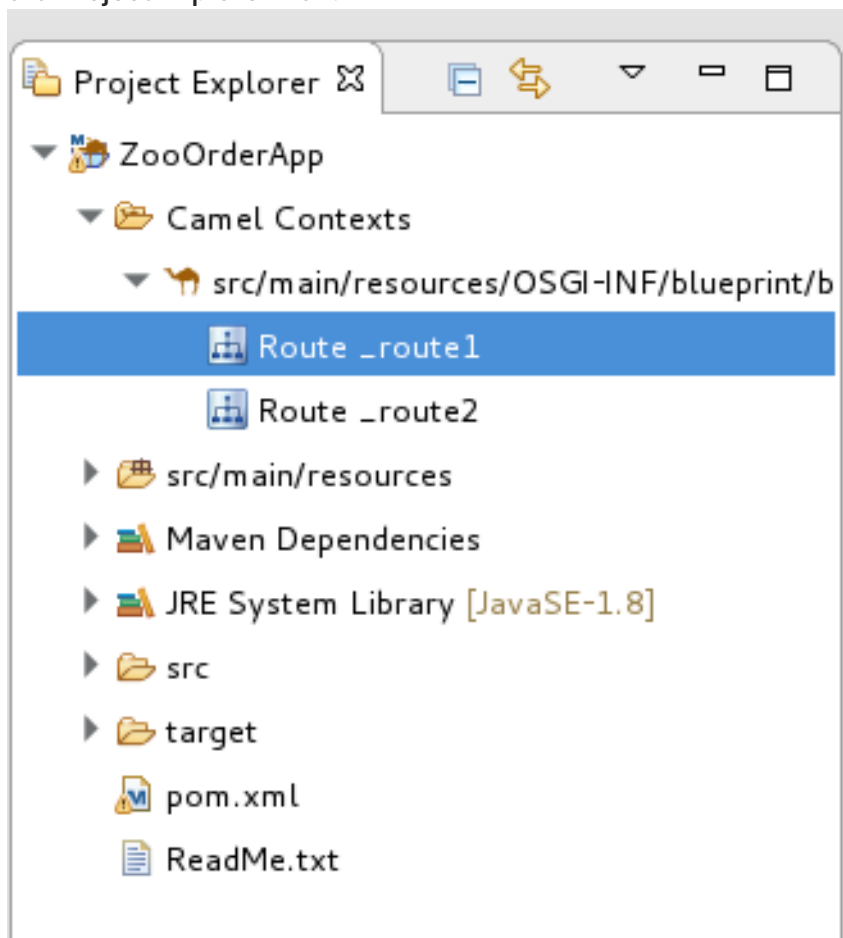
#### IMPORTANT

You cannot undo this operation.

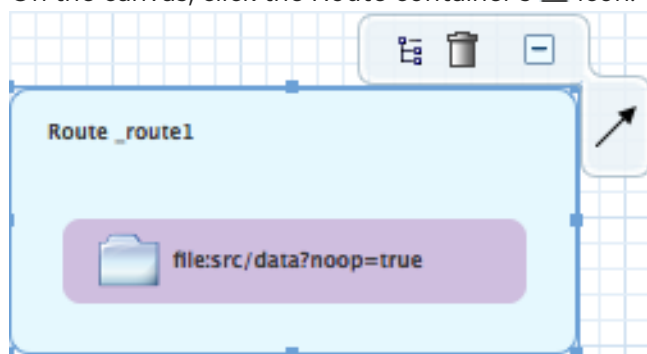
## Procedure

To delete a route:

1. If the routing context contains more than one route, first select the route you want to delete in the **Project Explorer** view.



2. On the canvas, click the Route container's  icon.



3. Click **Yes** when asked if you are sure you want to delete this element.

The route is removed from the canvas, from the context file, and from the **Project Explorer** view.

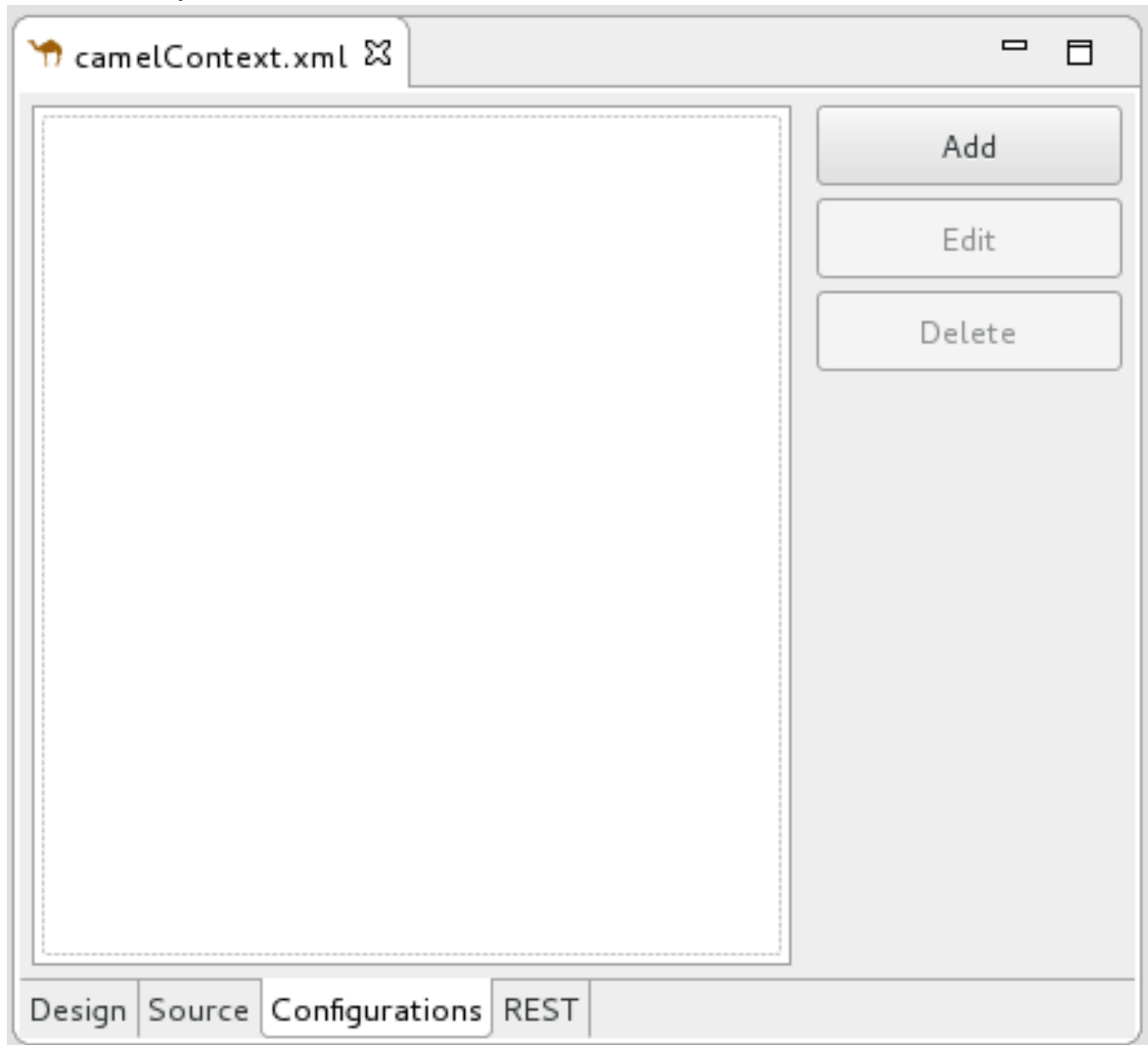
## 2.6. ADDING GLOBAL ENDPOINTS, DATA FORMATS, OR BEANS

### Overview

Some routes rely on shared configuration provided by global endpoints, global data formats, or global beans. You can add global elements to the project's routing context file by using the route editor's **Configurations** tab.

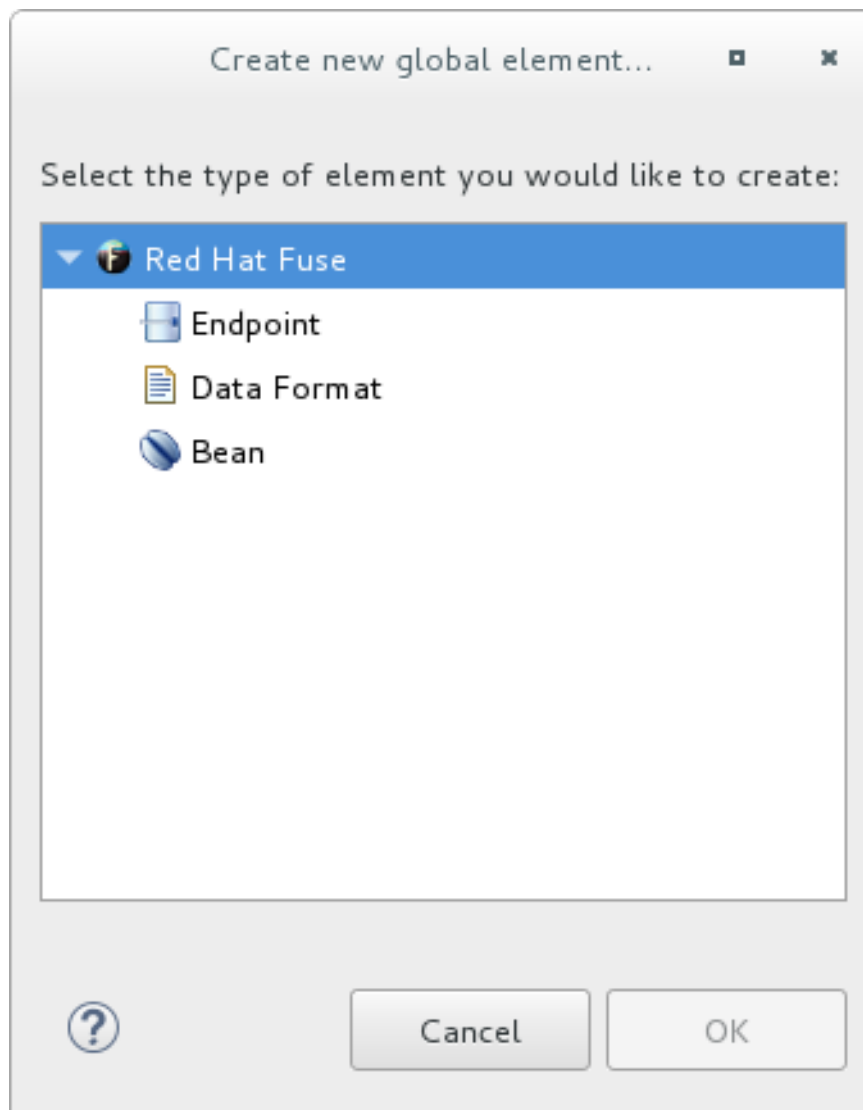
To add global elements to your routing context file:

1. Open your routing context file in the route editor.
2. At the bottom of the route editor, click the **Configurations** tab to display global configurations, if there are any.



3. Click **Add** to open the **Create a new global element** dialog.



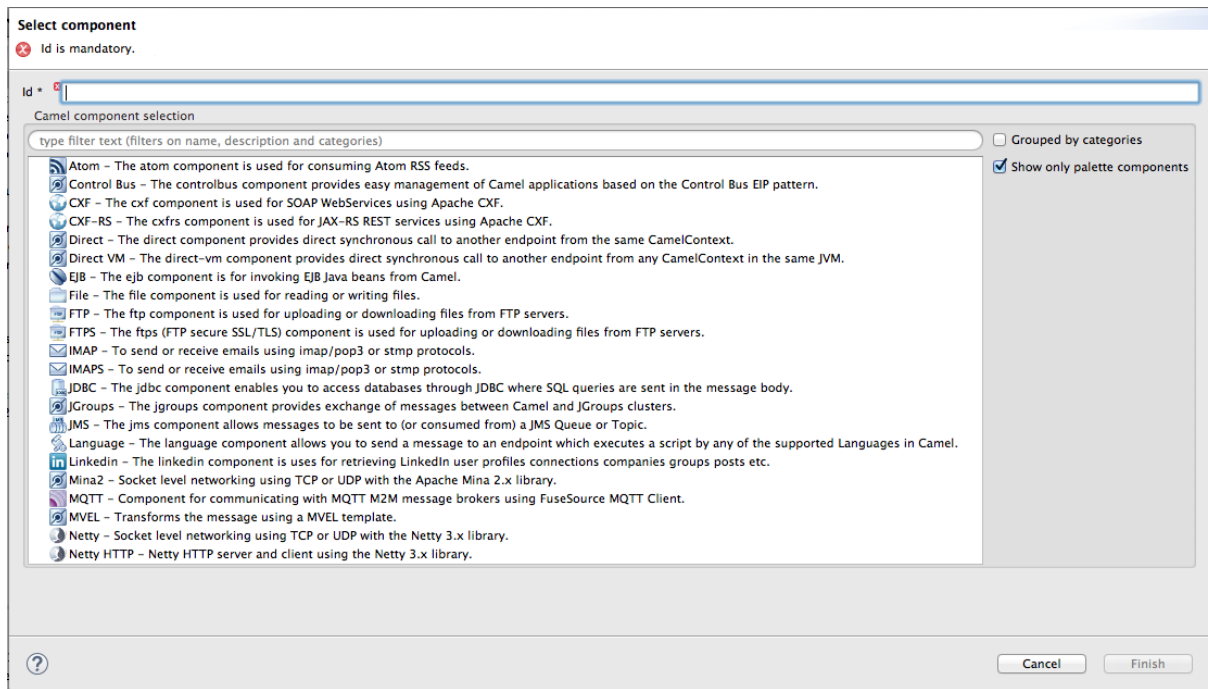


The options are:

- Endpoint – see [the section called "Adding a global endpoint"](#) .
- Data Format – see [the section called "Adding a global data format"](#) .
- Bean – see [the section called "Adding a global bean"](#) .

## Adding a global endpoint

1. In the **Create a new global element** dialog, select **Endpoint** and click **OK** to open the **Select component** dialog.



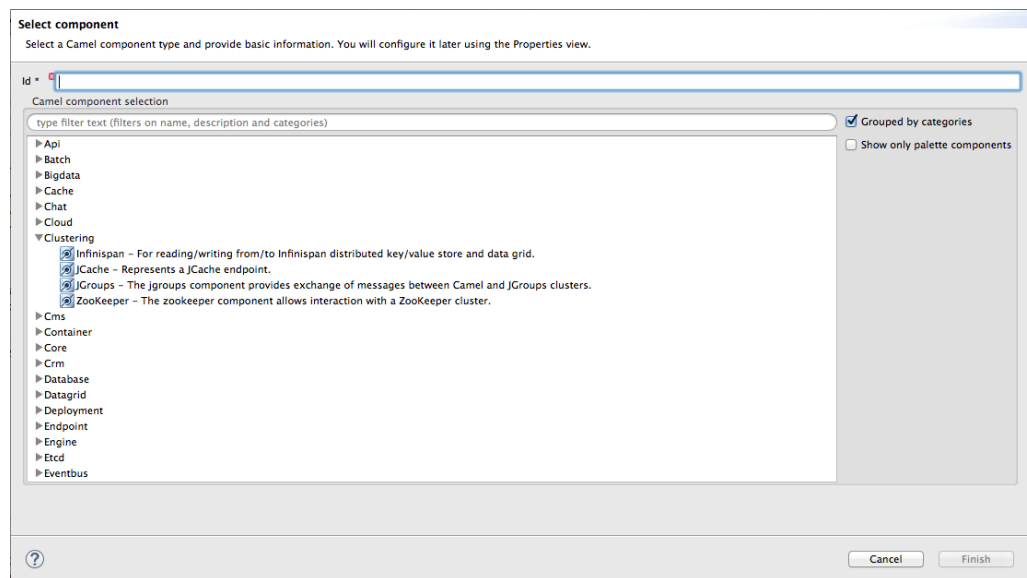
## NOTE

By default, the **Select component** dialog opens with the **Show only palette components** option enabled. To see all available components, uncheck this option.

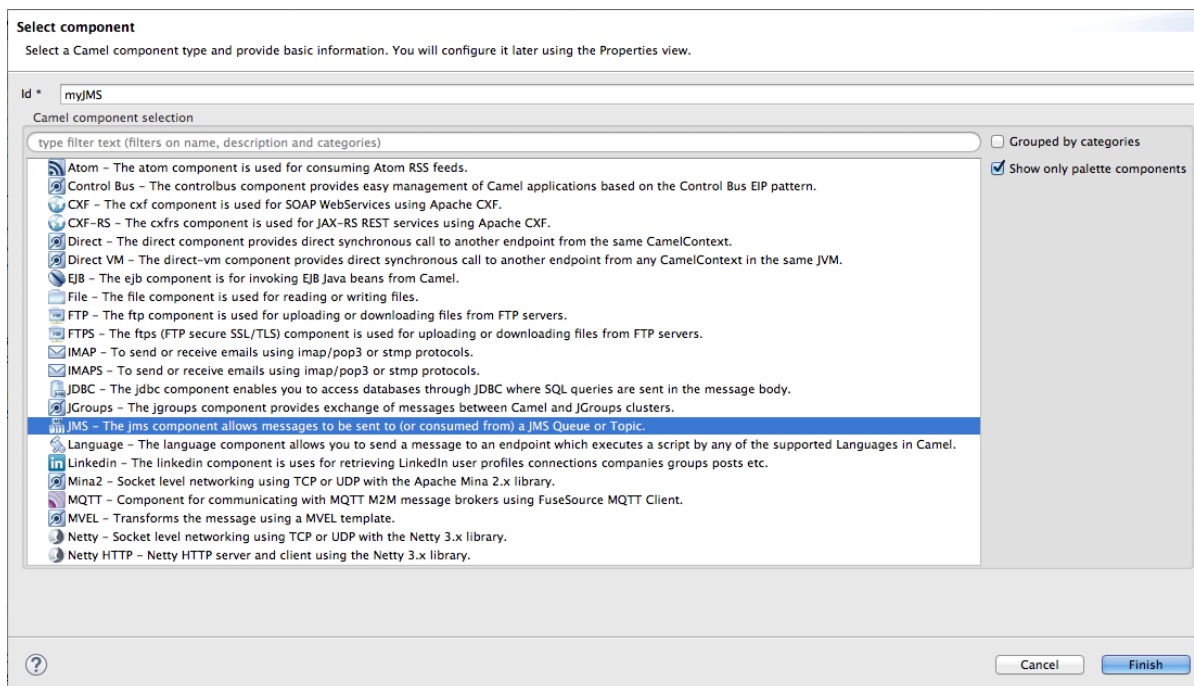


## NOTE

The **Grouped by categories** option groups components by type.

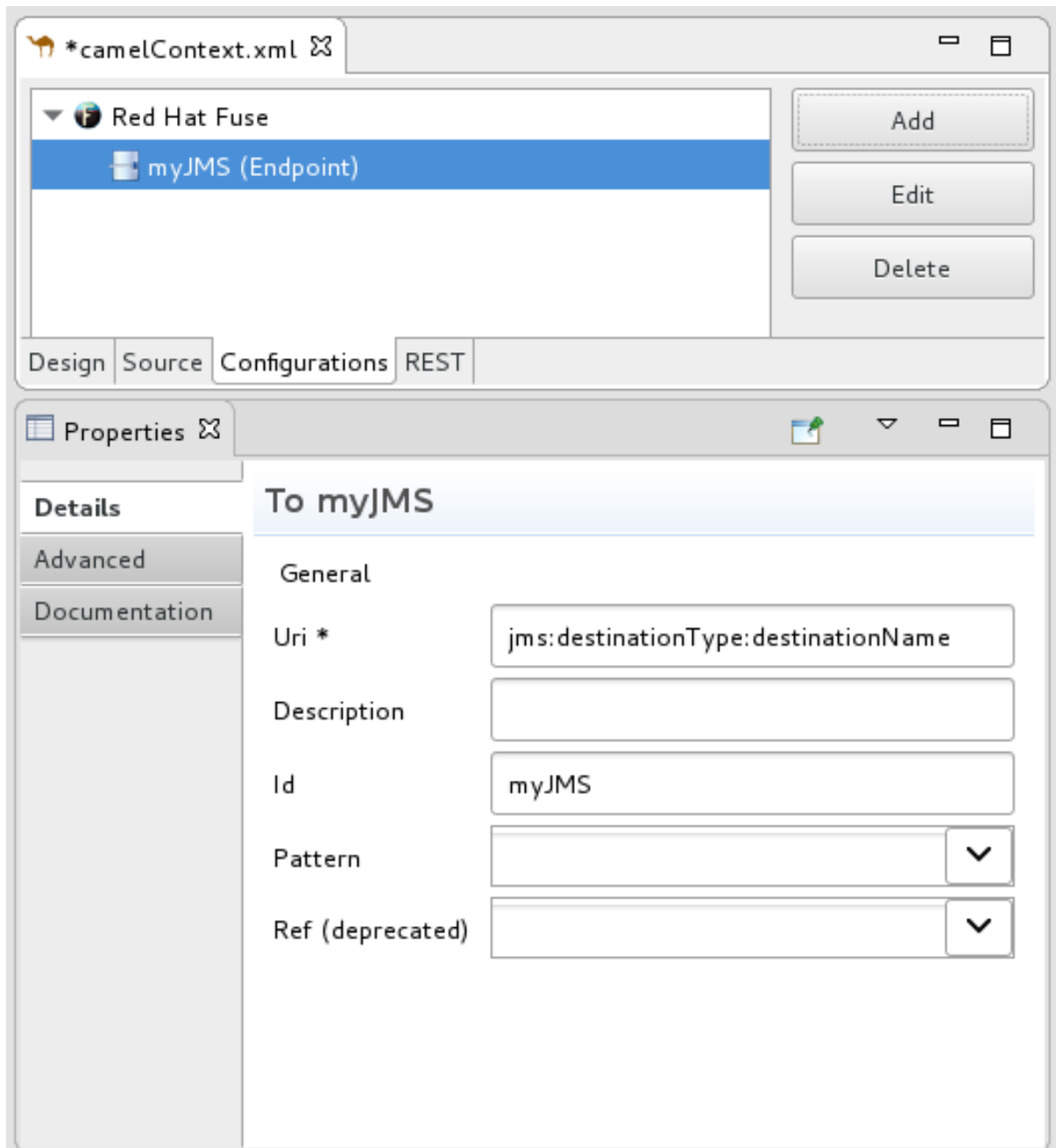


- In the **Select component** dialog, scroll through the list of Camel components to find and select the component you want to add to the context file, and then enter an ID for it in the **Id** field.



In this example, the JMS component is selected and **myJMS** is the **Id** value.

3. Click **Finish**.



You can now set properties in the **Properties** view as needed.

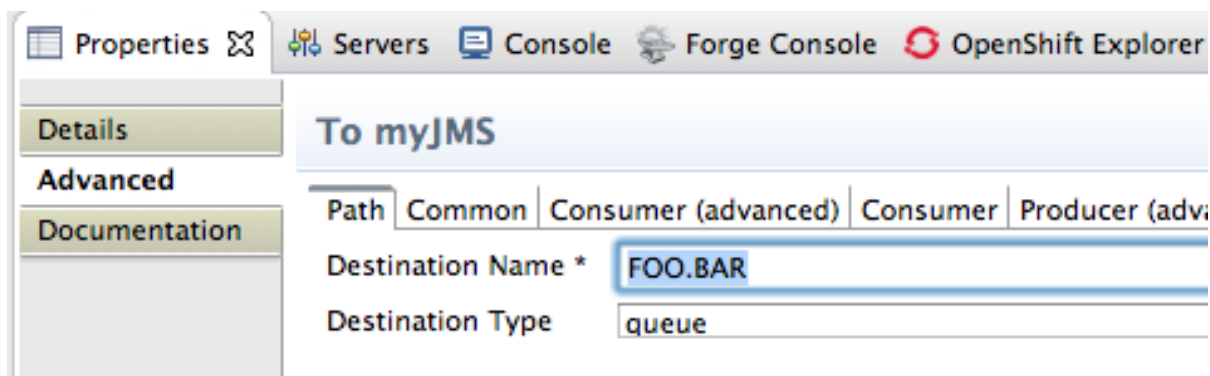
The tooling autofills **Id** with the value you entered in the component's **Id** field in [\[globalEndptSelect\]](#). In this example, Camel builds the **uri** (required field) starting with the component's schema (in this case, **jms:**), but you must specify the **destinationName** and the **destinationType** to complete the component's **uri**.



#### NOTE

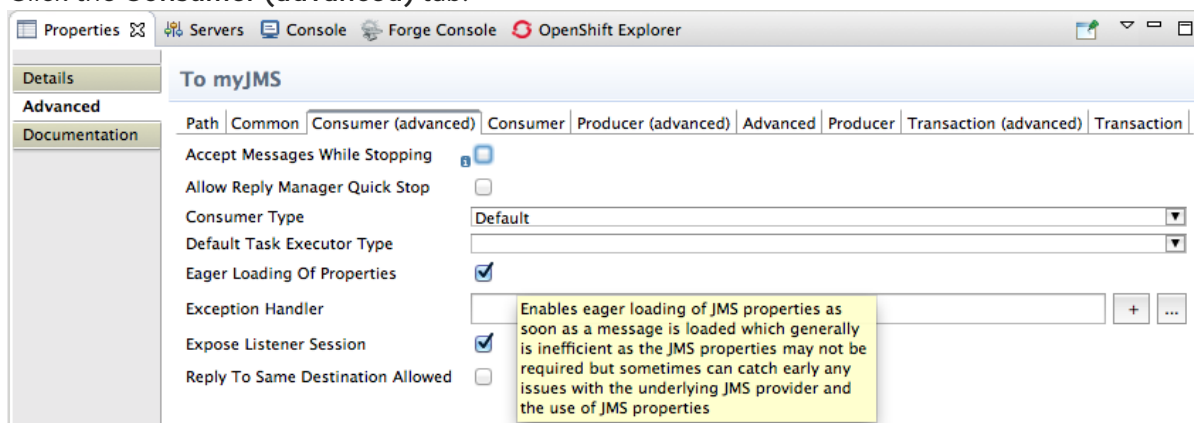
For the JMS component, the destination type defaults to **queue**. This default value does not appear in the **uri** field on the **Details** page until you have entered a value in **Destination Name** (required field).

4. To complete the component's uri, click **Advanced**.
5. In the **Destination Name** field, enter the name of the destination endpoint (for example, **FOO.BAR**). In the **Destination Type** field, enter the endpoint destination's type (for example, **queue**, **topic**, **temp:queue**, or **temp:topic**).



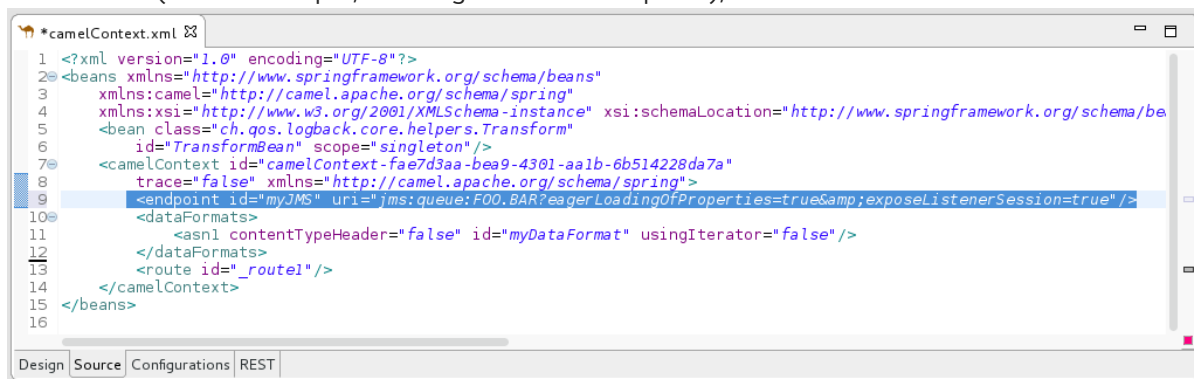
The **Properties** view's **Details** and **Advanced** tabs provide access to all properties available for configuring a particular component.

6. Click the **Consumer (advanced)** tab.



Enable the properties **Eager Loading Of Properties** and **Expose Listener Session**.

7. In the route editor, switch to the **Source** tab to see the code that the tooling added to the context file (in this example, a configured JMS endpoint), before the first route element.



8. When done, save your changes by selecting **File** → **Save** on the menu bar.

## Adding a global data format

1. In the **Create a new global element** dialog, select **Data Format** and click **OK** to open the **Create a global Data Format** dialog.

**Create a global Data Format**  
Select a Data Format and provide basic information. You will configure it using properties view.

Data Format: avro - Camel Avro data format

Id: \*

Cancel Finish

The data format defaults to **avro**, the format at the top of the list of those available.

2. Open the **Data Format** drop-down menu, and select the format you want, for example, **xmljson**.
3. In the **Id** field, enter a name for the format, for example, *myDataFormat*).

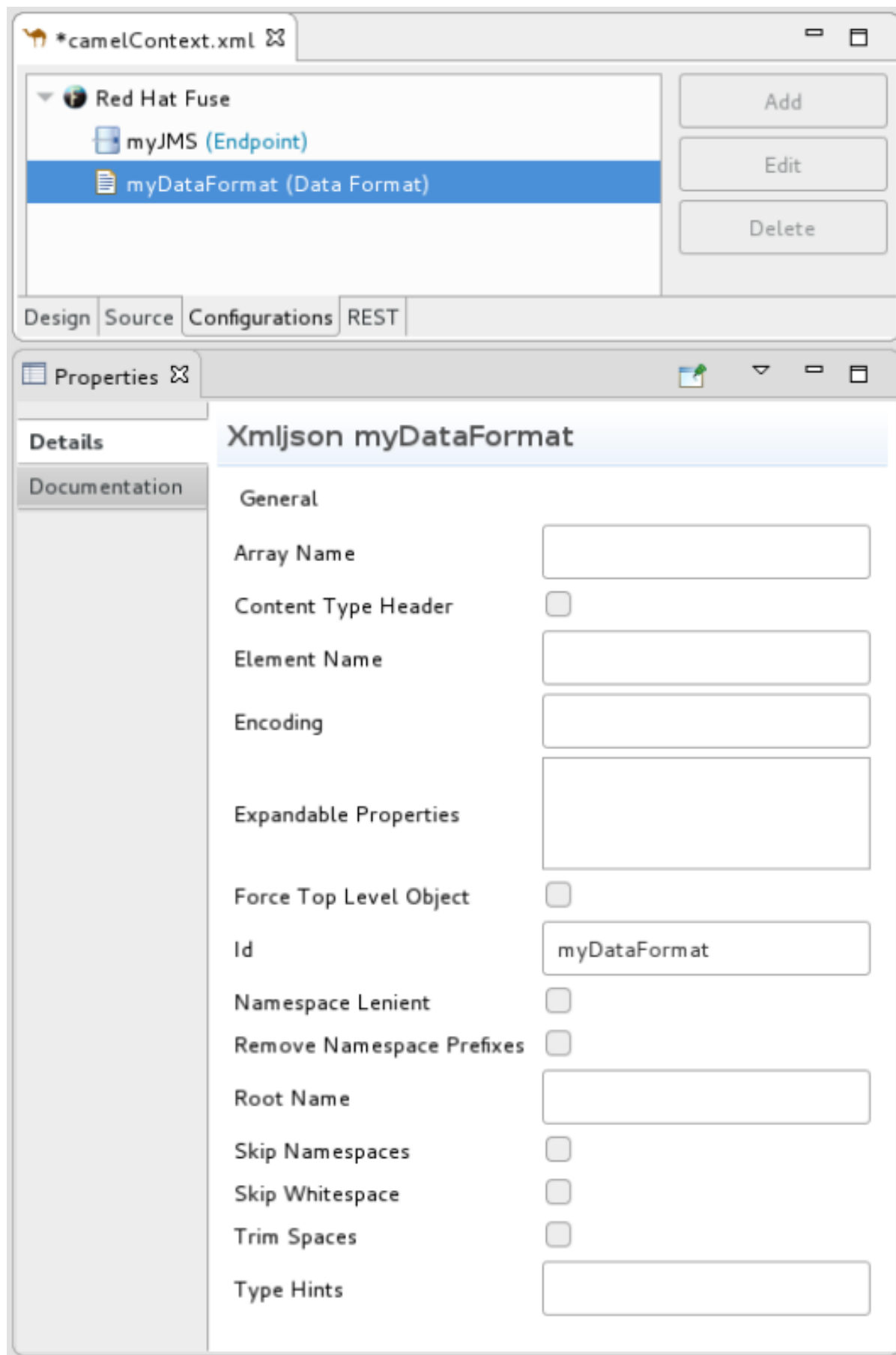
**Create a global Data Format**  
Select a Data Format and provide basic information. You will configure it using properties view.

Data Format: xmljson - Camel XML JSON Data Format

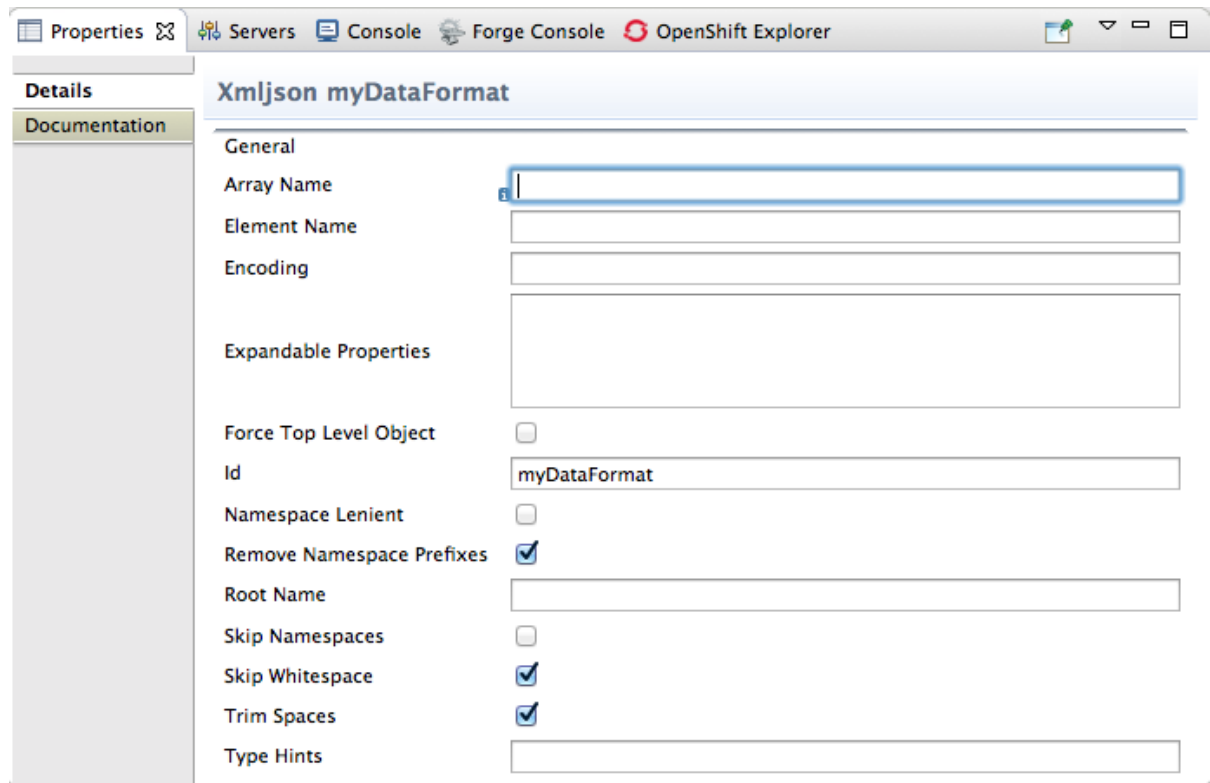
Id: \* myDataFormat

Cancel Finish

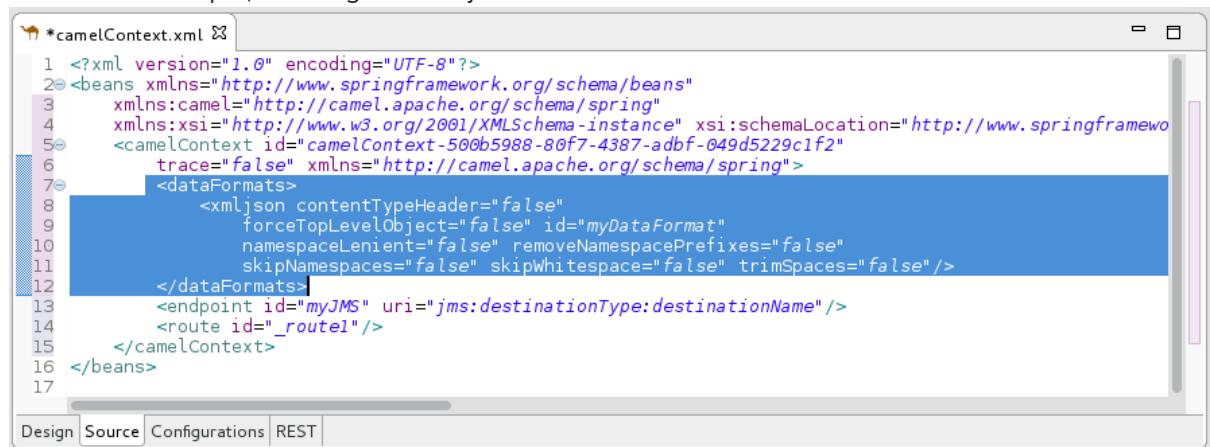
4. Click **Finish**.



5. In the **Properties** view, set property values as appropriate for your project, for example:



- In the route editor, click the **Source** tab to see the code that the tooling added to the context file. In this example, a configured xmljson data format is before the first route element.



- When done, save your changes by selecting **File** → **Save** on the menu bar.

## Adding a global bean

A global bean enables out-of-route bean definitions that can be referenced from anywhere in the route. When you copy a **Bean** component from the palette to the route, you can find defined global beans in the **Properties** view's **Ref** dropdown. Select the global bean that you want the **Bean** component to reference.

To add a global bean element:

- In the **Create a new global element** window, select **Bean** and click **OK** to open the **Bean Definition** dialog.



Add Bean
□ ×

### Bean Definition

Specify details for new bean definition.

Id \*

Class  ... +

Factory Bean

Constructor Arguments

Type	Value

Bean Properties

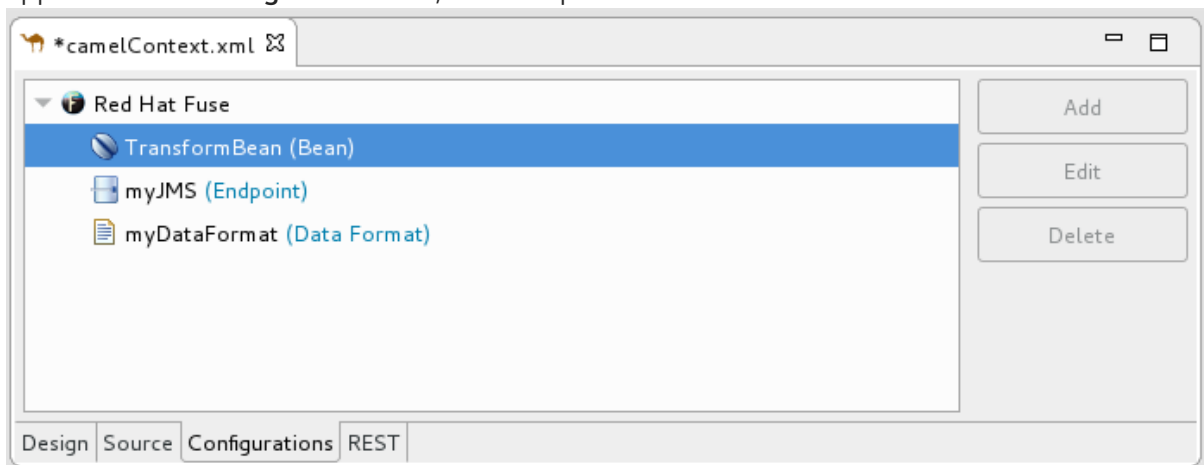
Name	Value

?

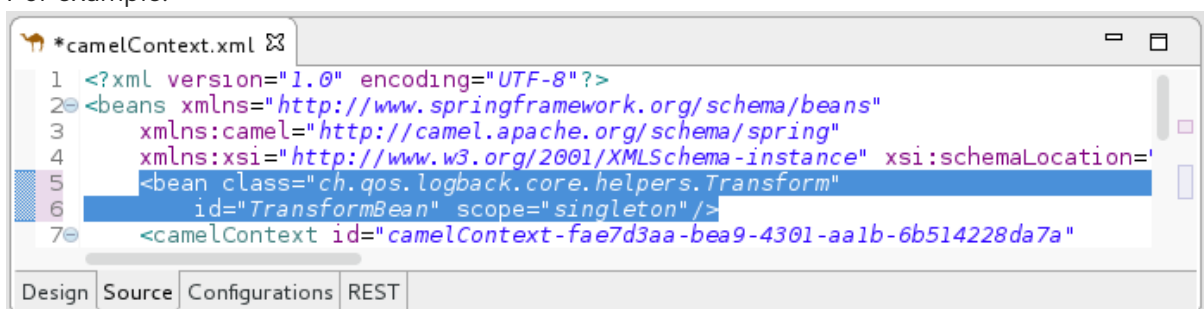
2. In the **Id** field, enter an ID for the global bean, for example, **TransformBean**. The ID must be unique in the configuration.
3. Identify a bean class or a factory bean.  
 To specify a factory bean, you must have already added another global bean with a factory class specified. You can then select that global bean to declare it as a global bean factory. One instance of the bean factory class will be in the runtime. Other global beans can call factory methods on that class to create their own instances of other classes.

To fill the **Class** field, do one of the following:

- Enter the name of a class that is in the project or in a referenced project.
  - Click ... to navigate to and select a class that is in the project or in a referenced project.
  - Click + to define a new bean class and add it as a global bean.
4. If the bean you are adding requires one or more arguments, in the **Constructor Arguments** section, for each argument:
    - a. Click **Add**.
    - b. Optionally, in the **Type** field, enter the type of the argument. The default is **java.lang.String**.
    - c. In the **Value** field, enter the value of the argument.
    - d. Click **OK**.
  5. Optionally specify one or more properties that are accessible to the global bean. In the **Bean Properties** section, do the following for each property:
    - a. Click **Add**.
    - b. In the **Name** field, enter the name of the property.
    - c. In the **Value** field, enter the value of the property.
    - d. Click **OK**.
  6. Click **Finish** to add the global bean to the configuration. The global bean ID you specified appears in the **Configurations** tab, for example:



7. Switch to the **Source** tab to see the **bean** element that the tooling added to the context file. For example:



- Click the **Configurations** tab to return to the list of global elements and select a global bean to display its standard properties in the **Properties** view, for example:

The screenshot shows a window titled 'Properties' with a sidebar containing 'Details' and 'Documentation'. The main area is titled 'Endpoint myJMS' and contains a 'General' section with the following fields:

- Uri \***:
- Camel Context Id**:
- Id**:
- Pattern (deprecated)**:
- Singleton (deprecated)**:



### NOTE

To view or edit a property that you specified when you added a global bean, select the bean in the **Configurations** tab and then click **Edit**.

- Set global bean properties as needed:
  - Depends-on** is a string that you can use to identify a bean that must be created before this global bean. Specify the ID (name) of the depended on bean. For example, if you are adding the **TransformBean** and you set **Depends-on** to **ChangeCaseBean** then **ChangeCaseBean** must be created and then **TransformBean** can be created. When the beans are being destroyed then **TransformBean** is destroyed first.
  - Factory-method** is useful only when the global bean is a factory class. In this situation, specify or select a static factory method to be called when the bean is referenced.
  - Scope** is **singleton** or **prototype**. The default, **singleton**, indicates that Camel uses the same instance of the bean each time the bean is called. Specify **prototype** when you want Camel to create a new instance of the bean each time the bean is called.
  - Init-method** lets you specify or select which of the bean's **init()** methods to call when the bean is referenced.
  - Destroy-method** lets you specify or select which of the bean's destroy methods to call when the processing performed by the bean is done.
- When done, save your changes by selecting **File** → **Save** on the menu bar.

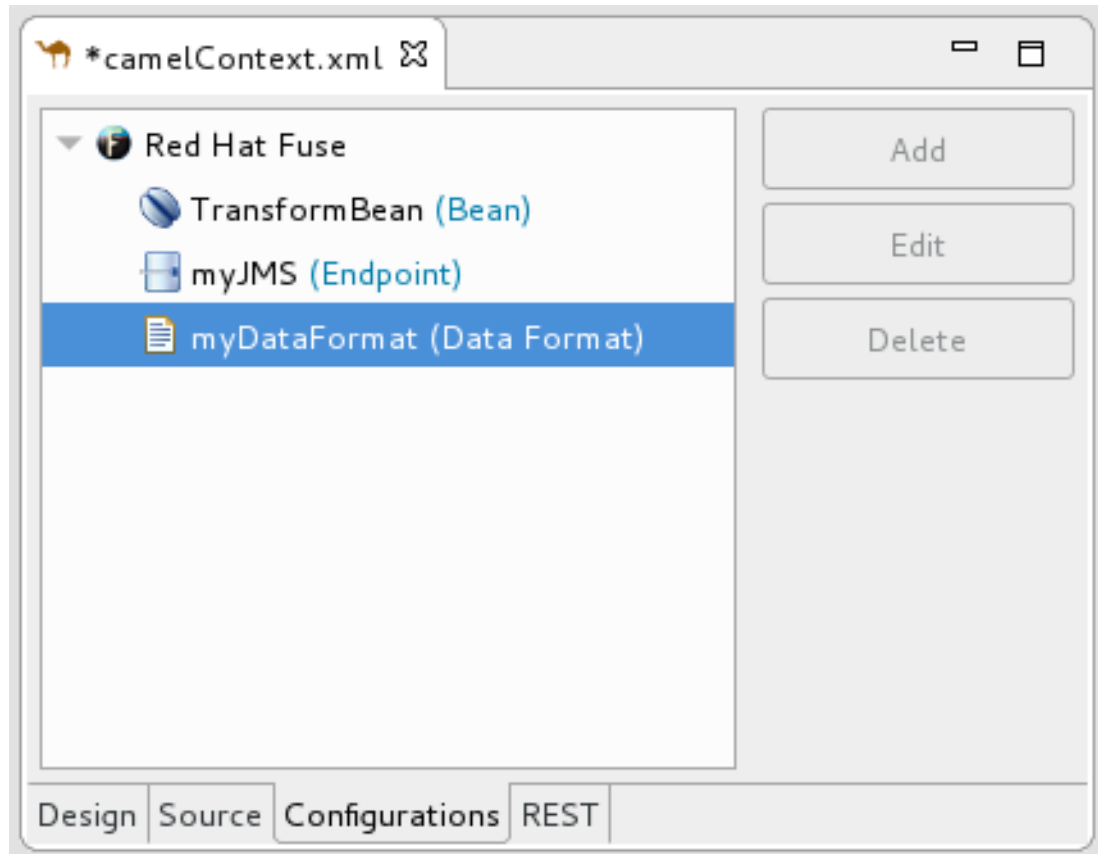
## Deleting a global element

The procedure is the same whether removing an endpoint, data format or bean that was previously added to the routing context.

**NOTE**

You cannot perform an undo operation for deletion of a global element. If you inadvertently delete a global element that you want to keep in the configuration you might be able to undo the deletion by closing the context file without saving it. If this is not feasible then re-add the inadvertently deleted global element.

1. In the **Configurations** tab, select the global element that you want to delete.  
For example, suppose you want to delete the data format **myDataFormat** that was added in [the section called "Adding a global data format"](#):



2. Click **Delete**.  
The global element **myDataFormat** disappears from the **Configurations** tab.
3. Switch to the **Source** tab to check that the tooling removed the XML code from the routing context.

```

1 | <?xml version="1.0" encoding="UTF-8"?>
2 | <beans xmlns="http://www.springframework.org/schema/beans"
3 |       xmlns:camel="http://camel.apache.org/schema/spring"
4 |       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.spr
5 | <bean
6 |     class="org.springframework.aop.framework.AbstractAdvisingBeanPostProcessor"
7 |     id="TransformBean" scope="singleton" />
8 | <camelContext id="camelContext-500b5988-80f7-4387-adbf-049d5229c1f2"
9 |   trace="false" xmlns="http://camel.apache.org/schema/spring">
10 |   <dataFormats>
11 |     <xmljson contentTypeHeader="false"
12 |       forceTopLevelObject="false" id="myDataFormat"
13 |       namespaceLenient="false" removeNamespacePrefixes="false"
14 |       skipNamespaces="false" skipWhitespace="false" trimSpaces="false" />
15 |   </dataFormats>
16 |   <endpoint id="myJMS" uri="jms:destinationType:destinationName" />
17 |   <route id="_route1" />
18 | </camelContext>
19 | </beans>
20 |

```

Design Source Configurations REST

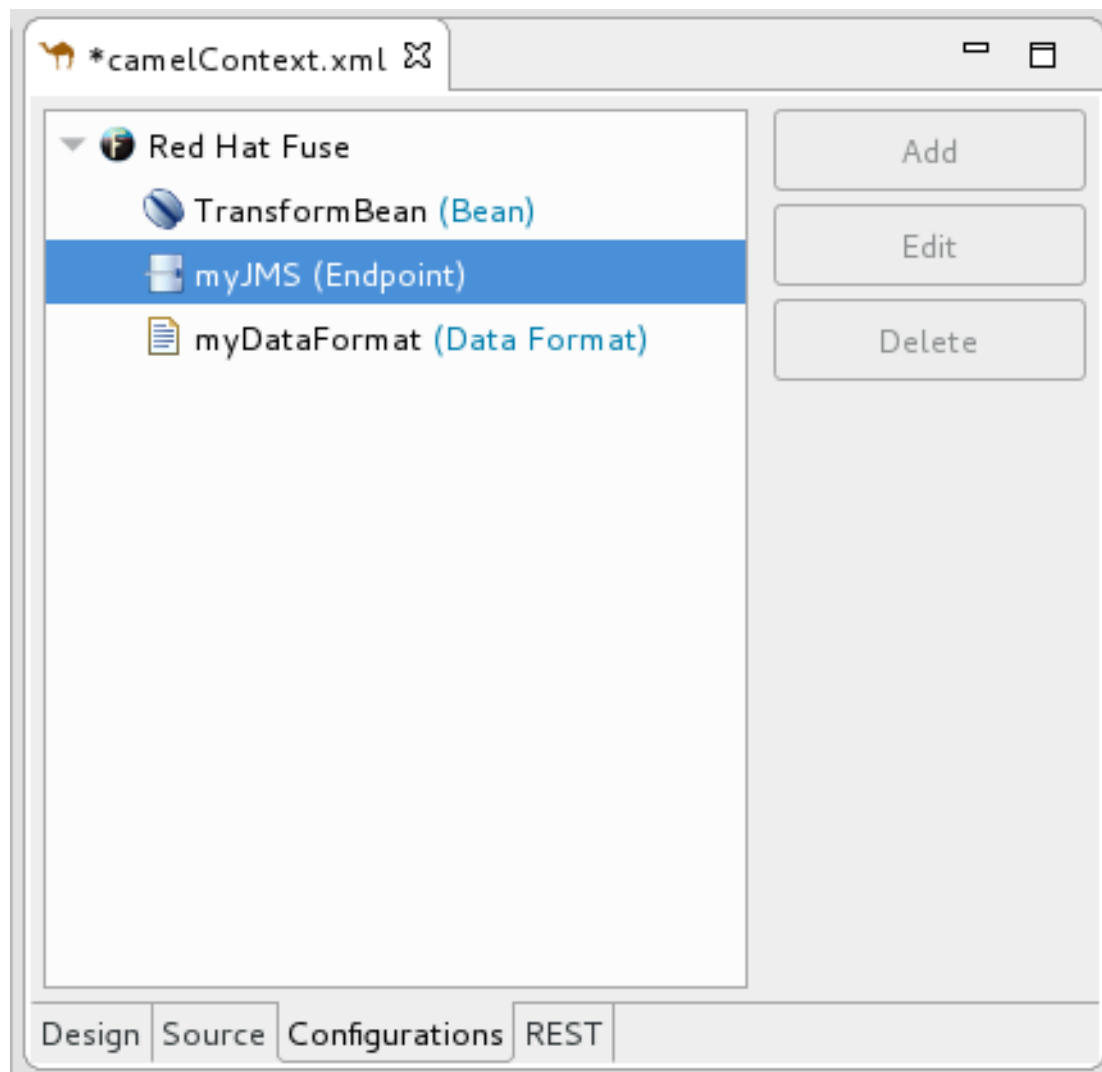
4. When done, save your changes by selecting **File** → **Save** on the menu bar.

## Editing a global element

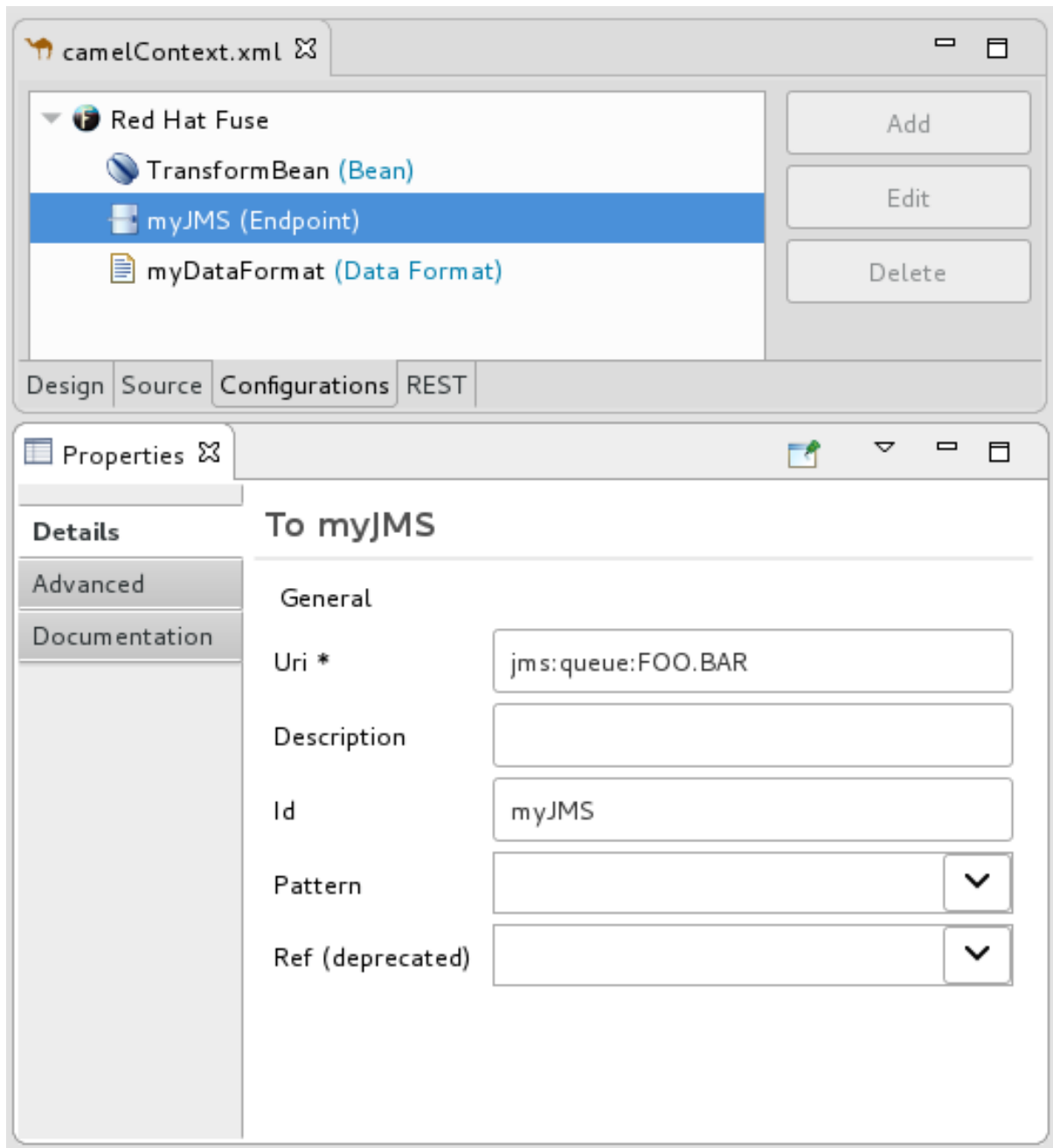
The procedure is the same whether modifying the properties of an endpoint, data format or bean that you added to the routing context.

Typically, you do not want to change the ID of a global element. If the global element is already in use in a running route, changing the ID can break references to the global element.

1. In the **Configurations** tab, select the global element that you want to edit.  
For example, to edit the endpoint **myJMS** that was added in [the section called "Adding a global endpoint"](#), select it:

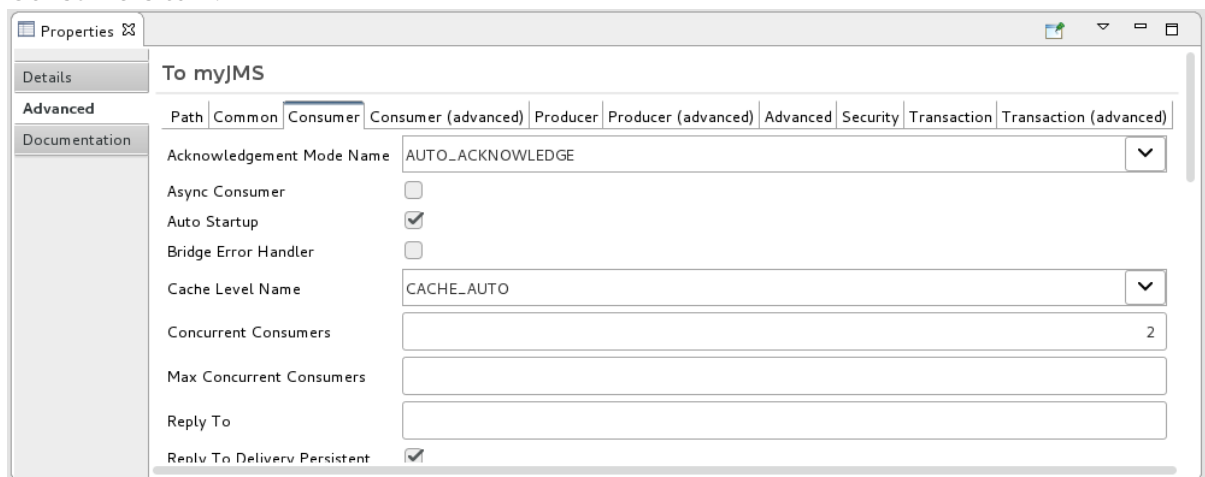


2. Click **Edit**.



In the **Properties** view, modify the element's properties as needed.

- For example, open the **Advanced** → **Consumer** tab, and change the value of **Concurrent Consumers** to **2**:



- In the route editor, click the **Source** tab and check that the tooling added the property **concurrentConsumers=2** to the routing context:



```

20 <beans xmlns="http://www.springframework.org/schema/beans"
3     xmlns:camel="http://camel.apache.org/schema/spring"
4     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www
5
6     <bean
7         class="org.springframework.aop.framework.AbstractAdvisingBeanPostProcessor"
8         id="TransformBean" scope="singleton" />
9     <camelContext id="camelContext-500b5988-80f7-4387-adbf-049d5229c1f2"
10        trace="false" xmlns="http://camel.apache.org/schema/spring">
11        <endpoint id="myJMS" uri="jms:queue:FOO.BAR?concurrentConsumers=2" />
12        <endpoint id="myJMS3" uri="jms:queue:destinationName" />
13        <endpoint id="myJMS2" uri="jms:queue:destinationName" />
14        <dataFormats>
15            <xmljson contentTypeHeader="false"
16                forceTopLevelObject="false" id="myDataFormat"
17                namespaceLenient="false" removeNamespacePrefixes="false"
18                skipNamespaces="false" skipwhitespace="false" trimSpaces="false" />
19        </dataFormats>
20        <route id="_route1" />
21    </camelContext>
22 </beans>

```

- When done, save your changes by selecting **File** → **Save** on the menu bar.

## 2.7. CONFIGURING THE ROUTE EDITOR

### Overview

Using Fuse preference settings, you can specify options for the route editor's behavior and user interface:

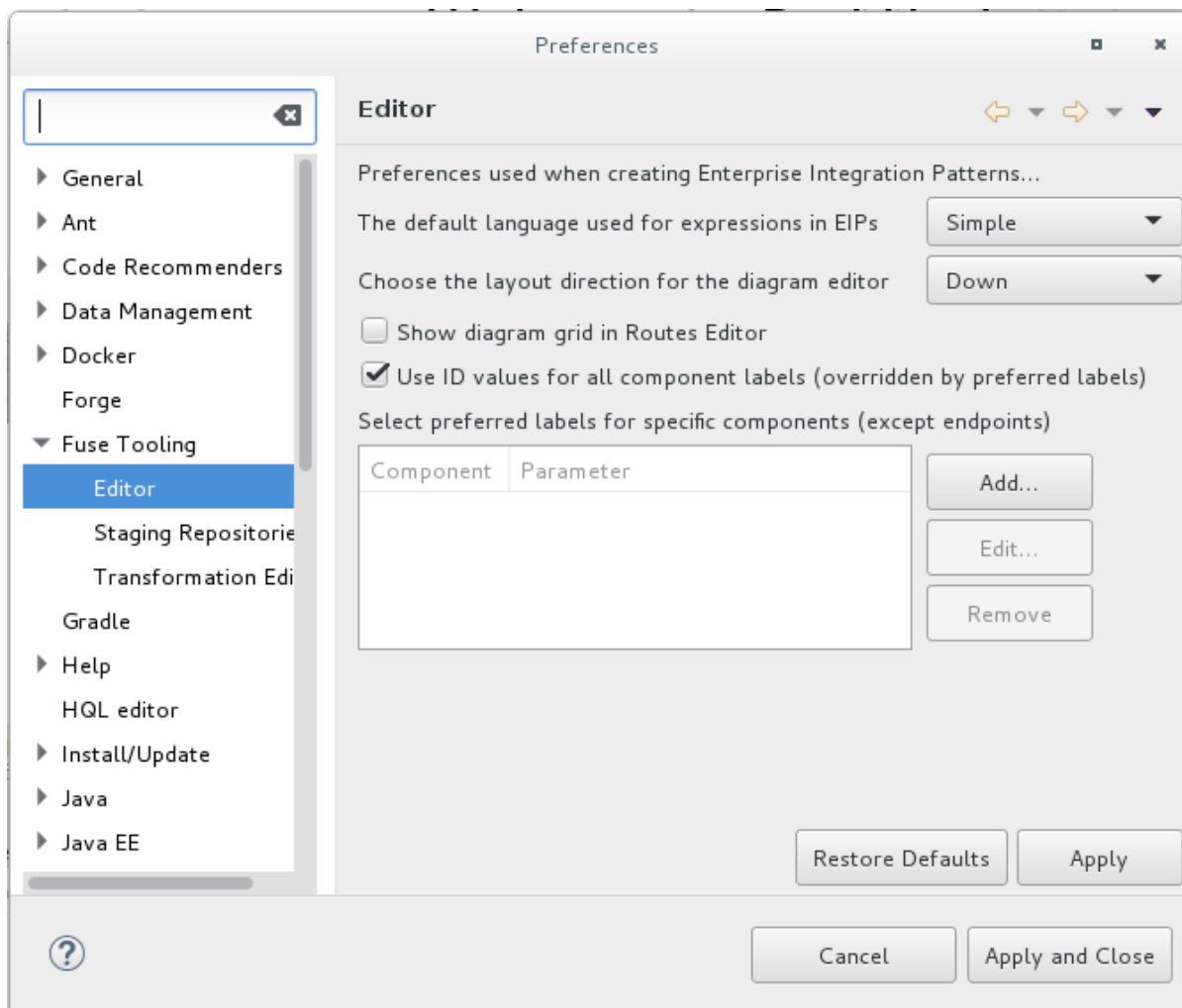
- The default language to use for expressions in Enterprise Integration Patterns (EIPs)
- The direction (to the right or down) in which patterns flow on the Design canvas when you create routes
- Whether the Design canvas displays a grid overlay in the background of the canvas.
- The method for labeling nodes on the Design canvas

### Procedure

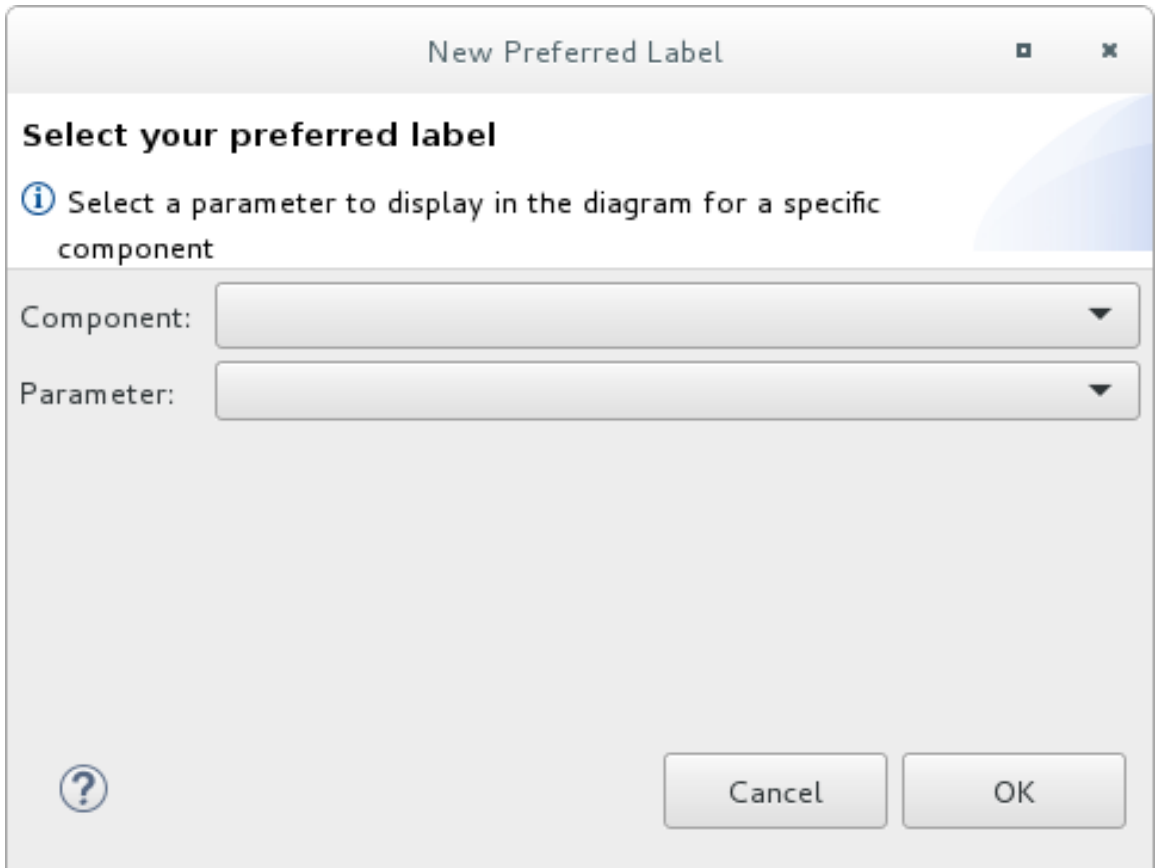
To configure the route editor:

- Open the **Editor** preferences window:
  - On Linux and Windows machines, select **Windows** → **Preferences** → **Fuse Tooling** → **Editor**.

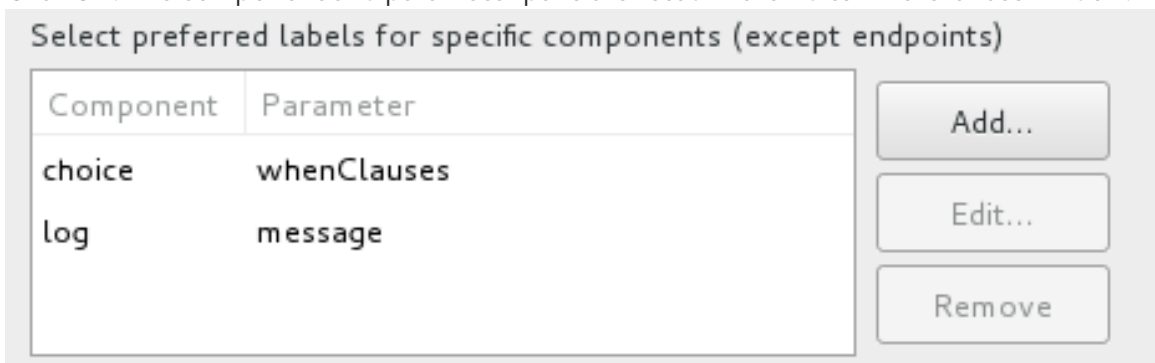




2. To select the default language that you want to use for expressions in Enterprise Integration Pattern (EIP) components, select a language from the drop-down list. The default is *Simple*.
3. To specify the direction in which you want the route editor to align the patterns in a route, select **Down** or **Right**. The default is *Down*.
4. To enable or disable displaying a grid overlay on the background of the canvas, check the box next to **Show diagram grid in Routes Editor**. The default is *enabled*.
5. To enable or disable using component IDs as labels in the route editor's **Design** tab, check the box next to **Use ID values for component labels**. The default is *disabled*.  
If you check this option and also specify a preferred label for a component (see Step 6), then the preferred label is used for that component instead of the ID value.
6. To use a parameter as the label for a component (except for endpoints, such as **File** nodes) in the route editor's **Design** tab:
  - a. In the **Preferred labels** section, click **Add**. The **New Preferred Label** dialog opens.



- b. Select a **Component** and then select the **Parameter** to use as the label for the component.
- c. Click **OK**. The component and parameter pairs are listed in the Editor Preferences window.



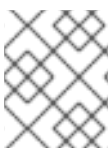
You can optionally **Edit** and **Remove** component labels.



**NOTE**

If you check the **Use ID values for component labels** option, it applies to all components except for the components listed in the **Preferred labels** section.

- 7. Click **Apply and Close** to apply the changes to the **Editor** preferences and close the **Preferences** window.



**NOTE**

You can restore the route editor’s original defaults at any time by returning to the **Editor** preferences dialog and clicking **Restore Defaults**.

## CHAPTER 3. VIEWING AND EDITING REST DSL COMPONENTS

Apache Camel supports multiple approaches to defining REST services. In particular, Apache Camel provides the REST DSL (Domain Specific Language), which is a simple but powerful API that can be layered over any REST component and provides integration with the [OpenAPI 2.0 specification](#). OpenAPI (formerly [Swagger](#)) is a vendor-neutral and portable open description format for API services.

For information about using the Camel Rest DSL, see the “Defining REST services” chapter of the [Apache Camel Development Guide](#).

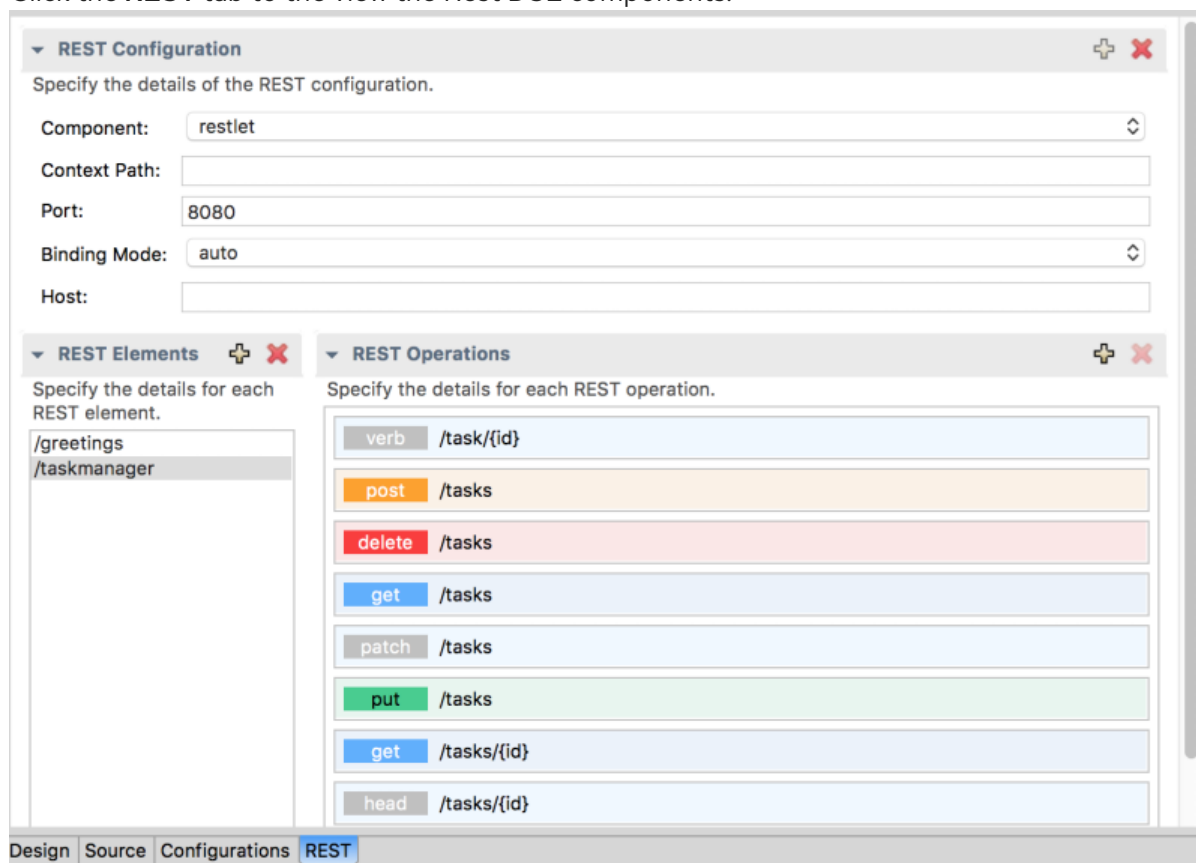
With the Fuse Tooling, you can view and edit Rest DSL components that are in your Camel Context file.

You can also configure your Fuse Integration project to expose your REST API to an OpenAPI client as described here: <https://access.redhat.com/articles/4296981>.

### 3.1. VIEWING A GRAPHICAL REPRESENTATION OF REST DSL COMPONENTS

To view the REST DSL components in your Camel Context file in graphical mode:

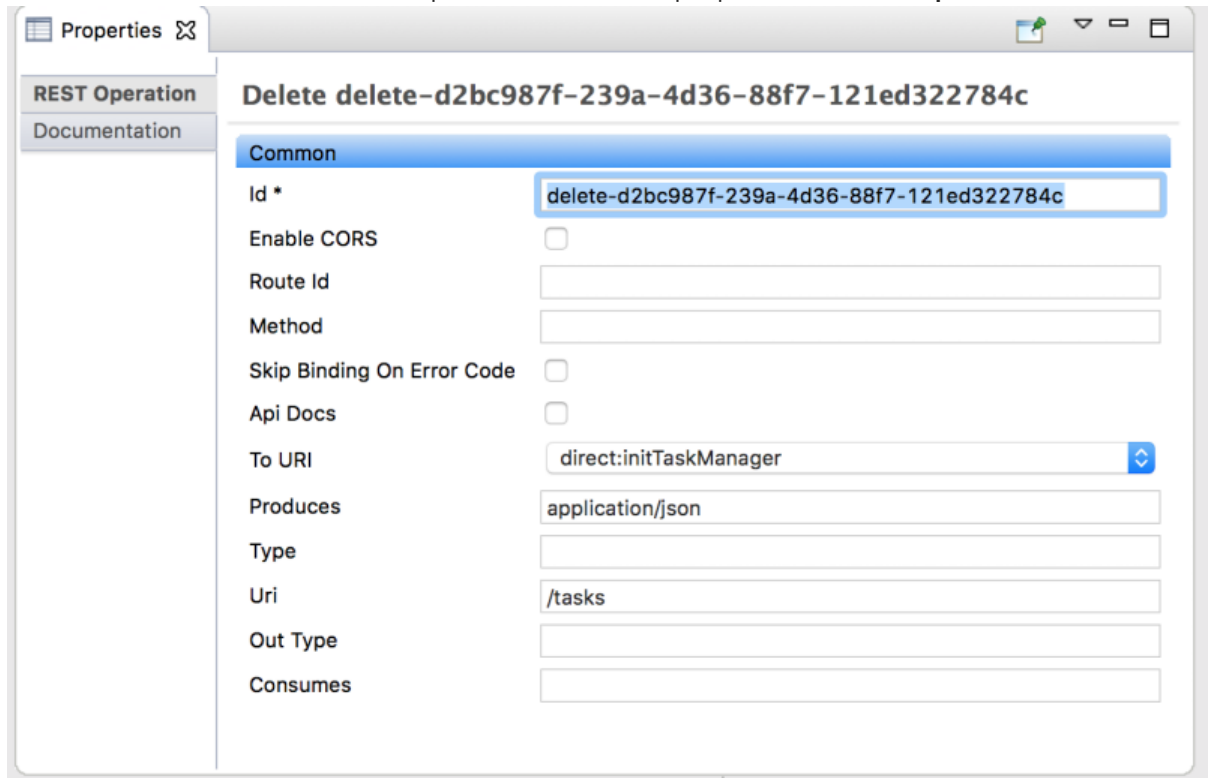
1. Open the Camel Context file in the route editor.
2. Click the **REST** tab to view the Rest DSL components.



The **REST Configuration** section displays these configuration options:

- **Component** – The Camel component to use for the REST transport.
- **Context Path** – The leading context-path for the REST services. You can use this option for components, such as Servlet, where the web application is deployed using a context-path.

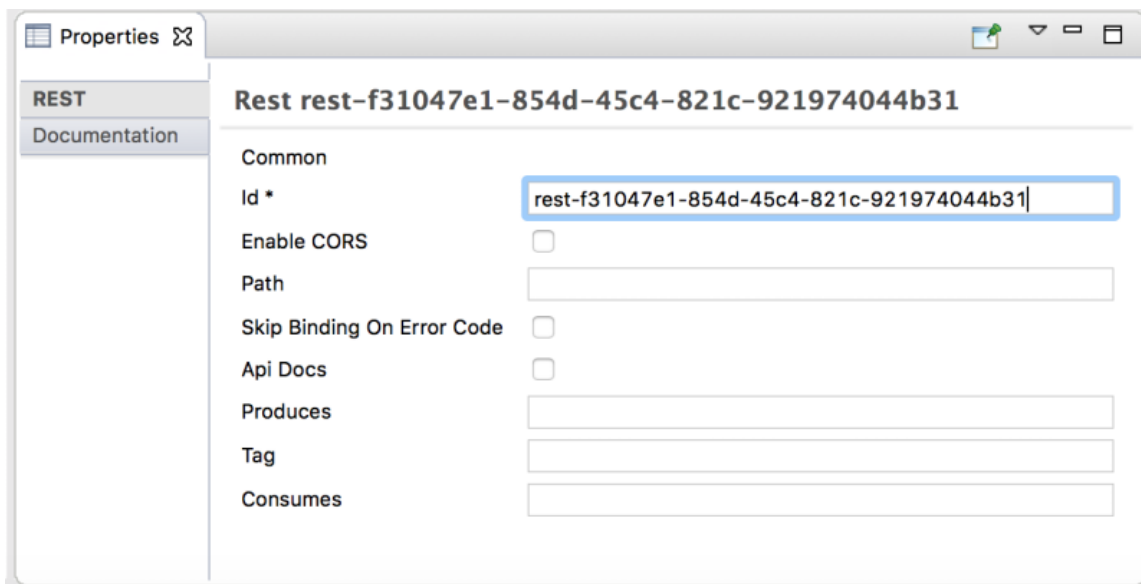
- **Port** – The port number that exposes the REST service.
  - **Binding Mode** – The binding mode for JSON or XML format messages. Possible values are: **off** (the default), **auto**, **json**, **xml**, or **json\_xml**.
  - **Host** – The hostname to use for exposing the REST service.
3. Click a REST element to view its associated operations (for example, **GET**, **POST**, **PUT**, and **DELETE**) in the **REST Operations** section.
  4. Click a REST element or a REST operation to view its properties in the **Properties** view.



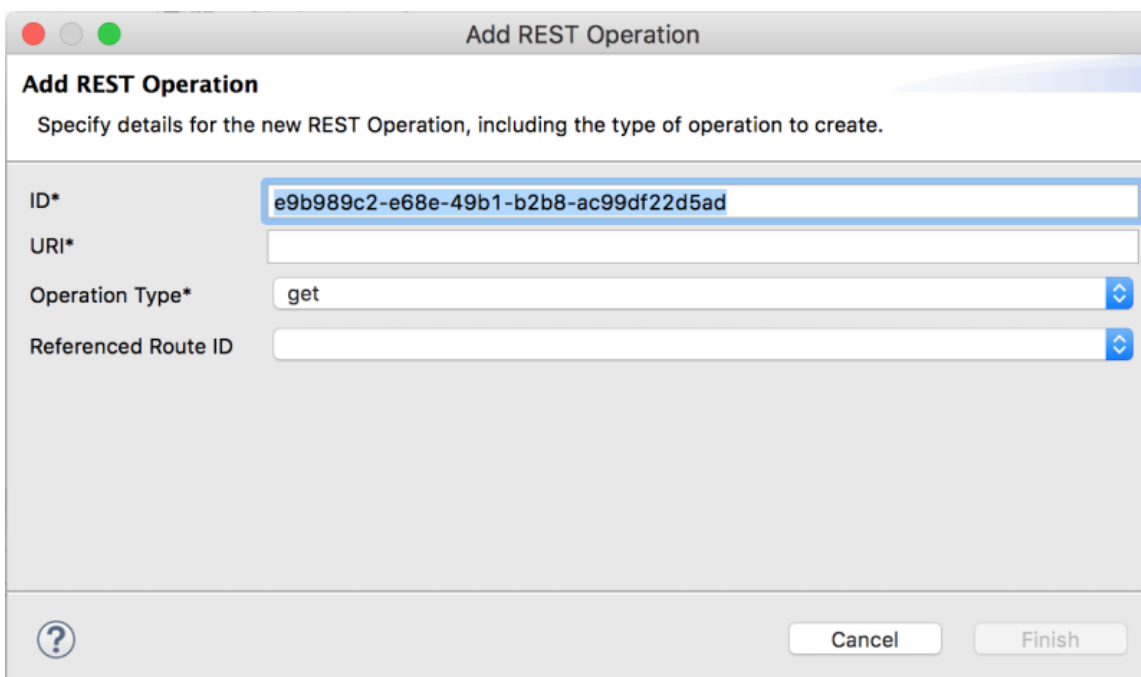
## 3.2. EDITING REST DSL COMPONENTS IN THE GRAPHICAL VIEW

You can add, edit, or delete REST elements in your project's Camel Context file in the **REST** tab.

- To add a new REST element:
  1. In the **REST elements** section, click the **+** button. A REST element is added to the list of **REST elements**.
  2. In the **Properties** view, edit the REST element properties.



- To add a REST operation to a REST element:
  1. In the list of **REST elements**, select a REST element.
  2. In the **REST operations** section, click the + button.  
The **Add REST Operation** dialog box opens.



3. Specify the **ID**, **URI**, and **Operation Type**. Optionally, select a **Referenced Route ID**.
  4. Click **Finish**. The new operation shows in the list of REST operations for the selected REST element.
- To edit a REST element or operation, select it in the **REST** tab and then edit its property values in the **Properties** tab.
  - To remove a selected REST element or operation, click the **x** button.

### 3.3. VIEWING AND EDITING THE REST DSL SOURCE CODE

You can also view and edit Rest DSL components in the **Source** tab:

1. Open the Camel Context file in the route editor.
2. Click the route editor's **Source** tab and then edit the code.

```

23 <blueprint xmlns="http://www.osgi.org/xmlns/blueprint/v1.0.0"
24   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.osgi.org/xmlns/blu
26   The namespace for the camelContext element in Blueprint is 'https://camel.apache.org/schema/blueprint
32   <bean class="com.mycompany.GreeterService" id="GreeterService"/>
33   <camelContext id="_context1" xmlns="http://camel.apache.org/schema/blueprint">
34     <restConfiguration component="netty-http" host="localhost" port="10000"/>
35     <rest path="/say">
36       <get uri="hello/{name}">
37         <to uri="direct:service-hello"/>
38       </get>
39       <get consumes="application/json" uri="/bye/{name}">
40         <to uri="direct:service-bye"/>
41       </get>
42       <post uri="/greeter">
43         <to uri="direct:service-greeter"/>
44       </post>
45     </rest>
46     <route id="service-hello">
47       <from id="_from1" uri="direct:service-hello"/>
48       <setBody id="_setBody1">
49         <simple>Hello ${header.name}</simple>
50       </setBody>
51     </route>
52     <route id="service-bye">
53       <from id="_from2" uri="direct:service-bye"/>
54       <transform id="_transform1">
55         <simple>Bye ${header.name}</simple>
56       </transform>
57     </route>
58     <route id="service-greeter">
59       <from id="_from3" uri="direct:service-greeter"/>
60       <unmarshal id="_unmarshal">
61         <json library="Jackson" unmarshalTypeName="com.mycompany.HelloRequest"/>
62       </unmarshal>
63       <to id="_to1" uri="bean:GreeterService?method=createHello"/>
64       <marshal id="_marshall">
65         <json library="Jackson"/>
66       </marshal>
67     </route>
68   </camelContext>
69 </blueprint>

```

Design Source Configurations REST

3. Optionally, click the **REST** tab to see the changes in the graphical view.
4. To save your changes, select **File** → **Save**.

## CHAPTER 4. CREATING A NEW APACHE CAMEL JUNIT TEST CASE

### OVERVIEW

A common way of testing routes is to use JUnit. The design time tooling includes a wizard that simplifies creating a JUnit test case for your routes. The wizard uses the endpoints you specify to generate the starting point code and configuration for the test.



#### NOTE

After you create the boilerplate JUnit test case, you need to modify it to add expectations and assertions specific to the route that you've created or modified, so the test is valid for the route.

### PREREQUISITES

Before you create a new JUnit test case, you need to perform a preliminary task:

- If you are replacing an existing JUnit test case, you need to delete it before you create a new one. See [the section called "Deleting and existing JUnit test case"](#) .
- If you are creating a new JUnit test case in a project that hasn't one, you need to first create the `project_root/src/test/java` folder for the test case that is included in the build path. See [the section called "Creating and adding the src/test/java folder to the build path"](#) .

### DELETING AND EXISTING JUNIT TEST CASE

1. In the **Project Explorer** view, expand the project's root node to expose the `<root_project>/src/test/java` folder.
2. Locate the JUnit test case file in the `/src/test/java` folder. Depending on which DSL the project is based on, the JUnit test case file is named **BlueprintXmlTest.java** or **CamelContextXmlTest.java**.
3. Right-click the JUnit test case `.java` file to open the context menu, and then select **Delete**. The JUnit test case `.java` file disappears from the **Project Explorer** view.

You can now [create a new JUnit test case](#) .

### CREATING AND ADDING THE SRC/TEST/JAVA FOLDER TO THE BUILD PATH

1. In the **Project Explorer** view, right-click the project's root to open the context menu.
2. Select **New** → **Folder** to open the **Create a new folder resource wizard**.
3. In the wizard's project tree pane, expand the project's root node and select the **src** folder. Make sure `<project_root>/src` appears in the **Enter or select the parent folder** field.
4. In **Folder name**, enter `/test/java`. This folder will store the new JUnit test case you create.

5. Click **Finish**.

In the **Project Explorer** view, the new **src/test/java** folder appears under the **src/main/resources** folder. You can verify that this folder is on the class path by opening its context menu and selecting **Build Path**. If **Remove from Build Path** is a menu option, you know the **src/test/java** folder is on the class path.

You can now [create a new JUnit test case](#).

## CREATING A JUNIT TEST CASE

To create a new JUnit test case for your route:

1. In the **Project Explorer** view, select the routing context **.xml** file in your project.
2. Right-click it to open the context menu, and then select **New → Camel Test Case** to open the **New Camel JUnit Test Case** wizard, as shown in [Figure 4.1, "New Camel JUnit Test Case wizard"](#).

Figure 4.1. New Camel JUnit Test Case wizard

**Camel JUnit Test Case**

✖ Source folder name is empty.

Source folder:

Package:  (default)

Camel XML file under test:

Name:

Which method stubs would you like to create?

setUpBeforeClass()  tearDownAfterClass()  
 setUp()  tearDown()  
 constructor

Do you want to add comments? (Configure templates and default value [here](#))

Generate comments

Alternatively, you can open the wizard by selecting **File → New → Other > Fuse > Camel Test Case** from the menu bar.

3. In **Source folder**, accept the default location of the source code for the test case, or enter another location.



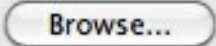
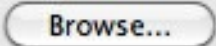
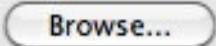
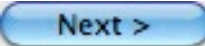
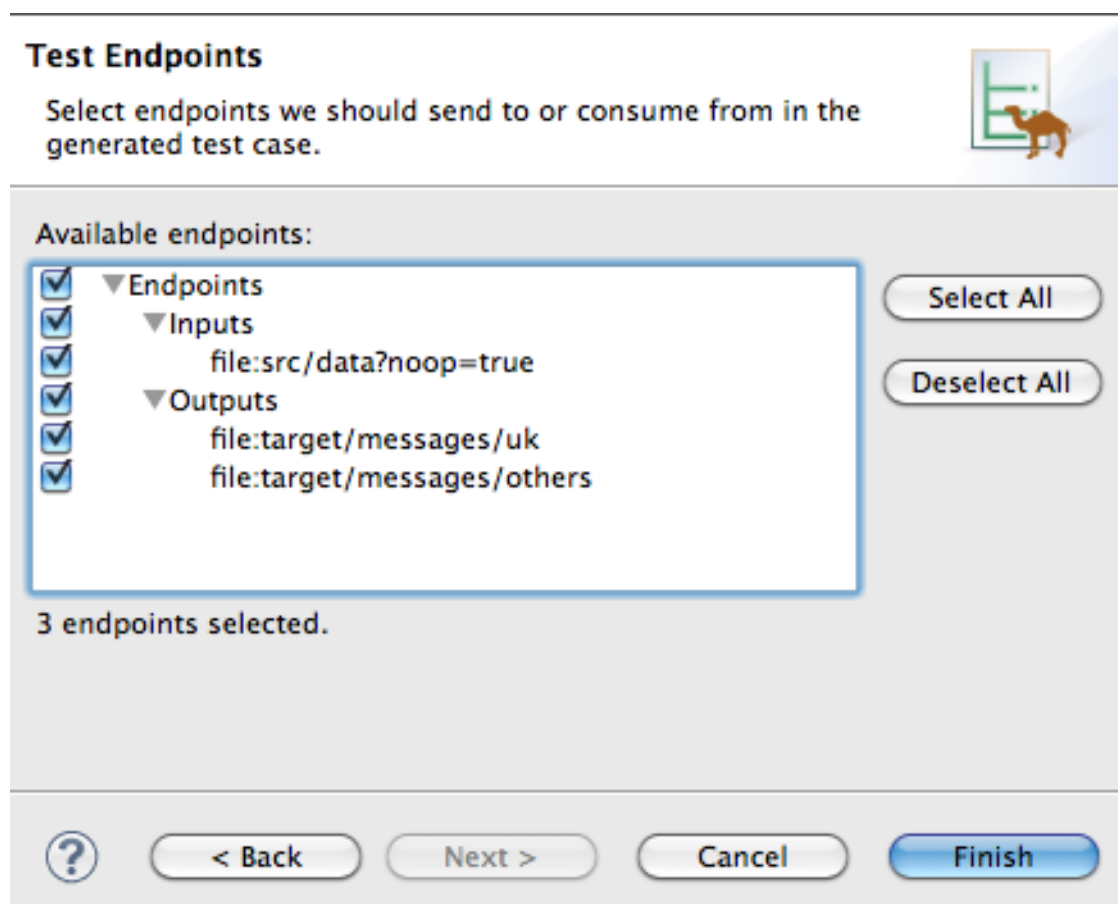

- You can click  to search for a location.
- In **Package**, accept the default package name for the generated test code, or enter another package name.  
You can click  to search for a package.
  - In **Camel XML file under test**, accept the default pathname of the routing context file that contains the route you want to test, or enter another pathname.  
You can click  to search for a context file.
  - In **Name**, accept the default name for the generated test class, or enter another name.
  - Select the method stubs you want to include in the generated code.
  - If you want to include the default generated comments in the generated code, check the **Generate comments** box.
  - Click  to open the **Test Endpoints** page. For example, [Figure 4.2, "New Camel JUnit Test Case page"](#) shows a route's input and output file endpoints selected.

Figure 4.2. New Camel JUnit Test Case page



- Under **Available endpoints**, select the endpoints you want to test. Click the checkbox next to any selected endpoint to deselect it.
- Click .

**NOTE**

If prompted, add JUnit to the build path.

The artifacts for the test are added to your project and appear in the **Project Explorer** view under **src/test/java**. The class implementing the test case opens in the Java editor.

## CHAPTER 5. RUNNING ROUTES INSIDE RED HAT FUSE TOOLING

There are two ways to run your routes using the tooling:

- [Section 5.1, “Running routes as a local Camel context”](#)
- [Section 5.2, “Running routes using Maven”](#)

### 5.1. RUNNING ROUTES AS A LOCAL CAMEL CONTEXT

#### Overview

The simplest way to run an Apache Camel route is as a **Local Camel Context**. This method enables you to launch the route directly from the **Project Explorer** view’s context menu. When you run a route from the context menu, the tooling automatically creates a runtime profile for you. You can also create a custom runtime profile for running your route.

Your route runs as if it were invoked directly from the command line and uses Apache Camel’s embedded Spring container. You can configure a number of the runtime parameters by editing the runtime profile.

#### Procedure

To run a route as a local Camel context:

1. In the **Project Explorer** view, select a routing context file.
2. Right-click it to open the context menu, and then select **Run As → Local Camel Context**.



#### NOTE

Selecting **Local Camel Context (without tests)** directs the tooling to run the project without performing validation tests, which may be faster.

#### Result

The **Console** view displays the output generated from running the route.

#### Related topics

- [Section 5.3.1, “Editing a Local Camel Context runtime profile”](#)

### 5.2. RUNNING ROUTES USING MAVEN

#### Overview

If the project containing your route is a Maven project, you can use the m2e plug-in to run your route. Using this option, you can execute any Maven goals, before the route runs.

#### Procedure

To run a route using Maven:

1. In the **Project Explorer** view, select the root of the project .
2. Right-click it to open the context menu, and then select **Run As → Maven build**.
  - a. The first time you run the project using Maven, the **Edit Configuration and launch** editor opens, so you can create a Maven runtime profile.  
To create the runtime profile, on the **Maven** tab:
    - i. Make sure the route directory of your Apache Camel project appears in the **Base directory:** field.  
For example, on Linux the root of your project is similar to `~/workspace/simple-router`.
    - ii. In the **Goals:** field, enter **camel:run**.



#### IMPORTANT

If you created your project using the Java DSL, enter **exec:java** in the **Goals:** field.

- iii. Click **Apply** and then **Run**.
- b. Subsequent Maven runs use this profile, unless you modify it between runs.

## Results

The **Console** view displays the output from the Maven run.

## Related topics

- [Section 5.3.2, “Editing a Maven runtime profile”](#)

## 5.3. WORKING WITH RUNTIME PROFILES

Red Hat Fuse Tooling stores information about the runtime environments for each project in *runtime profiles*. The runtime profiles keep track of such information as which Maven goals to call, the Java runtime environment to use, any system variables that need to be set, and so on. A project can have more than one runtime profile.

### 5.3.1. Editing a Local Camel Context runtime profile

#### Overview

A **Local Camel Context** runtime profile configures how Apache Camel is invoked to execute a route. A **Local Camel Context** runtime profile stores the name of the context file in which your routes are defined, the name of the **main** to invoke, the command line options passed into the JVM, the JRE to use, the classpath to use, any environment variables that need to be set, and a few other pieces of information.

The runtime configuration editor for a **Local Camel Context** runtime profile contains the following tabs:

- **Camel Context File** – specifies the name of the new configuration and the full path of the routing context file that contains your routes.

- **JMX** – specifies JMX connection details, including the JMX URI and the user name and password (optional) to use to access it.
- **Main** – specifies the fully qualified name of the project’s base directory, a few options for locating the base directory, any goals required to execute before running the route, and the version of the Maven runtime to use.
- **JRE** – specifies the JRE and command line arguments to use when starting the JVM.
- **Refresh** – specifies how Maven refreshes the project’s resource files after a run terminates.
- **Environment** – specifies any environment variables that need to be set.
- **Common** – specifies how the profile is stored and the output displayed.

The first time an Apache Camel route is run as a **Local Camel Context**, Red Hat Fuse Tooling creates for the routing context file a default runtime profile, which should not require editing.

### Accessing the Local Camel Context’s runtime configuration editor


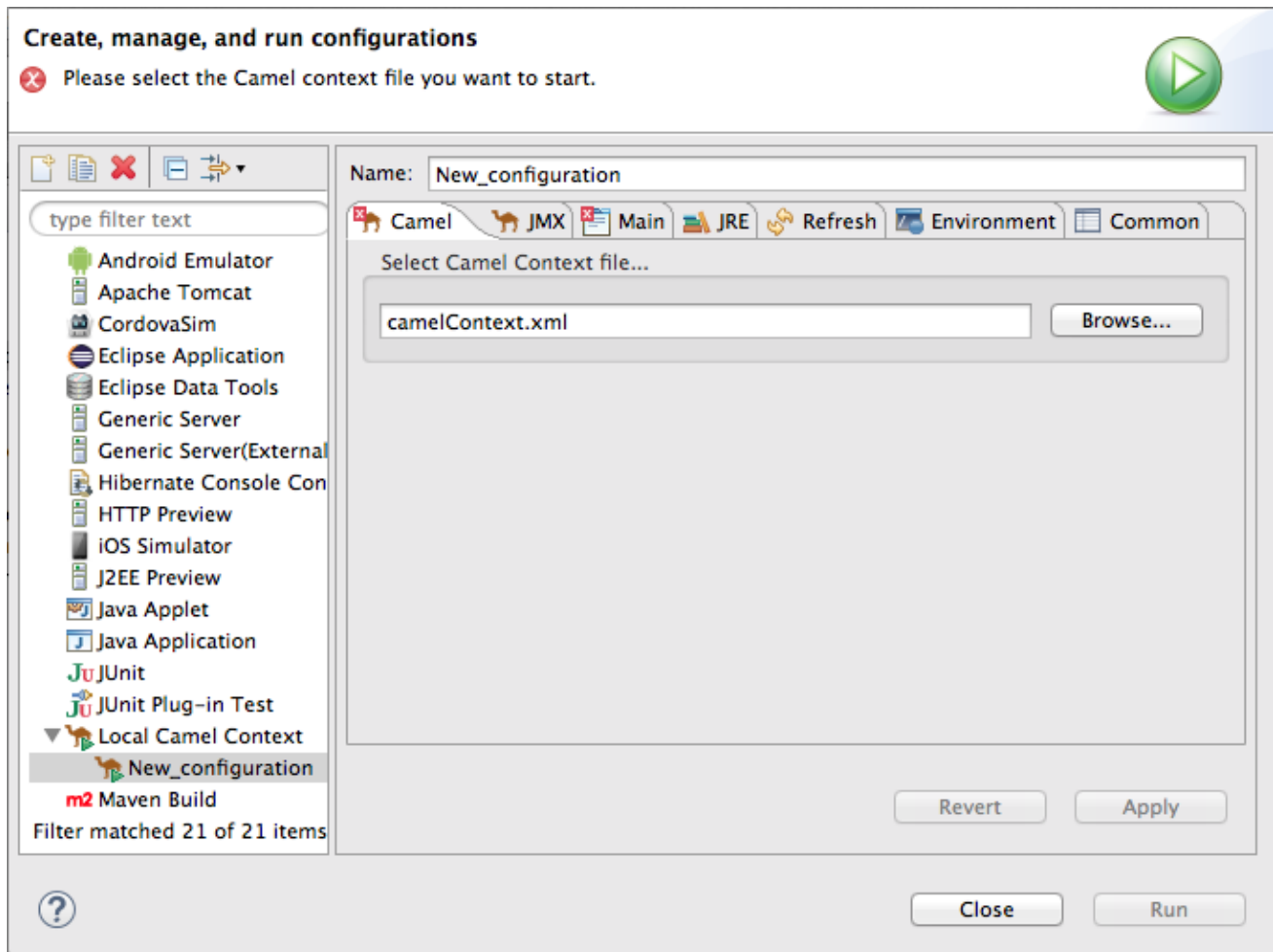
1. In the **Project Explorer** view, select the Camel context file for which you want to edit or create a custom runtime profile.
2. Right-click it to open the context menu, and then select **Run As → Run Configurations** to open the **Run Configurations** dialog.
3. In the **context selection** pane, select **Local Camel Context**, and then click  at the top, left of the **context selection** pane.
4. In the **Name** field, enter a new name for your runtime profile.

Figure 5.1. Runtime configuration editor for Local Camel Context



## Setting the camel context file

The **Camel Context File** tab has one field, **Select Camel Context file...** Enter the full path to the routing context file that contains your route definitions.

The **Browse** button accesses the **Open Resource** dialog, which facilitates locating the target routing context file. This dialog is preconfigured to search for files that contain Apache Camel routes.

## Changing the command line options

By default the only command line option passed to the JVM is:

```
-fa context-file
```

If you are using a custom main class you may need to pass in different options. To do so, on the **Main** tab, click the **Add** button to enter a parameter's name and value. You can click the **Add Parameter** dialog's **Variables...** button to display a list of variables that you can select.

To add or modify JVM-specific arguments, edit the **VM arguments** field on the **JRE** tab.

## Changing where output is sent

By default, the output generated from running the route is sent to the **Console** view. But you can redirect it to a file instead.

To redirect output to a file:

1. Select the **Common** tab.
2. In the **Standard Input and Output** pane, click the checkbox next to the **Output File:** field, and then enter the path to the file where you want to send the output.  
The **Workspace**, **File System**, and **Variables** buttons facilitate building the path to the output file.

## Related topics

- [Section 5.1, “Running routes as a local Camel context”](#)

## 5.3.2. Editing a Maven runtime profile

### Overview

A Maven runtime profile configures how Maven invokes Apache Camel. A Maven runtime profile stores the Maven goals to execute, any Maven profiles to use, the version of Maven to use, the JRE to use, the classpath to use, any environment variables that need to be set, and a few other pieces of information.



### IMPORTANT

The first time an Apache Camel route is run using Maven, you must create a default runtime profile for it.

The runtime configuration editor for a Fuse runtime profile contains the following tabs:

- **Main** – specifies the name of the new configuration, the fully qualified name of the project’s base directory, a few options for locating the base directory, any goals required to execute before running the route, and the version of the Maven runtime to use.
- **JRE** – specifies the JRE and command line arguments to use when starting the JVM.
- **Refresh** – specifies how Maven refreshes the project’s resource files after a run terminates.
- **Source** – specifies the location of any additional sources that the project requires.
- **Environment** – specifies any environment variables that need to be set.
- **Common** – specifies how the profile is stored and the output displayed.

### Accessing the Maven runtime configuration editor


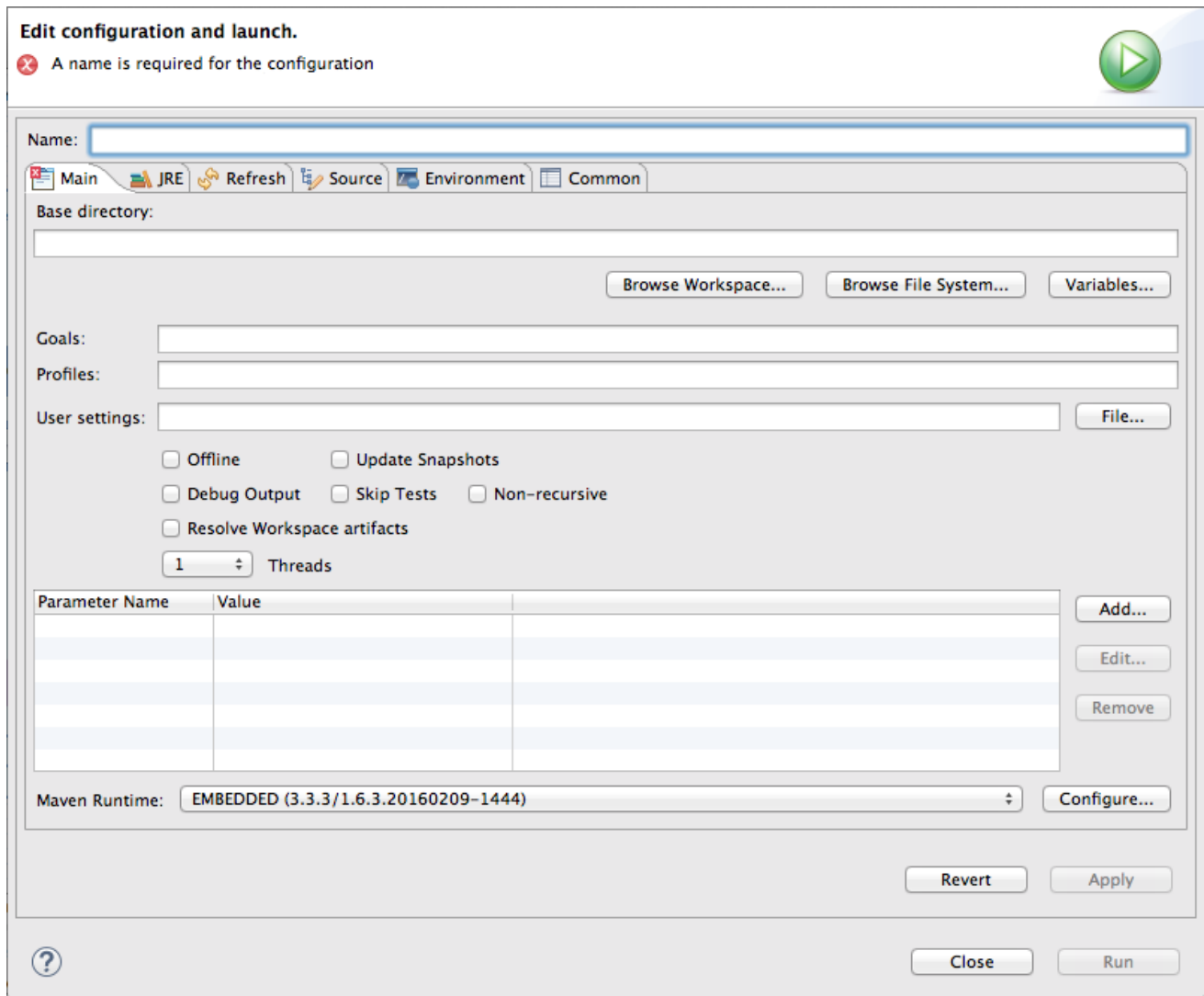
1. In the **Project Explorer** view, select the root of the project for which you want to edit or create a custom runtime profile.
2. Right-click it to open the context menu, and then select **Run As → Run Configurations** to open the **Run Configurations** dialog.
3. In the **context selection** pane, select **Maven Build**, and then click  at the top, left of the **context selection** pane.

Figure 5.2. Runtime configuration editor for Maven



## Changing the Maven goal

The most commonly used goal when running a route is **camel:run**. It loads the routes into a Spring container running in its own JVM.

The Apache Camel plug-in also supports a **camel:embedded** goal that loads the Spring container into the same JVM used by Maven. The advantage of this is that the routes should bootstrap faster.

Projects based on Java DSL use the **exec:java** goal.

If your POM contains other goals, you can change the Maven goal used by clicking the **Configure...** button next to the **Maven Runtime** field on the **Main** tab. On the **Installations** dialog, you edit the **Global settings for <selected\_runtime> installation** field.

## Changing the version of Maven

By default, Red Hat Fuse Tooling for Eclipse uses m2e, which is embedded in Eclipse. If you want to use a different version of Maven or have a newer version installed on your development machine, you can select it from the **Maven Runtime** drop-down menu on the **Main** tab.

## Changing where the output is sent



By default, the output from the route execution is sent to the **Console** view. But you can redirect it to a file instead.

To redirect output to a file:

1. Select the **Common** tab.
2. Click the checkbox next to the **Output File:** field, and then enter the path to the file where you want to send the output.

The **Workspace**, **File System**, and **Variables** buttons facilitate building the path to the output file.

## Related topics

- [Section 5.2, "Running routes using Maven"](#)

## CHAPTER 6. GETTING STARTED WITH FUSE ON OPENSHIFT

Fuse on OpenShift (the name for Fuse Integration Services since 7.0) enables you to deploy Fuse applications on OpenShift Container Platform.



### IMPORTANT

For Fuse Integration projects (Fuse on OpenShift projects), Fuse Tooling requires installation of the Red Hat Container Development Kit (CDK) v3.x. See the [Getting Started Guide](#) for instructions. In addition to the prerequisites specified in this guide, you need to establish a Red Hat account if you do not have one. Your Red Hat user name and password are required to start the virtual OpenShift instance provided in the Red Hat Container Development Kit.

You can easily get an account by registering on the [Red Hat Customer Portal](#). Click

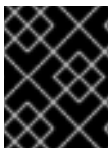


in the upper right corner of the white banner, and then click

**REGISTER**

on the [Login to Your Red Hat Account](#) page.

Fuse Tooling enables you to develop and deploy Fuse Integration projects using the s2i binary workflow. In this workflow, the tooling builds your project locally, assembles it into an image stream, then pushes the image stream to OpenShift, where it is used to build the Docker container. Once the Docker container is built, OpenShift deploys it in a pod.



### IMPORTANT

Fuse Tooling works only with the S2I binary workflow and only with projects based on the Spring Boot framework.



### NOTE

Although Fuse Tooling can deploy Fuse Integration projects created using the tooling to remote OpenShift servers, this chapter describes creating and deploying Fuse Integration projects to a virtual OpenShift instance, installed locally using the Red Hat Container Development Kit (CDK) v3.x.

The following sections describe how to create and deploy your first Fuse Integration project:

- [Section 6.1, "Adding the Red Hat Container Development Kit server"](#)
- [Section 6.2, "Starting the Container Development Environment \(CDE\) and virtual OpenShift server"](#)
- [Section 6.3, "Creating a new OpenShift project"](#)
- [Section 6.4, "Creating a new Fuse Integration project"](#)
- [Section 6.5, "Deploying the Fuse Integration project to OpenShift"](#)

**NOTE**

You can also run a Fuse Integration project as a local Camel context, see [Section 5.1, “Running routes as a local Camel context”](#), and then connect to it in the **JMX Navigator** view, where you can monitor and test the routing context. You can also run the Camel debugger on a Fuse Integration project ([Part II, “Debugging Routing Contexts”](#)) to expose and fix any logic errors in the routing context.

## 6.1. ADDING THE RED HAT CONTAINER DEVELOPMENT KIT SERVER

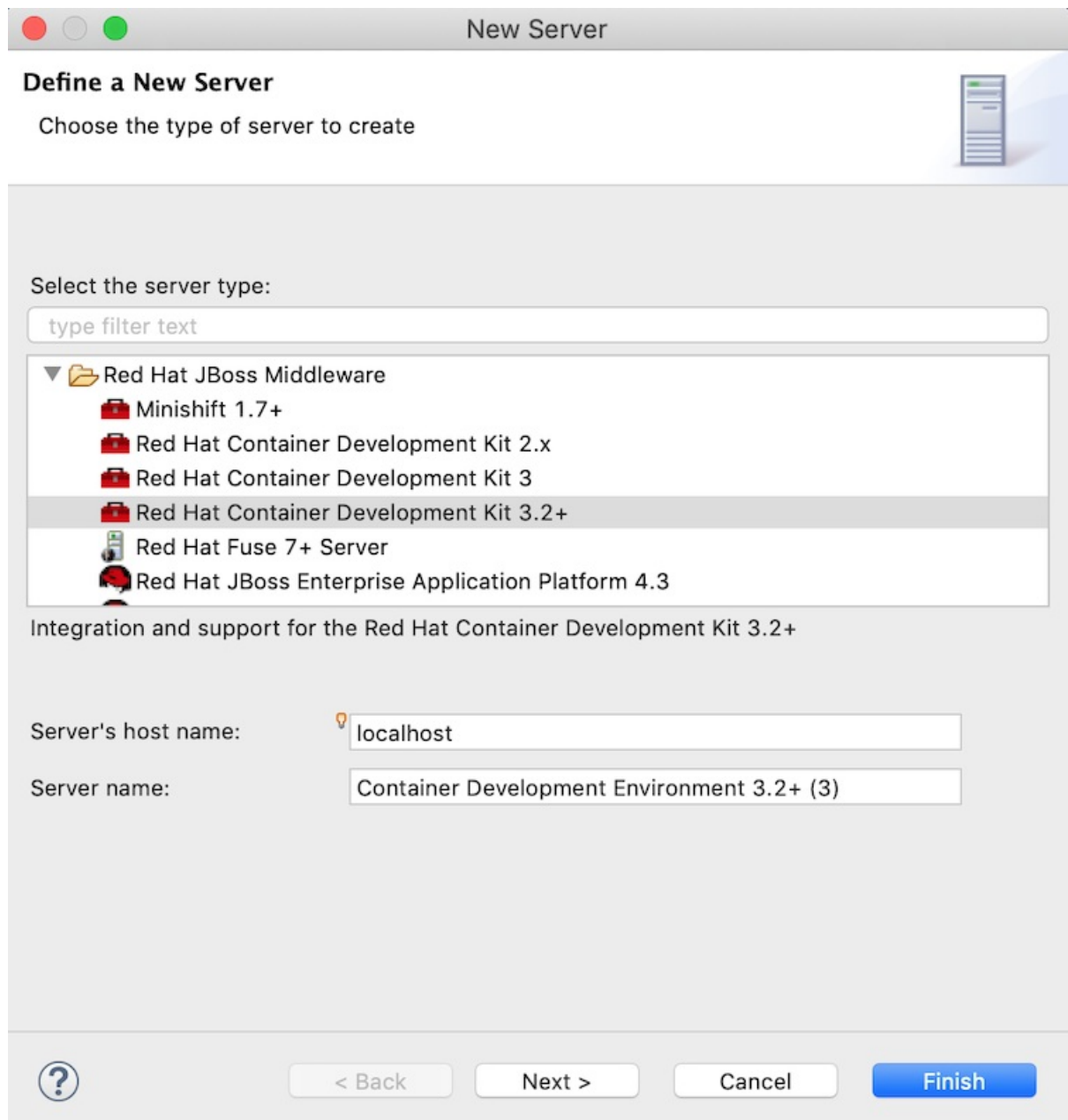
To add the Red Hat Container Development Kit to the **Servers** view:

1. If necessary, switch to the **Fuse Integration** perspective by selecting **Window → Perspective → Open Perspective → Fuse Integration**.

**NOTE**

If a view that is described in this procedure is not open, you can open it by selecting **Window → Show View → Other** and then select the name of the view that you want to open.

2. In the **Servers** view, click the link **No servers are available. Click this link to create a new server...** to open the **Define a New Server** wizard. This link appears only when the **Servers** view contains no server entry. Otherwise, right-click in the **Servers** view to open the context menu, and then select **New → Server** to open the **Define a New Server** wizard.



3. Select **Red Hat JBoss Middleware** → **Red Hat Container Development Kit 3.2+**.  
Accept the defaults for:
  - **Server's hostname** – **localhost**
  - **Server name** – **Container Development Environment**
4. Click **Next** to open the **Red Hat Container Development Environment** page.
5. Next to **MiniShift Binary**, click **Browse**, navigate to the location where you installed the Red Hat Container Development Kit 3.x and then click **Open**.
6. Next to **Username**, click **Add** to open the **Add a Credential** page.
7. Set the credentials this way:
  - **Username** – Enter the name you use to log into your Red Hat account.
  - **Always prompt for password** – Leave as is (disabled).

- **Password** – Enter the password you use to log into your Red Hat account.
8. Click **OK** to return to the **Red Hat Container Development Environment** page, which is now populated. For example:

The screenshot shows a 'New Server' dialog box titled 'Red Hat Container Development Environment'. It contains the following fields and controls:


- Domain:** access.redhat.com
- Username:** mflinn@redhat.com (with 'Edit...' and 'Add...' buttons)
- Hypervisor:** xhyve (with a 'Download and install runtime...' link)
- Minishift Binary:** /Users/mflinn/bin/minishift (with a 'Browse...' button)
- Minishift Home:** /Users/mflinn/.minishift (with a 'Browse...' button)
- Minishift Profile:** minishift

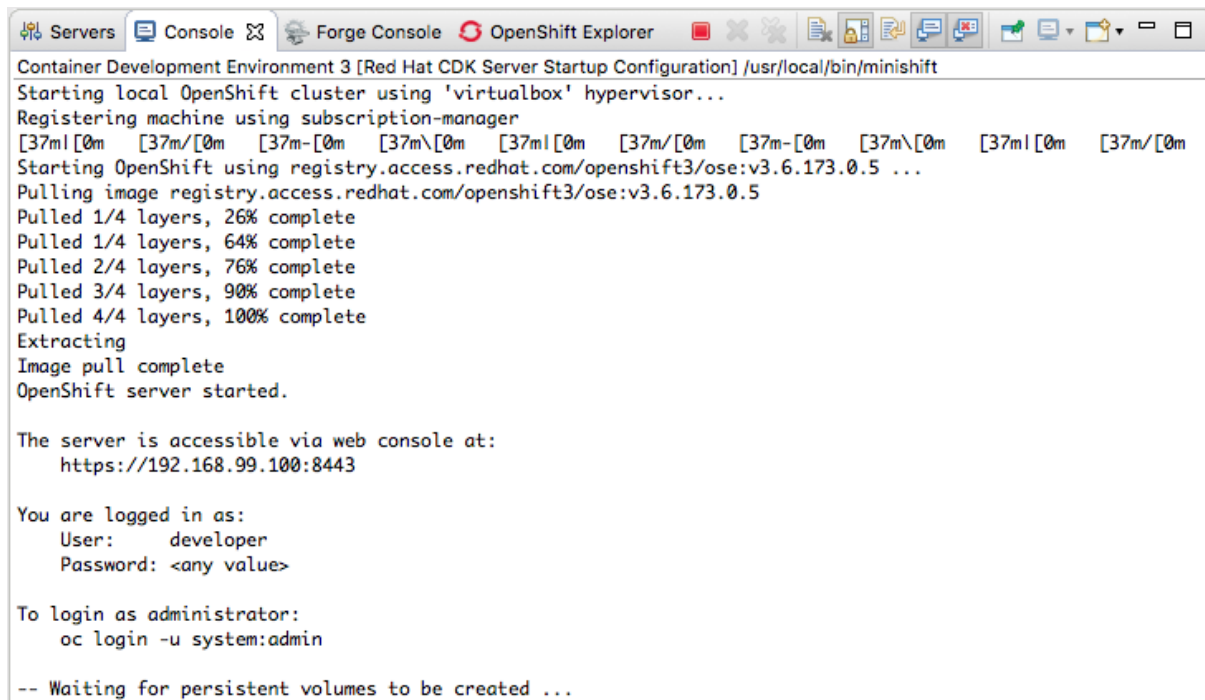
At the bottom, there are navigation buttons: '?', '< Back', 'Next >', 'Cancel', and 'Finish'.

9. Click **Finish**. **Container Development Environment 3.2+ [Stopped, Synchronized]** appears in the **Servers** view. **Container Development Environment 3.2+** is the default server name when you add a CDK 3.x server.

## 6.2. STARTING THE CONTAINER DEVELOPMENT ENVIRONMENT (CDE) AND VIRTUAL OPENSIFT SERVER

Starting the Container Development Environment (CDE) also starts the virtual OpenShift server. Stopping the CDE also stops the virtual OpenShift server.

1. In the **Servers** view, select **Container Development Environment 3 [stopped, Synchronized]** and then click  on the **Servers** menu bar. **Console** view opens and displays the status of the startup process:



```

Container Development Environment 3 [Red Hat CDK Server Startup Configuration] /usr/local/bin/minishift
Starting local OpenShift cluster using 'virtualbox' hypervisor...
Registering machine using subscription-manager
[37m][0m [37m/[0m [37m-[0m [37m\[0m [37m|0m [37m/[0m [37m-[0m [37m\[0m [37m|0m [37m/[0m
Starting OpenShift using registry.access.redhat.com/openshift3/ose:v3.6.173.0.5 ...
Pulling image registry.access.redhat.com/openshift3/ose:v3.6.173.0.5
Pulled 1/4 layers, 26% complete
Pulled 1/4 layers, 64% complete
Pulled 2/4 layers, 76% complete
Pulled 3/4 layers, 90% complete
Pulled 4/4 layers, 100% complete
Extracting
Image pull complete
OpenShift server started.

The server is accessible via web console at:
  https://192.168.99.100:8443

You are logged in as:
  User:     developer
  Password: <any value>

To login as administrator:
  oc login -u system:admin

-- Waiting for persistent volumes to be created ...

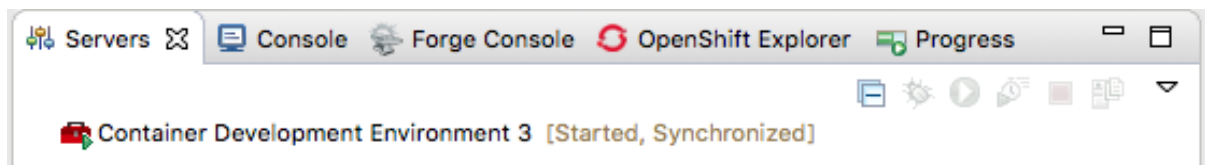
```



## NOTE

On initial startup, the CDE asks whether you accept the untrusted SSL certificate. Click **Yes**.

When the startup process has finished, the **Servers** view displays:



2. Switch to the **OpenShift Explorer** view.

The virtual OpenShift server instance, **developer**, is also running:



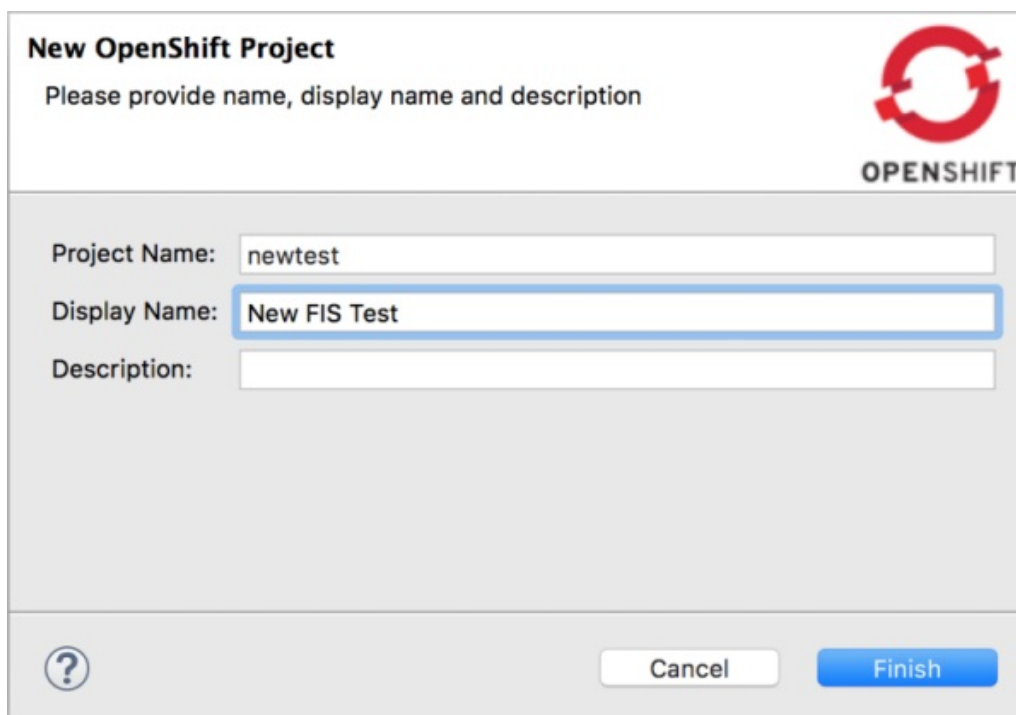
<https://192.168.99.100:8443> is an example of a URL for the OpenShift developer web console. Your installation displays the URL for your instance. For more details, see [Section 6.6, "Accessing the OpenShift web console"](#).

## 6.3. CREATING A NEW OPENSIFT PROJECT

When you deploy your Fuse Integration project to OpenShift, it is published to the OpenShift project you create here.

1. In the **OpenShift Explorer** view, right-click the **developer** entry, to open the context menu.
2. Select **New** → **Project** to open the **New OpenShift Project** wizard.
3. Set the new project's properties this way:

- In the **Project Name** field, enter the name for the project's namespace on the virtual OpenShift server.  
Only lower case letters, numbers, and dashes are valid.
- In the **Display Name** field, enter the name to display on the virtual OpenShift web console's **Overview** page.
- Leave the **Description** field as is.  
For example:



**New OpenShift Project**  
Please provide name, display name and description

Project Name:

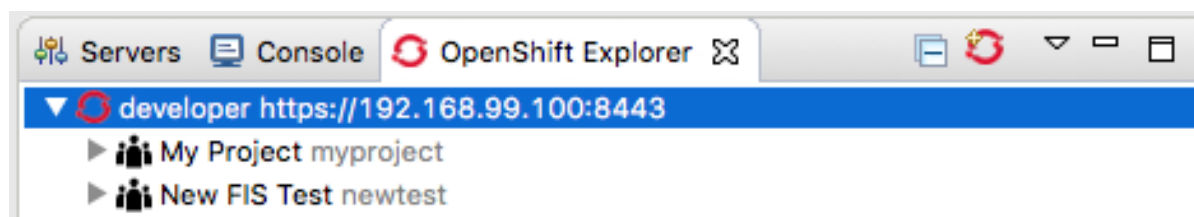
Display Name:

Description:

Cancel Finish

4. Click **Finish**.

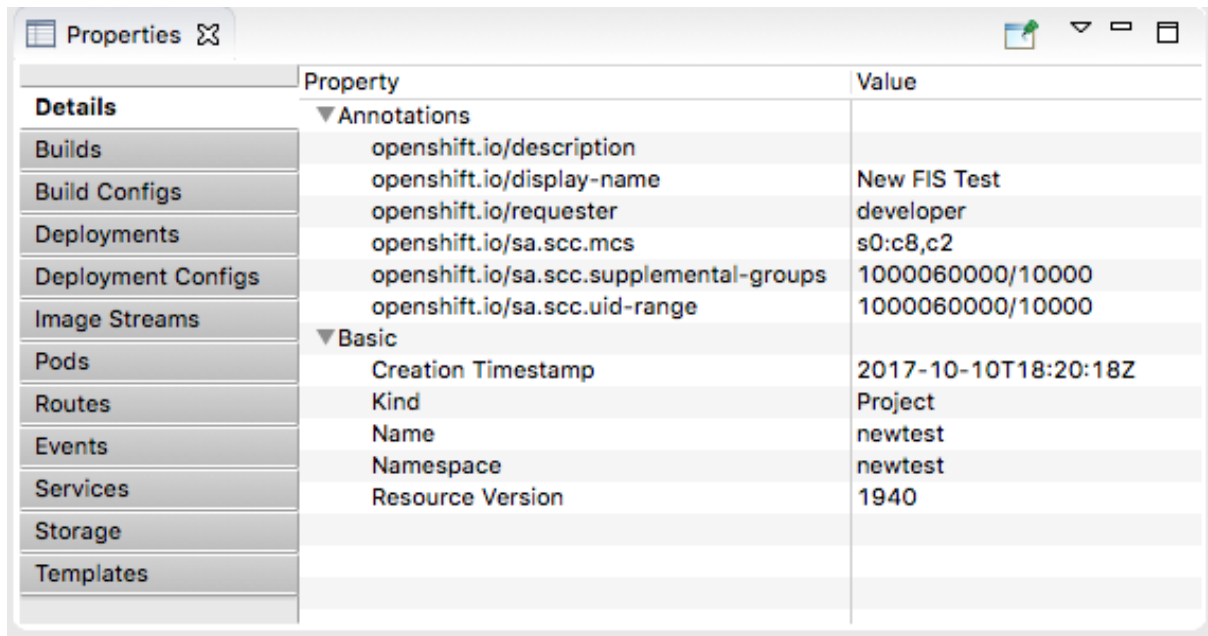
The new OpenShift project (in this example, **New FIS Test newtest**) appears in the **OpenShift Explorer** tab, under, in this example, **developer** <https://192.168.99.100:8443>:



#### NOTE

**MyProject myproject** is an initial example project included with OpenShift.

With **New FIS Test newtest** selected in the **OpenShift Explorer** view, the **Properties** view displays the project's details. For example:



	Property	Value
<b>Details</b>	▼ Annotations	
Builds	openshift.io/description	
Build Configs	openshift.io/display-name	New FIS Test
Deployments	openshift.io/requester	developer
Deployment Configs	openshift.io/sa.scc.mcs	s0:c8,c2
Image Streams	openshift.io/sa.scc.supplemental-groups	1000060000/10000
Pods	openshift.io/sa.scc.uid-range	1000060000/10000
Routes	▼ Basic	
Events	Creation Timestamp	2017-10-10T18:20:18Z
Services	Kind	Project
Storage	Name	newtest
Templates	Namespace	newtest
	Resource Version	1940



## NOTE

When you deploy the project to OpenShift, the **Properties** view gathers and displays the same information about the project that the OpenShift web console does.

## 6.4. CREATING A NEW FUSE INTEGRATION PROJECT

Before you create a new Fuse Integration project, you should enable staging repositories. This is needed because some Maven artifacts are not in default Maven repositories. To enable staging repositories, select **Window → Preferences → Fuse Tooling → Staging Repositories**.

To create a Fuse Integration project, use the **Spring Boot on OpenShift** template:

1. In the **Project Explorer** view, right-click to open the context menu and then select **New → Fuse Integration Project** to open the wizard's **Choose a project name** page:



New Fuse Integration Project

**Choose a project name**

Enter a name for your new project.

Project Name

Location

Path

Use default workspace location

2. In the **Project Name** field, type a name that is unique to the workspace you are using, for example, **myFISproject**.  
Accept the defaults for the other options.
3. Click **Next** to open the **Select a Target Runtime** page:

New Fuse Integration Project

### Select a Target Environment

Select a target environment for deploying your new project.

Choose the deployment platform

Kubernetes/OpenShift

Standalone

Choose the runtime environment

Spring Boot

Karaf/Fuse on Karaf

Runtime (optional) None selected

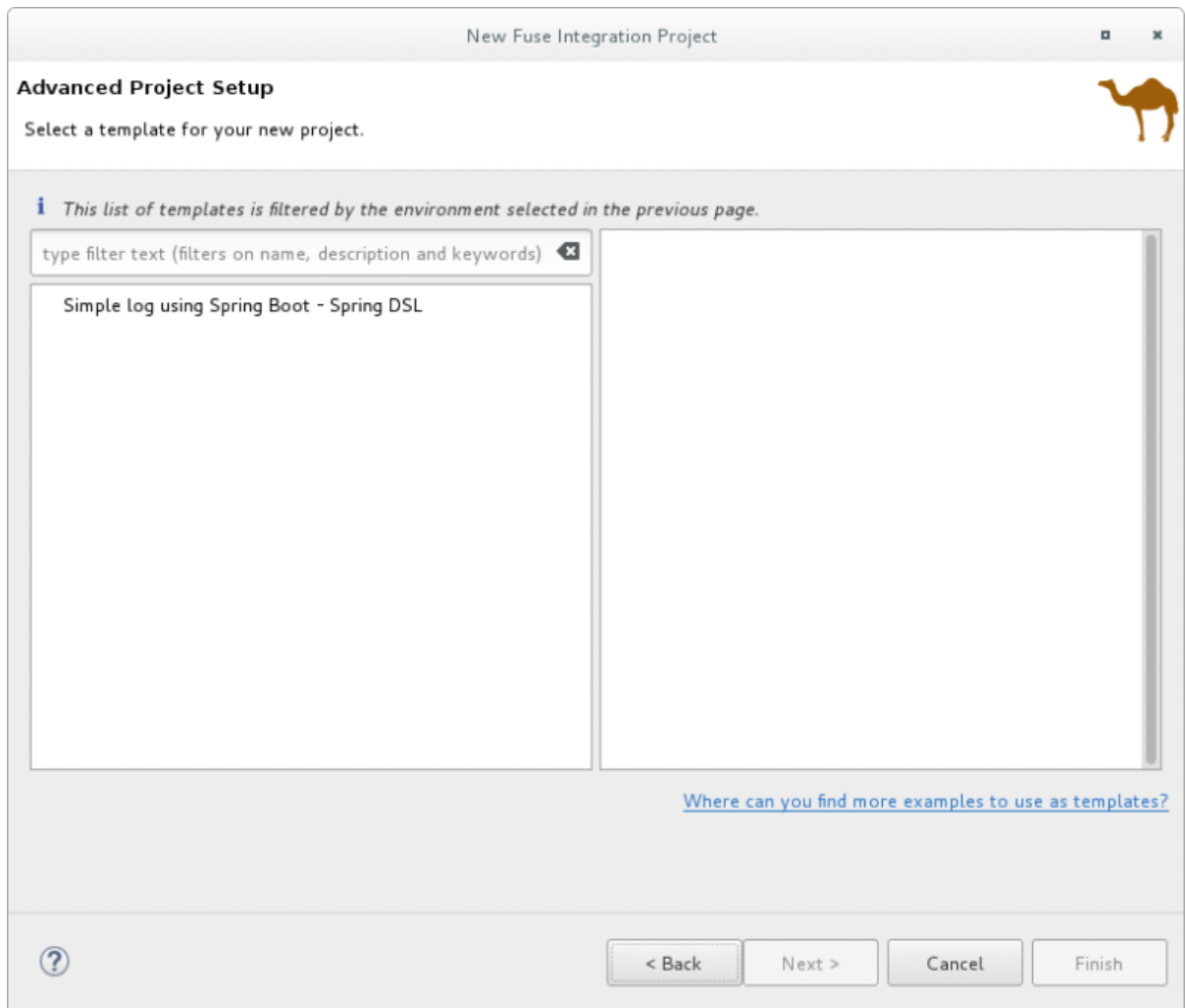
Wildfly/Fuse on EAP

Runtime (optional) None selected

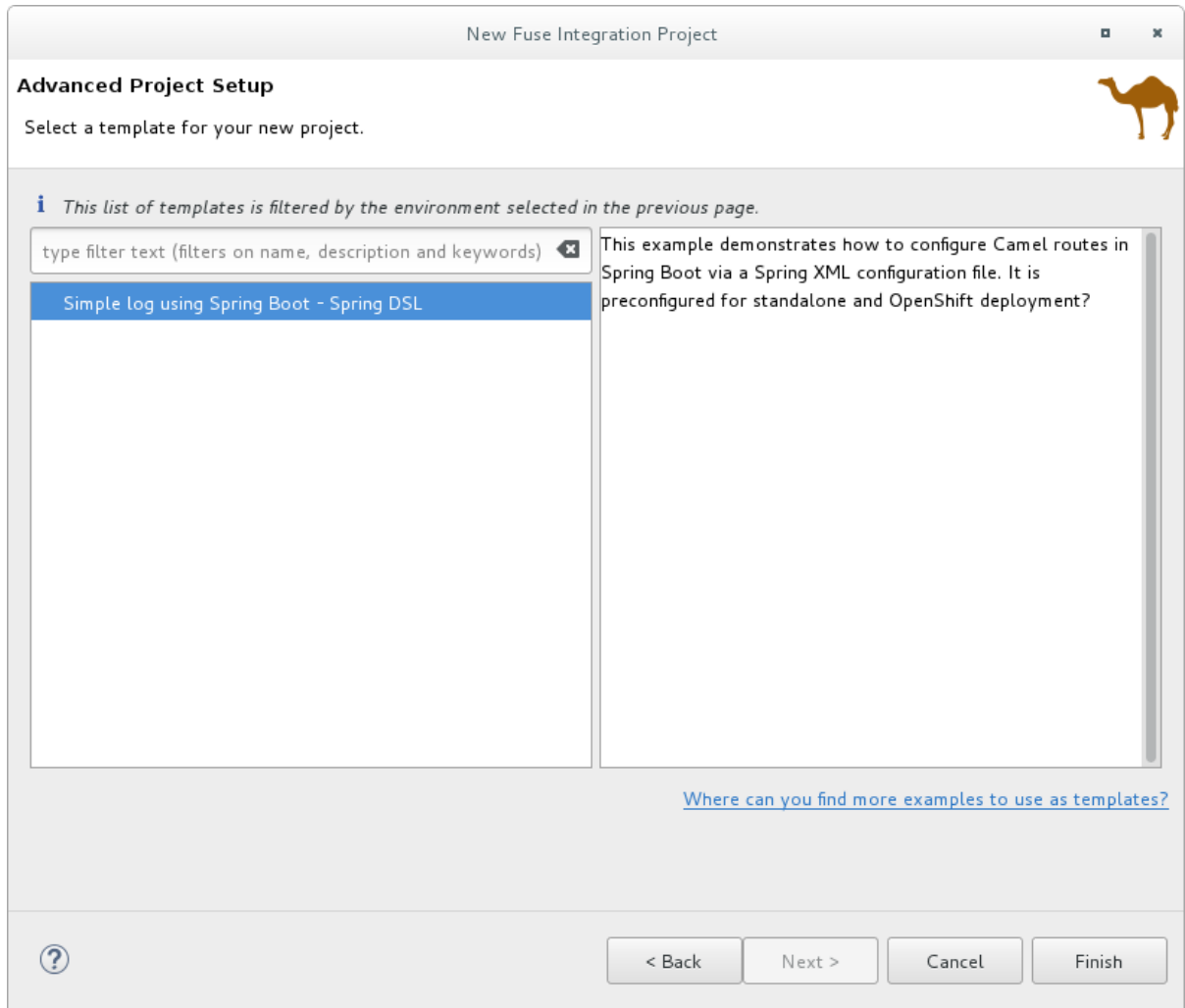
Select the Camel version

Leave the defaults for **Target Runtime** (*No Runtime selected*) and **Camel Version**.

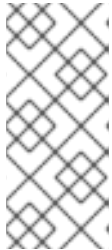
4. Click **Next** to open the **Advanced Project Setup** page:



5. Select the **Simple log using Spring Boot - Spring DSL** template.



6. Click **Finish**.

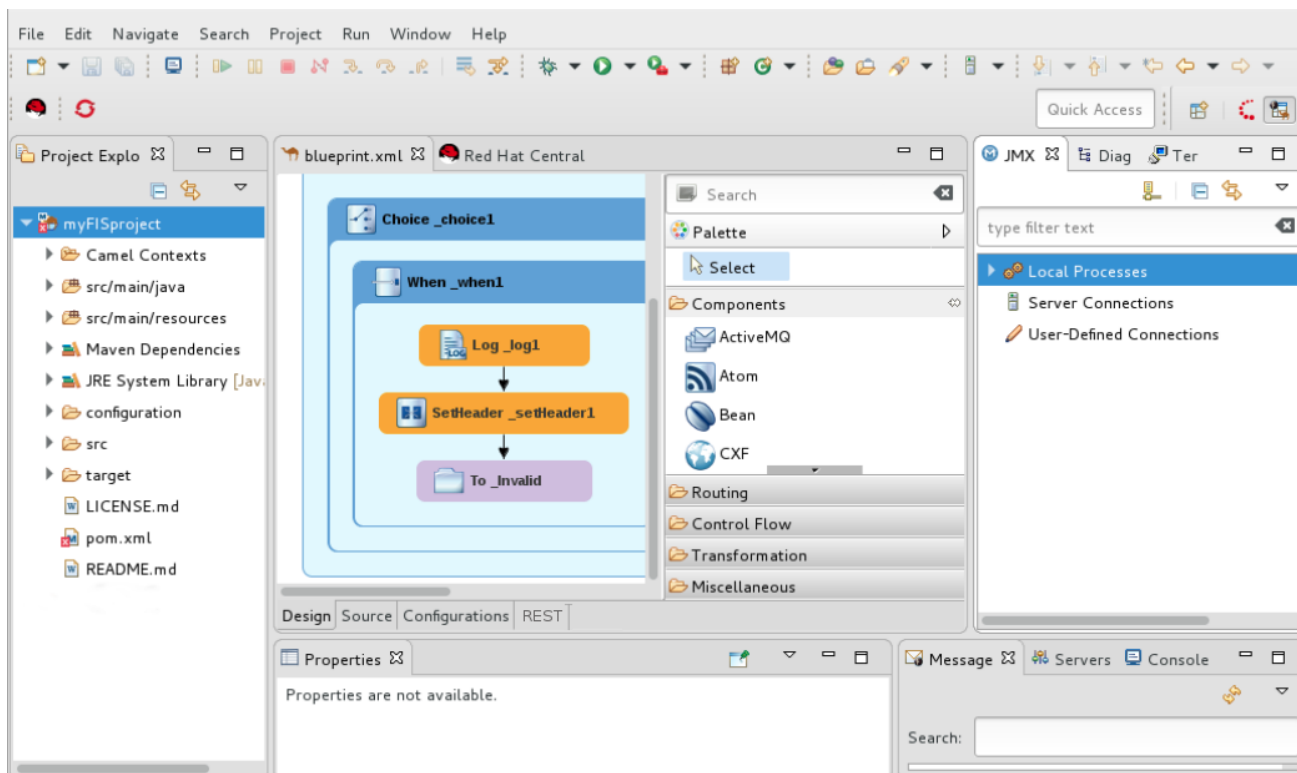


#### NOTE

Because of the number of dependencies that are downloaded for a first-time Fuse Integration project, building it can take some time.

If the **Fuse Integration** perspective is not already open, Developer Studio prompts you to indicate whether you want to open it now. Click **Yes**.

When the build is done the **Fuse Integration** perspective displays the project, for example:

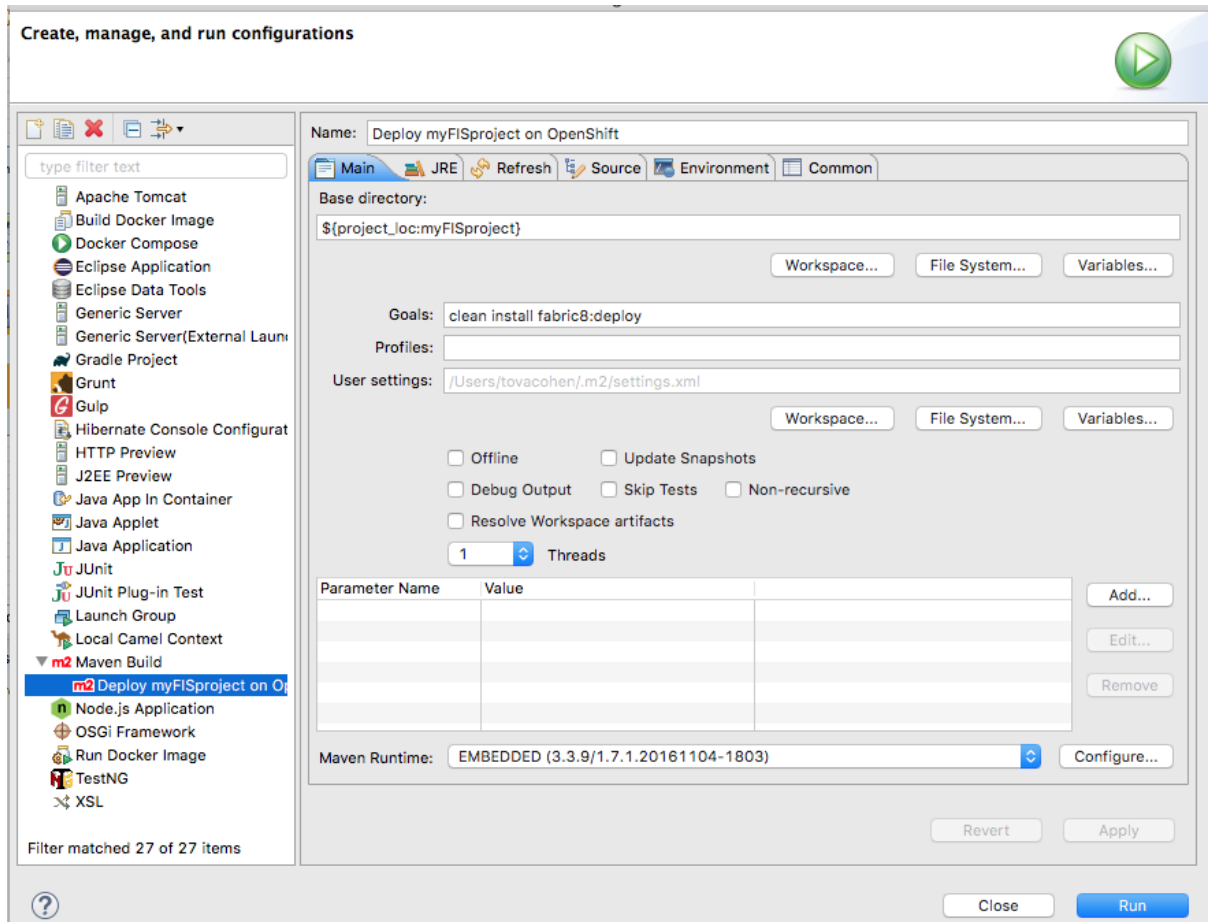


At this point, you can:

- [Deploy the project on OpenShift](#)
- [Section 5.1, “Running routes as a local Camel context”](#) to verify that the routing context runs successfully on your local machine  
Connecting to the running context in the **JMX Navigator** view (see [the section called “Viewing processes in a local JMX server”](#)), you can monitor route components and test whether the route performs as expected:
  - View a route component’s JMX statistics – see [Chapter 20, Viewing a component’s JMX statistics](#).
  - Edit the running route – see [Chapter 24, Managing routing endpoints](#).
  - Suspend/resume the running route – see [Chapter 26, Managing routing contexts](#)
  - Start/stop tracing on the running route – see [Chapter 22, Tracing Routes](#)
- Run the Camel debugger on the project’s **camel-context.xml** file to discover and fix logic errors – see [Part II, “Debugging Routing Contexts”](#)

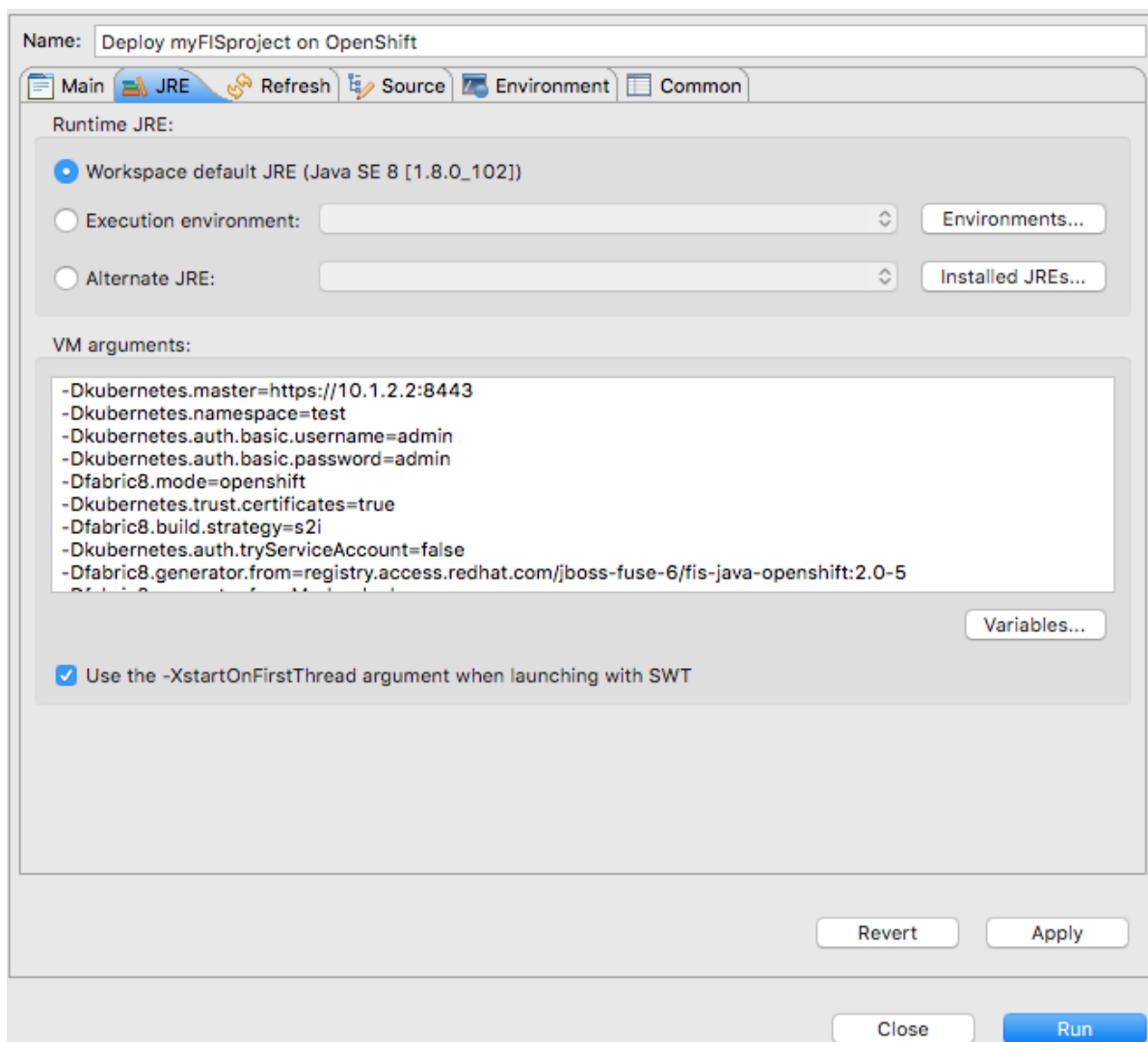
## 6.5. DEPLOYING THE FUSE INTEGRATION PROJECT TO OPENSIFT

1. In the **Project Explorer** view, right-click the project’s root (in this example, **myFISproject**) to open the context menu.
2. Select **Run As** → **Run Configurations** to open the **Run Configurations** wizard.
3. In the sidebar menu, select **Maven Build** → **Deploy <projectname> on OpenShift** (in this example, **Deploy myFISproject on OpenShift**) to open the project’s default run configuration:

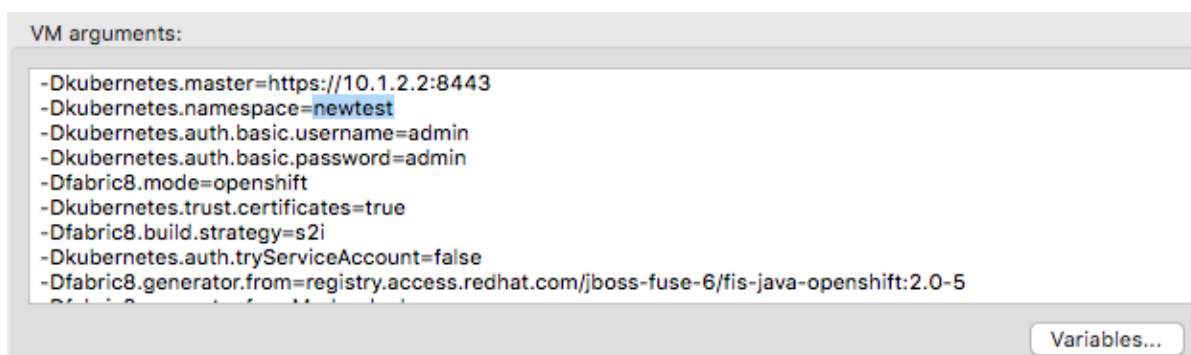


Leave the default settings as they are on the **Main** tab.

4. Open the **JRE** tab to access the VM arguments:



- In the **VM arguments** pane, change the value of the **-Dkubernetes.namespace=test** argument to match the project name that you used for the OpenShift project when you created it ([OpenShift project name](#) in [Section 6.3, "Creating a new OpenShift project"](#)). In this example, change the default value **test** to **newtest**:



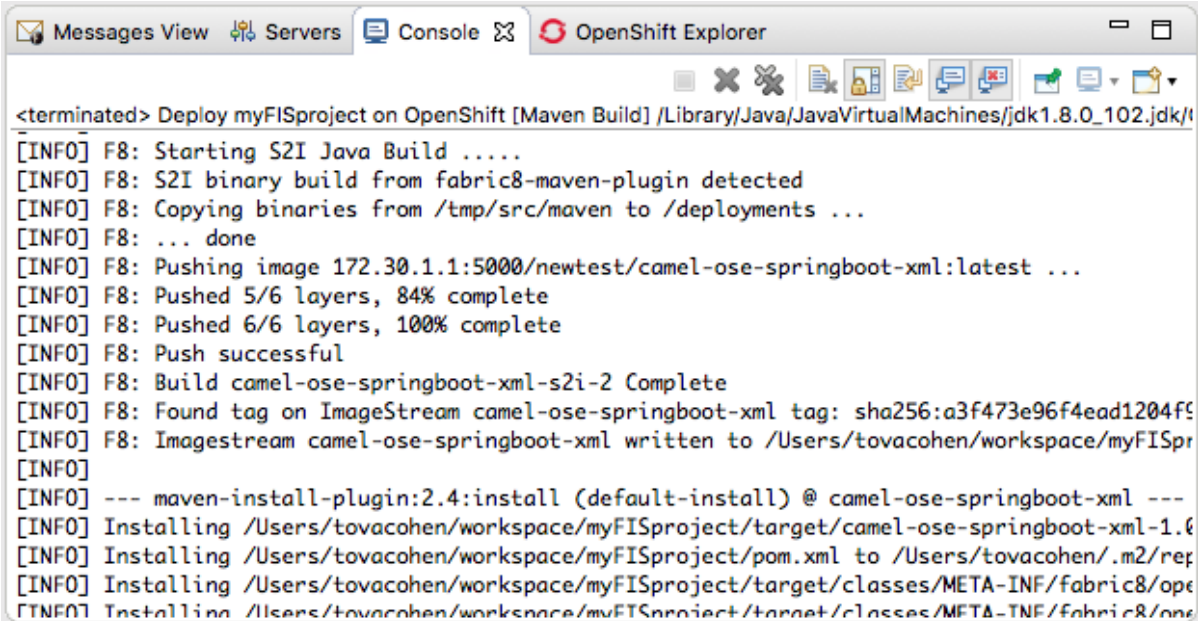
Depending on your OpenShift configuration, you may need to modify other VM arguments to support it:

- **-Dkubernetes.master=https://192.168.99.1:8443**  
When running multiple OpenShift instances or using a remote instance, you need to specify the URL of the OpenShift instance targeted for the deployment. The URL above is an example.
- **-Dkubernetes.trust.certificates=true**

- When using the CDK, this argument is required. Leave it set to **true**.
  - If you are using an OpenShift instance that has a valid SSL certificate, change the value of this argument to **false**.
6. Click **Apply** and then click **Run**.

Because of the number of dependencies to download, first-time deployment can take some time. The speed of your computer and your internet connection are contributing factors. Typically, it takes 25 to 35 minutes to complete a first-time deployment.

In the **Console** view, you can track the progress of the deploy process. In the following output, the entry `*Pushing image 172.30.1.....*` indicates that the project built successfully and the application images are being pushed to OpenShift, where they will be used to build the Docker container.



```
<terminated> Deploy myFISproject on OpenShift [Maven Build] /Library/Java/JavaVirtualMachines/jdk1.8.0_102.jdk/Contents/Home
[INFO] F8: Starting S2I Java Build .....
[INFO] F8: S2I binary build from fabric8-maven-plugin detected
[INFO] F8: Copying binaries from /tmp/src/maven to /deployments ...
[INFO] F8: ... done
[INFO] F8: Pushing image 172.30.1.1:5000/newtest/camel-ose-springboot-xml:latest ...
[INFO] F8: Pushed 5/6 layers, 84% complete
[INFO] F8: Pushed 6/6 layers, 100% complete
[INFO] F8: Push successful
[INFO] F8: Build camel-ose-springboot-xml-s2i-2 Complete
[INFO] F8: Found tag on ImageStream camel-ose-springboot-xml tag: sha256:a3f473e96f4ead1204f9...
[INFO] F8: Imagestream camel-ose-springboot-xml written to /Users/tovacohen/workspace/myFISpr...
[INFO]
[INFO] --- maven-install-plugin:2.4:install (default-install) @ camel-ose-springboot-xml ---
[INFO] Installing /Users/tovacohen/workspace/myFISproject/target/camel-ose-springboot-xml-1.0...
[INFO] Installing /Users/tovacohen/workspace/myFISproject/pom.xml to /Users/tovacohen/.m2/repo...
[INFO] Installing /Users/tovacohen/workspace/myFISproject/target/classes/META-INF/fabric8/ope...
[INFO] Installing /Users/tovacohen/workspace/myFISproject/target/classes/META-INF/fabric8/ope...
```

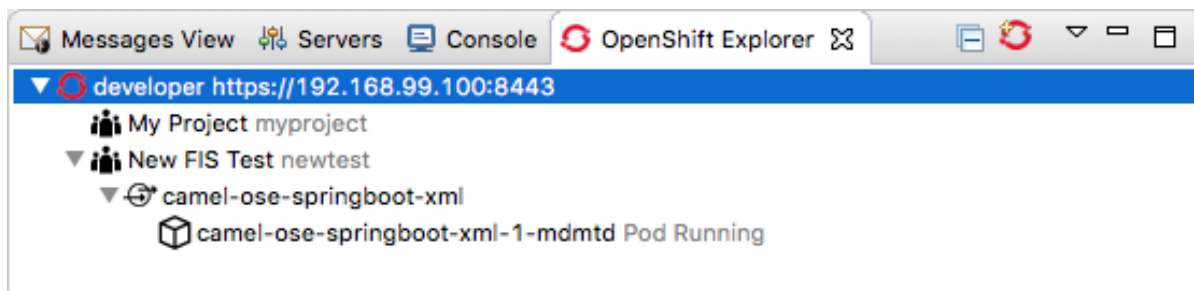
The **Console** view displays **BUILD SUCCESS** when deployment completes successfully:



```
<terminated> Deploy myFISproject on OpenShift [Maven Build] /Library/Java/JavaVirtualMachines/jdk1.8.0_102.jdk/Contents/Home
[INFO]
[INFO] --- fabric8-maven-plugin:3.1.80.redhat-000013:deploy (default-cli) @ camel-ose-springboot-xml ---
[INFO] F8: Using OpenShift at https://192.168.99.100:8443/ in namespace newtest with manifest /Users/tovacohen/workspace/myFISproject/target/fabric8/applyJson/newtest/service-camel-ose-springboot-xml.json
[INFO] OpenShift platform detected
[INFO] Using project: newtest
[INFO] Creating a Service from openshift.yml namespace newtest name camel-ose-springboot-xml
[INFO] Created Service: target/fabric8/applyJson/newtest/service-camel-ose-springboot-xml.json
[INFO] Creating a DeploymentConfig from openshift.yml namespace newtest name camel-ose-springboot-xml
[INFO] Created DeploymentConfig: target/fabric8/applyJson/newtest/deploymentconfig-camel-ose-springboot-xml
[INFO] F8: HINT: Use the command `oc get pods -w` to watch your pods start up
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 12:27 min
[INFO] Finished at: 2017-10-10T16:59:12-04:00
[INFO] Final Memory: 61M/657M
[INFO] -----
```

7. Switch to the **OpenShift Explorer** view and select **New FIS Test newtest**





In the **Properties** view, the **Details** page displays all of the project's property values.

Property	Value
<b>Annotations</b>	
openshift.io/description	
openshift.io/display-name	New FIS Test
openshift.io/requester	developer
openshift.io/sa.scc.mcs	s0:c8,c2
openshift.io/sa.scc.supplemental-groups	1000060000/10000
openshift.io/sa.scc.uid-range	1000060000/10000
<b>Basic</b>	
Creation Timestamp	2017-10-10T18:20:18Z
Kind	Project
Name	newtest
Namespace	newtest
Resource Version	1940

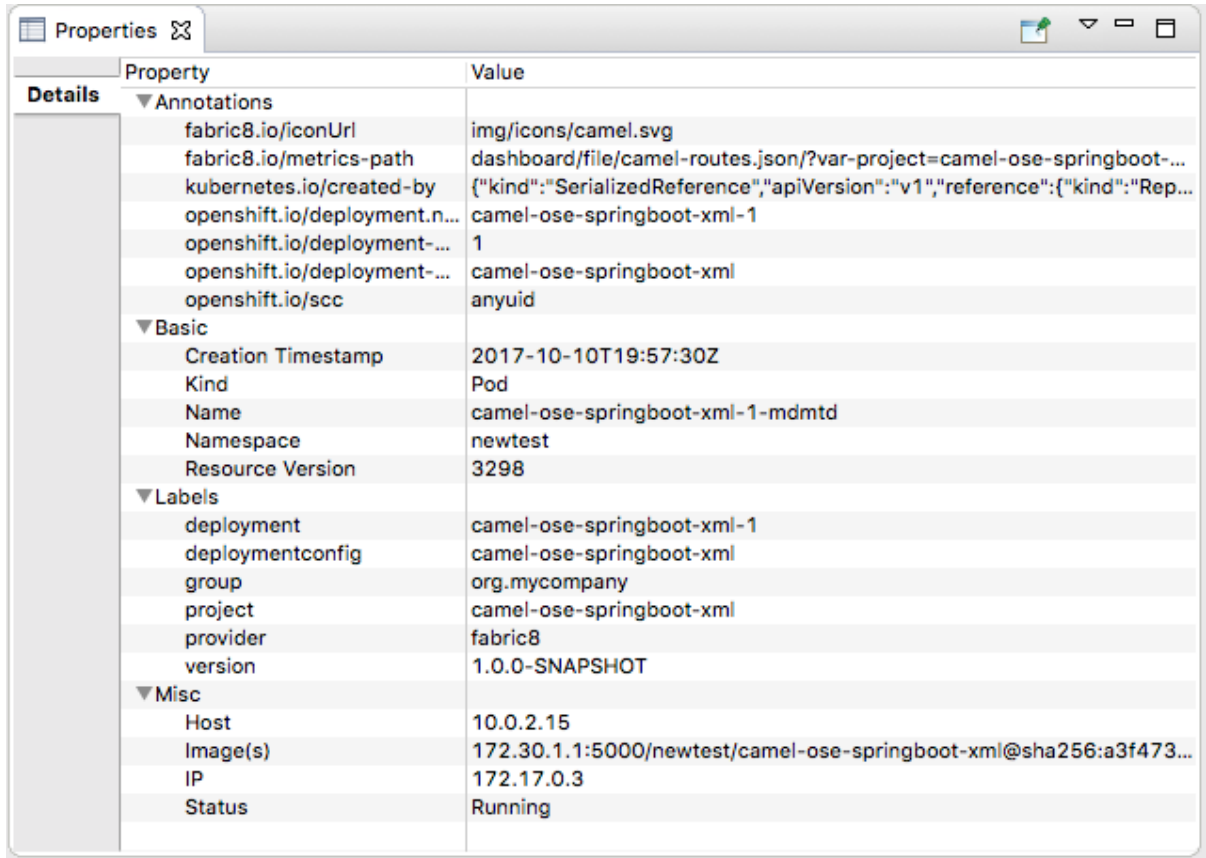
Open the other tabs (**Builds**, **Build Configs**, **Deployments**,...) to view other properties of the project. The **Properties** view provides the same information as the OpenShift Web Console.

- In the **OpenShift Explorer** view, select **camel-ose-springboot-xml** to view its details in the **Properties** view:

Property	Value
<b>Annotations</b>	
fabric8.io/iconUrl	img/icons/camel.svg
<b>Basic</b>	
Creation Timestamp	2017-10-10T19:57:26Z
Kind	Service
Name	camel-ose-springboot-xml
Namespace	newtest
Resource Version	3252
<b>Labels</b>	
expose	true
group	org.mycompany
project	camel-ose-springboot-xml
provider	fabric8
version	1.0.0-SNAPSHOT
<b>Misc</b>	
Container Port	8080
IP	172.30.122.129
Port	80
Selector	group=org.mycompany,project=camel-ose-springboot-xml,provider=fabric8

Scroll through the other tabs to view other properties of the deployment configuration.

9. In the **OpenShift Explorer** view, select **camel-ose-springboot-xml-1-mdmtd Pod Running**, and then view the details of the running instance in the **Properties** view:



The screenshot shows the 'Properties' view in OpenShift Explorer. The 'Details' section is expanded, showing a table of properties and their values. The properties are categorized into Annotations, Basic, Labels, and Misc.

Property	Value
<b>Annotations</b>	
fabric8.io/iconUrl	img/icons/camel.svg
fabric8.io/metrics-path	dashboard/file/camel-routes.json?var-project=camel-ose-springboot-...
kubernetes.io/created-by	{"kind": "SerializedReference", "apiVersion": "v1", "reference": {"kind": "Rep..."}}
openshift.io/deployment.n...	camel-ose-springboot-xml-1
openshift.io/deployment-...	1
openshift.io/deployment-...	camel-ose-springboot-xml
openshift.io/scc	anyuid
<b>Basic</b>	
Creation Timestamp	2017-10-10T19:57:30Z
Kind	Pod
Name	camel-ose-springboot-xml-1-mdmtd
Namespace	newtest
Resource Version	3298
<b>Labels</b>	
deployment	camel-ose-springboot-xml-1
deploymentconfig	camel-ose-springboot-xml
group	org.mycompany
project	camel-ose-springboot-xml
provider	fabric8
version	1.0.0-SNAPSHOT
<b>Misc</b>	
Host	10.0.2.15
Image(s)	172.30.1.1:5000/newtest/camel-ose-springboot-xml@sha256:a3f473...
IP	172.17.0.3
Status	Running

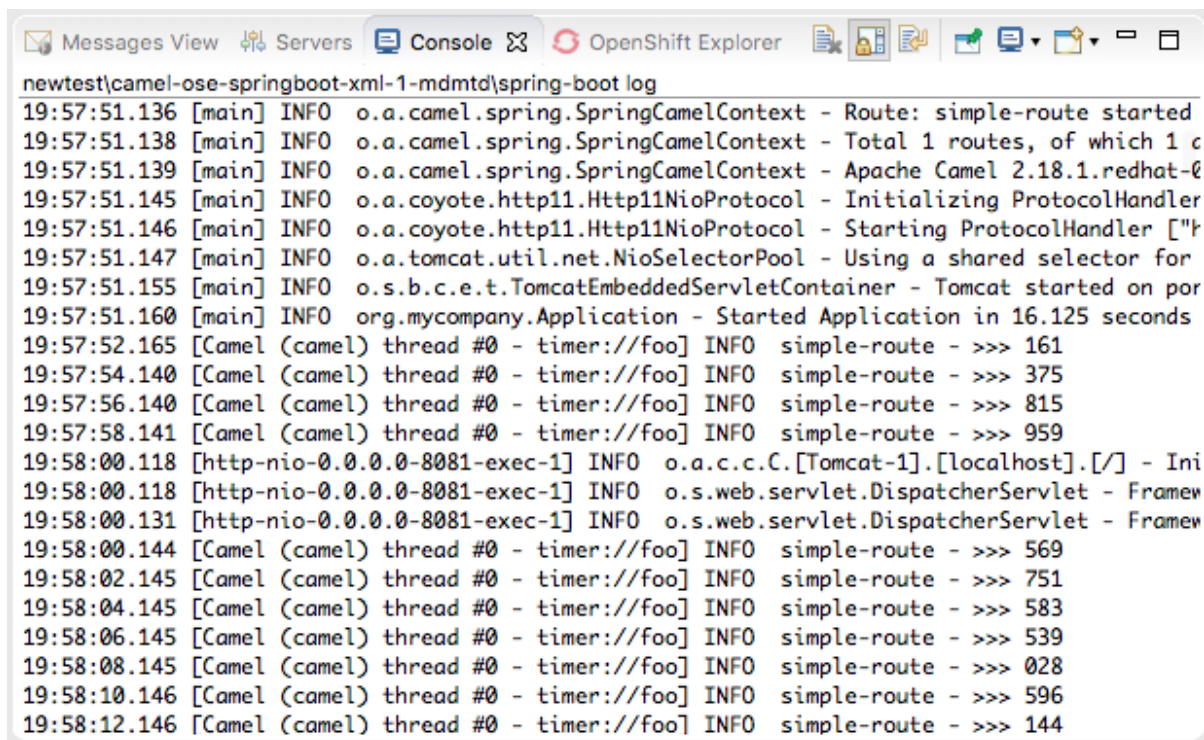
10. In the **OpenShift Explorer** view, right-click **camel-ose-springboot-xml-1-mdmtd Pod Running**, and then select **Pod Logs...**



#### NOTE

If prompted, enter the path to the installed **oc** executable. It is required to retrieve pod logs.


The **Console** view automatically opens, displaying the logs from the running pod:



```

newtest\camel-ose-springboot-xml-1-mdmtd\spring-boot log
19:57:51.136 [main] INFO o.a.camel.spring.SpringCamelContext - Route: simple-route started
19:57:51.138 [main] INFO o.a.camel.spring.SpringCamelContext - Total 1 routes, of which 1 c
19:57:51.139 [main] INFO o.a.camel.spring.SpringCamelContext - Apache Camel 2.18.1.redhat-0
19:57:51.145 [main] INFO o.a.coyote.http11.Http11NioProtocol - Initializing ProtocolHandler
19:57:51.146 [main] INFO o.a.coyote.http11.Http11NioProtocol - Starting ProtocolHandler ["t
19:57:51.147 [main] INFO o.a.tomcat.util.net.NioSelectorPool - Using a shared selector for
19:57:51.155 [main] INFO o.s.b.c.e.t.TomcatEmbeddedServletContainer - Tomcat started on por
19:57:51.160 [main] INFO org.mycompany.Application - Started Application in 16.125 seconds
19:57:52.165 [Camel (camel) thread #0 - timer://foo] INFO simple-route - >>> 161
19:57:54.140 [Camel (camel) thread #0 - timer://foo] INFO simple-route - >>> 375
19:57:56.140 [Camel (camel) thread #0 - timer://foo] INFO simple-route - >>> 815
19:57:58.141 [Camel (camel) thread #0 - timer://foo] INFO simple-route - >>> 959
19:58:00.118 [http-nio-0.0.0.0-8081-exec-1] INFO o.a.c.c.C.[Tomcat-1].[localhost].[/] - Ini
19:58:00.118 [http-nio-0.0.0.0-8081-exec-1] INFO o.s.web.servlet.DispatcherServlet - Framew
19:58:00.131 [http-nio-0.0.0.0-8081-exec-1] INFO o.s.web.servlet.DispatcherServlet - Framew
19:58:00.144 [Camel (camel) thread #0 - timer://foo] INFO simple-route - >>> 569
19:58:02.145 [Camel (camel) thread #0 - timer://foo] INFO simple-route - >>> 751
19:58:04.145 [Camel (camel) thread #0 - timer://foo] INFO simple-route - >>> 583
19:58:06.145 [Camel (camel) thread #0 - timer://foo] INFO simple-route - >>> 539
19:58:08.145 [Camel (camel) thread #0 - timer://foo] INFO simple-route - >>> 028
19:58:10.146 [Camel (camel) thread #0 - timer://foo] INFO simple-route - >>> 596
19:58:12.146 [Camel (camel) thread #0 - timer://foo] INFO simple-route - >>> 144

```

Click  in the **Console** view's menu bar to terminate the session and clear console output.

## 6.6. ACCESSING THE OPENSIFT WEB CONSOLE



### NOTE

This information applies to Red Hat Container Development Kit installations only.

To access the OpenShift web console, open a browser and enter the OpenShift server's URL, which is specific to your instance and your machine. For example, enter <https://192.168.99.100:8443>, in the browser's address field.

You can log into the web console either as a developer or as an administrator, using the default credentials:

- **Default developer role**  
Developer users can view only their own projects and the supplied OpenShift sample project, which demonstrates OpenShift v3 features. Developer users can create, edit and delete any project that they own that is deployed on OpenShift.
  - **Username - developer**
  - **Password - developer**
- **Default administrator role**  
An administrator user can view and access all projects on OpenShift (CDK). Administrator users can create, edit and delete, any project deployed on OpenShift.
  - **Username - admin**
  - **Password - admin**

For more information on using the OpenShift web console, see [Getting Started Guide](#).

## CHAPTER 7. USING THE RED HAT FUSE SAP TOOL SUITE

The Red Hat Fuse SAP Tool Suite makes it possible to integrate your Camel routes with a remote SAP Application Server. A variety of SAP components are provided to support Remote Function Calls (RFC) and the sending and receiving of Intermediate Documents (IDocs). The SAP Tool Suite depends on the JCo and IDoc client libraries from SAP. To install and use these libraries, you must have an SAP Service Marketplace Account.

### 7.1. INSTALLING THE RED HAT FUSE SAP TOOL SUITE

#### Overview

The Red Hat Fuse SAP Tool Suite provides the Edit SAP Connection Configuration dialog, which helps you to create and manage the SAP Application Server and Destination connections. The suite is not installed by default, because it requires third-party JCo and IDoc client libraries, which are licensed separately by SAP.

#### Platform restrictions for SAP tooling

Because the SAP tool suite depends on the third-party [JCo](#) and [IDoc](#) libraries, it can only be installed on the platforms that these libraries support. For details about the platform restrictions for SAP tooling, see [Red Hat Fuse 7.12 Supported Configurations](#) .

#### Prerequisites

- Before you can install the Fuse SAP Tool Suite, you must download the JCo and IDoc libraries from: <http://service.sap.com/connectors>
- To determine the appropriate JCo and IDoc libraries for your operating system, see the [Red Hat Fuse Supported Configurations](#) page.
- To download the JCo and IDoc libraries, you need an SAP Service Marketplace Account.
- For this installation procedure, you can leave the downloaded files in archive format. There is no need to extract the contents.

## CREATE AND TEST SAP DESTINATION CONNECTION

#### Overview

In Fuse SAP Tool suite, the Edit SAP Connection Configuration dialog helps you to create and manage the SAP Application Destination connections. This section describes how to create and test the SAP destination connection.

#### Procedure

To create and test an SAP destination connection, perform the following steps:

1. Navigate to the global **Configurations** tab of the route editor and click **Add**.  
The **Create new global element** view appears.
2. Under **SAP**, select the type of connection you would like to create. Choose the **SAP Connection** and click **Ok**.

The **Edit SAP Connection Configuration** dialog appears. It allows you to create, edit and delete the Destination and Server Connection Configurations.

3. To create a new **Destination Data Store**, click the **Add Destination** tab.  
The **Create Destination** dialog appears.
4. Enter a name for the destination in the **Destination Name** field and click **Ok**.
5. In the **Properties** dialog,
  - a. Click the **Basic** tab to configure the basic properties required to connect to an SAP destination. In this tab, fill in the following property fields to configure the connection:
    - **SAP Application Server**
    - **SAP System Number**
    - **SAP Client**
    - **Logon User**
    - **Logon Password**
    - **Logon Language**
  - b. Click the **Connection** tab to add values required to connect to an SAP destination. Fill in the following property fields to configure the connection:
    - **SAP System Number**
    - **SAP Router String**
    - **SAP Application Server**
    - **SAP Message Server**
    - **SAP Message Server Port**
    - **Gateway Host**
    - **Gateway Port**
    - **SAP System ID**
    - **SAP Application Server Group**
  - c. Click the **Authenticate** tab to add values required to validate an SAP destination. Fill in the following property fields to configure the connection.
    - **SAP Authentication type**
    - **SAP Client**
    - **Logon User**
    - **Logon User Alias**
    - **Logon Password**

- SAP SSO Logon Ticket
  - SAP X509 Login Ticket
  - Logon Language
- d. Click the **Special** tab. In this tab, fill in the following property fields to configure the connection:
- Select CPIC Trace
  - Initial Codepage
- e. Click the **Pool** tab and fill in the following property fields to configure the connection:
- Connection Pool Peak Limit
  - Connection Pool Capacity
  - Connection Pool Expiration Time
  - Connection Pool Expire Check Period
  - Connection Pool Max Get Client Time
- f. Click the **SNC** tab and fill in the following property fields to configure the connection:
- SNC Partner Name
  - SNC Level of Security
  - SNC Name
  - SNC Library Path
- g. Click the **Repository** tab and fill in the following property fields to configure the connection:
- Repository Destination
  - Repository Logon User
  - Repository Logon Password

**NOTE**

If you need more information about these settings, refer the SAP documentation.

6. You are now ready to test the destination connection. In the **Edit SAP Connection Configuration** dialog, right-click on the destination name and select **Test**. The **Test Destination Connection** dialog opens.
7. The dialog uses the current destination configuration settings to connect to the **SAP Destination Data Store**. If the test is successful, you will see the following message in the status area:

Connection test for destination 'YourDestination' succeeded.

Otherwise, an error report appears in the status area.

8. Click **Close** to close the **Test Destination Connection** dialog.
9. Click **Finish**. The newly created **SAP Destination Connection** appears under SAP.

## 7.2. CREATE AND TEST SAP SERVER CONNECTION

### Overview

In Fuse SAP Tool suite, the Edit SAP Connection Configuration dialog helps you to create and manage the SAP Application Server connections. This section describes how to create and test the SAP Server connection.

### Procedure

To create and test the SAP Server connection, perform the following steps:

1. Navigate to the global **Configurations** tab of route editor and click **Add**.  
The **Create new global element** view appears.
2. Under **SAP**, select the type of connection you would like to create. Choose the **SAP Connection** and click **Ok**.  
The **Edit SAP Connection Configuration** dialog appears. It allows you to create, edit and delete the Destination and Server Connection Configurations.
3. To create a new **Server Data Store**, click the **Add Server** tab.  
The **Create Server** dialog appears.
4. Enter a name for the Server in the **Server Name** field and click **Ok**.
5. In the **Properties** dialog,
  - a. Click the **Mandatory** tab to configure the basic properties required to connect to an SAP server. In this tab, fill in the following property fields to configure the connection:
    - **Gateway Host**
    - **Gateway Port**
    - **Program ID**
    - **Repository Destination**
    - **Connection Count**
  - b. Click the **Optional** tab and fill in the following property fields to configure the connection:
    - **SAP Router String**
    - **Worker Thread Count**
    - **Minimum Worker Thread Count**
    - **Maximum Startup Delay**

- **Repository Map**

c. Click the **SNC** tab and fill in the following property fields to configure the connection.

- **SNC Level of Security**
- **SNC Name**
- **SNC Library Path**

**NOTE**

For more information about the settings, refer the SAP documentation.

6. You are now ready to test the server connection. In the **Edit SAP Connection Configuration** dialog, right-click on the server name and select **Test**.

The **Test Server Connection** dialog opens.

7. The dialog uses the current server configuration settings to connect to the **SAP Server Data Store**. If the test is successful, you will see the following message in the status area:

```
Server state: STARTED
Server state: ALIVE
```

If the test fails, the server status is reported as **DEAD**.

8. Click **Stop** to shut down the Test Sever.

9. Click **Close** to close the **Test Server Connection** dialog.

10. Click **Finish**. The newly created **SAP Server Connection** appears under SAP.

## 7.3. DELETING DESTINATION AND SERVER CONNECTIONS

### Overview

This following section describes how to delete the SAP Destination and Server connections in the Edit SAP Connection Configuration dialog.

### Procedure

If you want to delete the Destination and Server connections, perform the following steps:

1. Navigate to the global **Configurations** tab of route editor and click **Add**.  
The **Create new global element** view appears.
2. Under **SAP**, select the **SAP Connection** and click **Ok**.  
The **Edit SAP Connection Configuration** dialog appears. It allows you to create, edit and delete the Destination and Server Connection Configurations.
3. In the **Edit SAP Connection Configuration** dialog, select the Destination and Server Data Stores which you want to delete.
4. Click **Delete**. It will delete the selected connections.

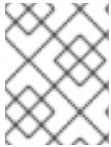


Atlast, click **Finish**. It will save all the changes.

## 7.4. CREATE A NEW SAP ENDPOINT

### Overview

You can use the Components palette in the route editor to add SAP components to a route with the help of the Edit SAP Connection Configuration dialog.



#### NOTE

If you are using the SAP Connection view, remember to paste the requisite SAP connection configuration data into your Blueprint XML or Spring XML code.

### Prerequisites

You must already have created some SAP destination connections and/or server connections with the help of the Edit SAP Connection Configuration dialog.



#### NOTE

If you are using the SAP Connection view, export this configuration to a file of the appropriate type (Blueprint XML or Spring XML).

### Procedure

To create a new SAP endpoint, perform the following steps:

1. It is assumed that you already have a Fuse project and a Camel XML file to work with (which could either be in Blueprint XML or Spring XML format).
2. Open your Camel XML file in the route editor. If you have already installed the Red Hat Fuse SAP Tool Suite, you should be able to see the SAP components under the **Components** palette in the route editor. The following SAP components are provided by the tool suite:
  - **SAP IDoc Destination**
  - **SAP IDoc List Destination**
  - **SAP IDoc List Server**
  - **SAP qRFC Destination**
  - **SAP Queued IDoc Destination**
  - **SAP Queued IDoc List Destination**
  - **SAP sRFC Destination**
  - **SAP sRFC Server**
  - **SAP tRFC Destination**
  - **SAP tRFC Server**

In the **Design** tab of the route editor, drag one of these components onto the canvas to create a new SAP endpoint in the current **camelContext**.

**NOTE**

The SAP Netweaver component does not belong to the Red Hat Fuse SAP Tool Suite. It is hosted in the Apache Camel project.

3. Switch to the **Source** tab of the route editor, by clicking the **Source** tab at the bottom of the canvas. You can see the XML source of the routes.
4. When specifying an SAP endpoint URI, you must embed either a destination name or a server connection name in the URI format. For example, the **sap-srfc-destination** component has the following URI format:

```
sap-srfc-destination:destinationName:rfcName
```

To reference a particular destination, use the value of the relevant **entry** element's **key** attribute as the **destinationName** in this URI.

## CHAPTER 8. GETTING STARTED WITH DATA TRANSFORMATION

One of the challenges that comes with system and data integration is that the component systems often work with different data formats. You cannot simply send messages from one system to another without translating it into a format (or language) recognized by the receiving system. Data transformation is the term given to this translation.

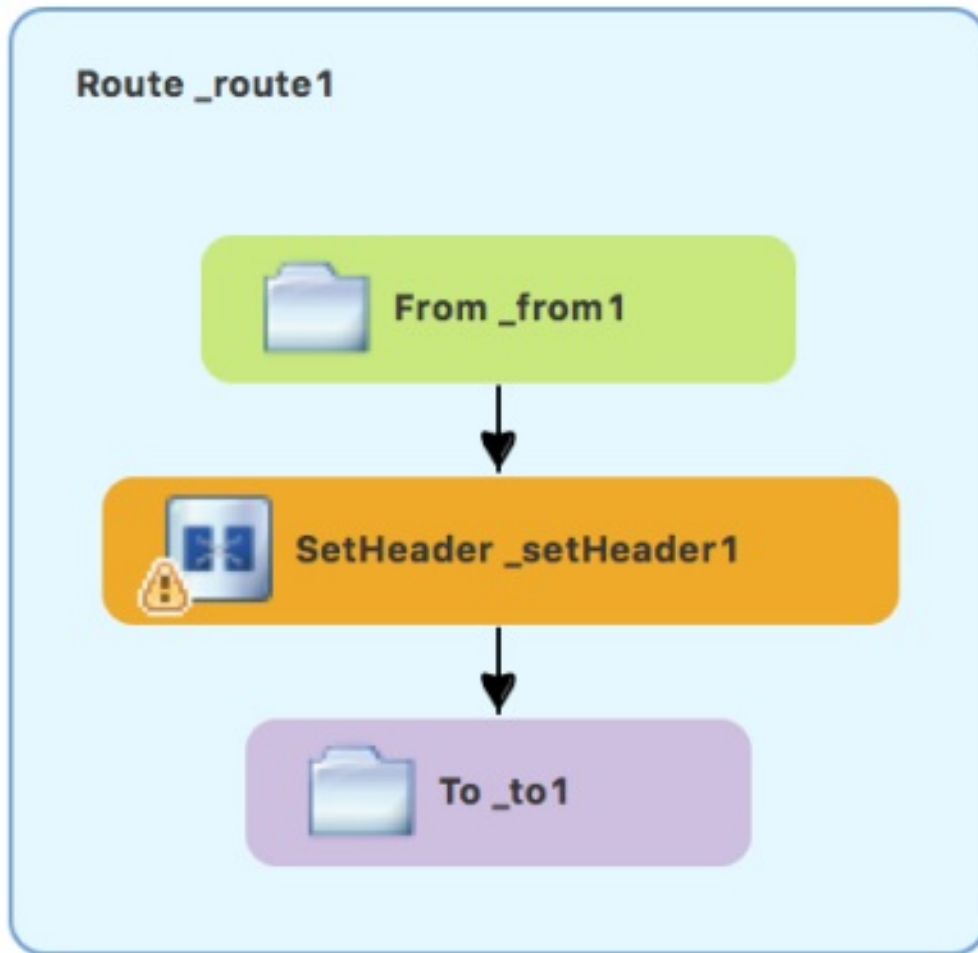
In this chapter, you learn how to include data transformation in a predefined Camel route. The Camel route directs messages from a source endpoint that produces XML data to a target endpoint that consumes JSON data. You add and define a data transformation component that maps the source's XML data format to the target's JSON data format.

### 8.1. CREATING A PROJECT FOR THE DATA TRANSFORMATION EXAMPLE

1. Create a new Fuse Integration Project (select **File** → **New** → **Fuse Integration Project**). Provide the following information in the wizard:
  - Project name: **starter**
  - Deployment platform: **Standalone**
  - Runtime environment: **Karaf/Fuse on Karaf**
  - Camel version: Use the default
  - Template: **Empty - Blueprint DSL**
2. Download the prepared data examples from: <https://github.com/FuseByExample/fuse-tooling-tutorials/archive/user-guide-11.1.zip>
3. Extract the **data** folder and the three files that it contains from the **user-guide-11.1.zip** archive into the Fuse Integration project's **src** directory (**starter/src/data**).
4. In the **Project Explorer** view, expand the starter project.
5. Double-click **Camel Contexts** → **src/main/resources/OSGI-INF/blueprint/blueprint.xml** to open the route in the route editor's **Design** tab.
6. Click the **Source** tab to view the underlying XML.
7. Replace `<route id="_route1"/>` with the following code:

```
<route id="_route1">
  <from id="_from1" uri="file:src/data?fileName=abc-order.xml&amp;noop=true"/>
  <setHeader headerName="approvalID" id="_setHeader1">
    <simple>AUTO_OK</simple>
  </setHeader>
  <to id="_to1" uri="file:target/messages?fileName=xyz-order.json"/>
</route>
```

8. Click the **Design** tab to return to the graphical display of the route:



## 8.2. ADDING A DATA TRANSFORMATION NODE TO THE CAMEL ROUTE

1. In the **Palette**, expand the **Transformation** drawer.
2. Click the **Data Transformation** pattern and then, in the canvas, click the arrow between the **SetHeader\_setHeader1** and **To\_to1** nodes.  
The **New Transformation** wizard opens with the **Dozer File Path** field auto-filled.

**New Fuse Transformation**

**New Transformation**

Supply the ID, project, and path, as well as the source and target types for the transformation.

Transformation ID:

Dozer File Path:  ...

Types Transformed

Source Type  → Target Type


? < Back Next > Cancel Finish


3. Fill in the remaining fields:

- In the **Transformation ID** field, enter **xml2json**.
- For **Source Type**, select **XML** from the drop-down menu.
- For **Target Type**, select **JSON** from the drop-down menu.

4. Click **Next**.



The **Source Type (XML)** definition page opens, where you specify either an **XML Schema** (default) or an example **XML Instance Document** to provide the type definition of the source data:


**Source Type (XML)** 

 A source file path must be supplied for the transformation.


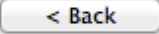
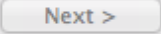
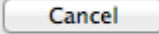
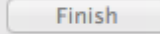
XML Type Definition

XML Schema  
 XML Instance Document

Source File:   

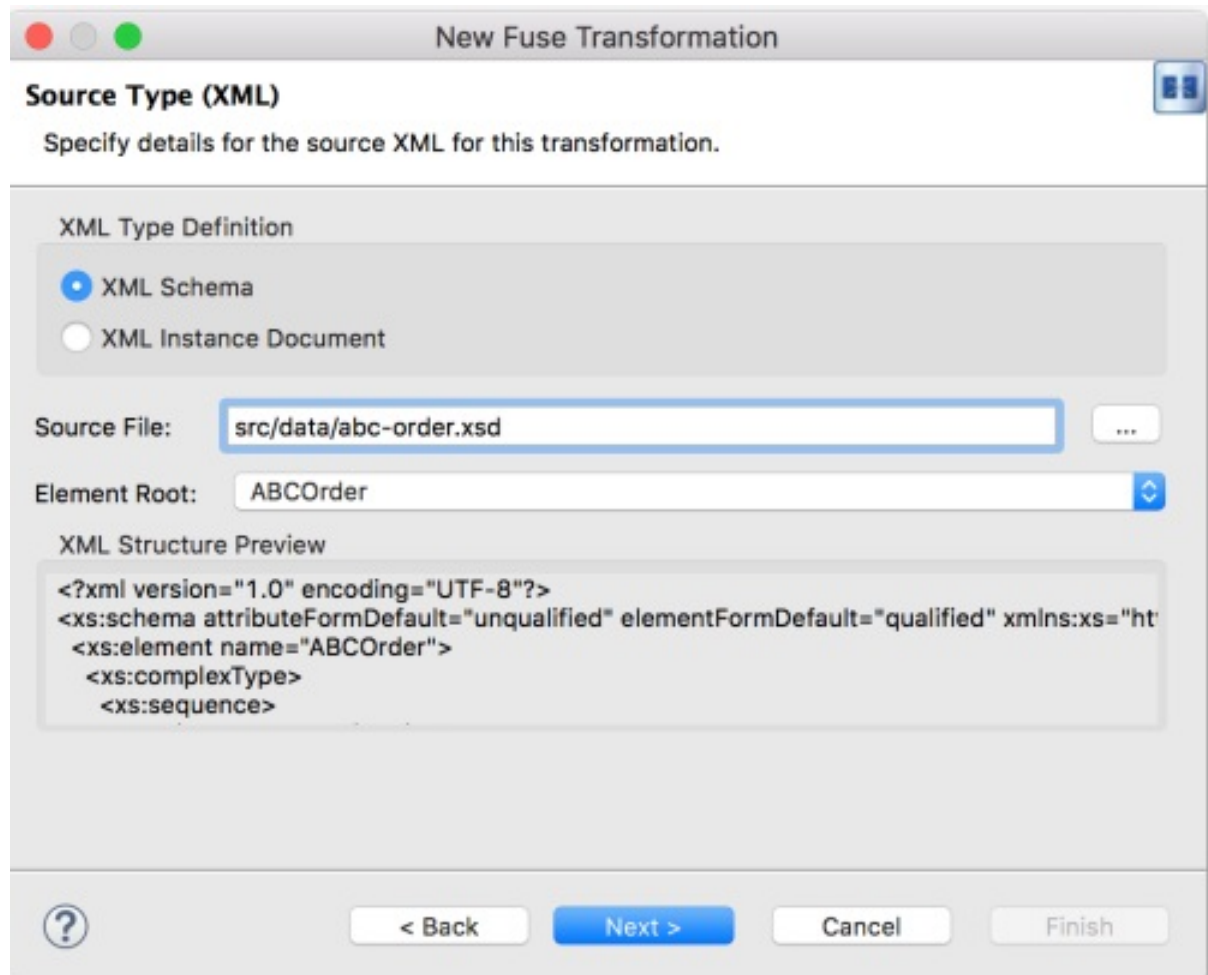
Element Root: 

XML Structure Preview

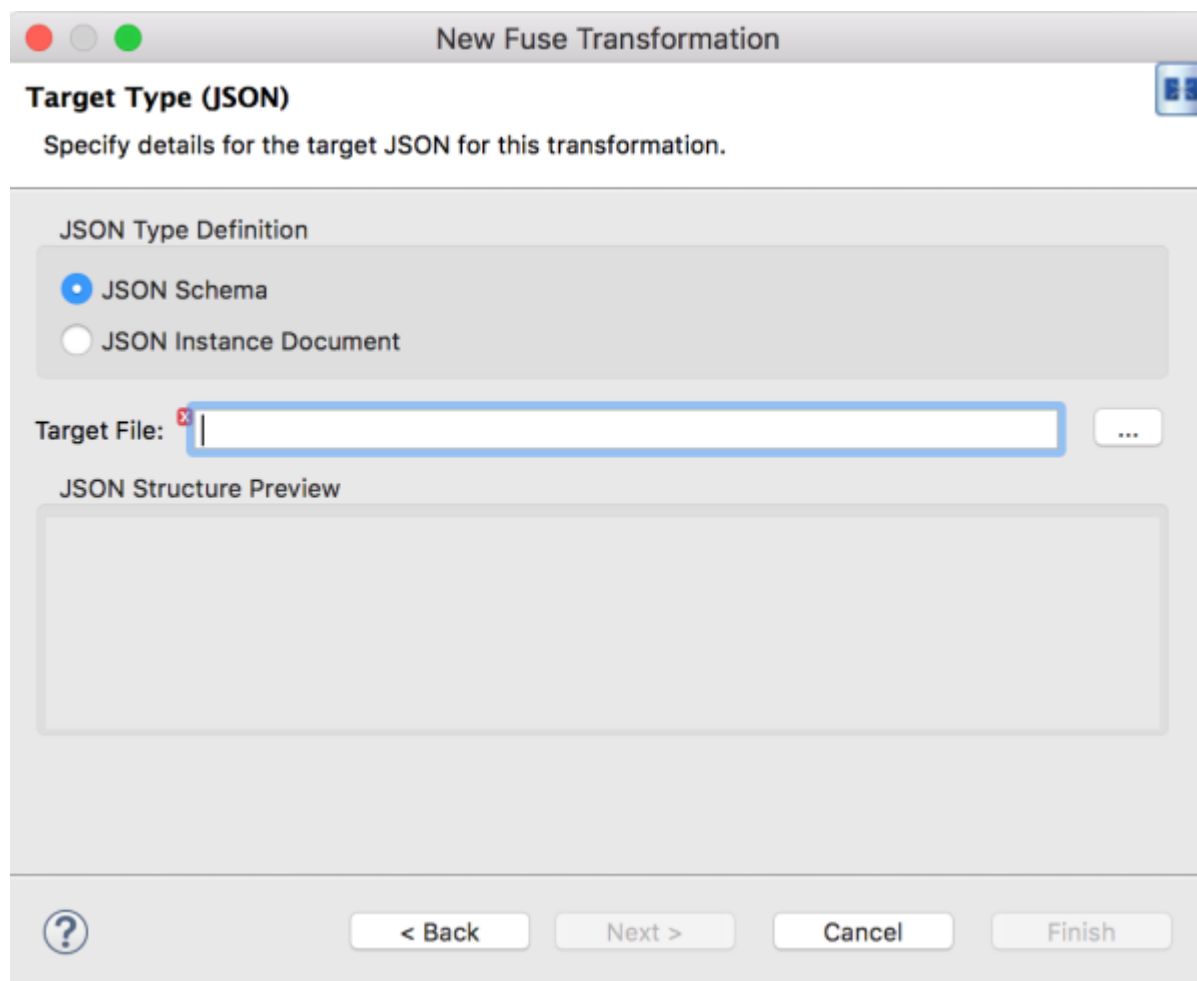
    

5. Leave **XML Schema** enabled.
6. For **Source file**, browse to the location of the XML schema file or the XML instance file to use for the type definition of the source data, and select it (in this case, **abc-order.xsd**). The **XML Structure Preview** pane displays a preview of the XML structure.
7. In the **Element root** field, enter **ABCOrder**. The tooling uses this text to label the pane that displays the source data items to map.

The **Source Type (XML)** definition page should now look like this:



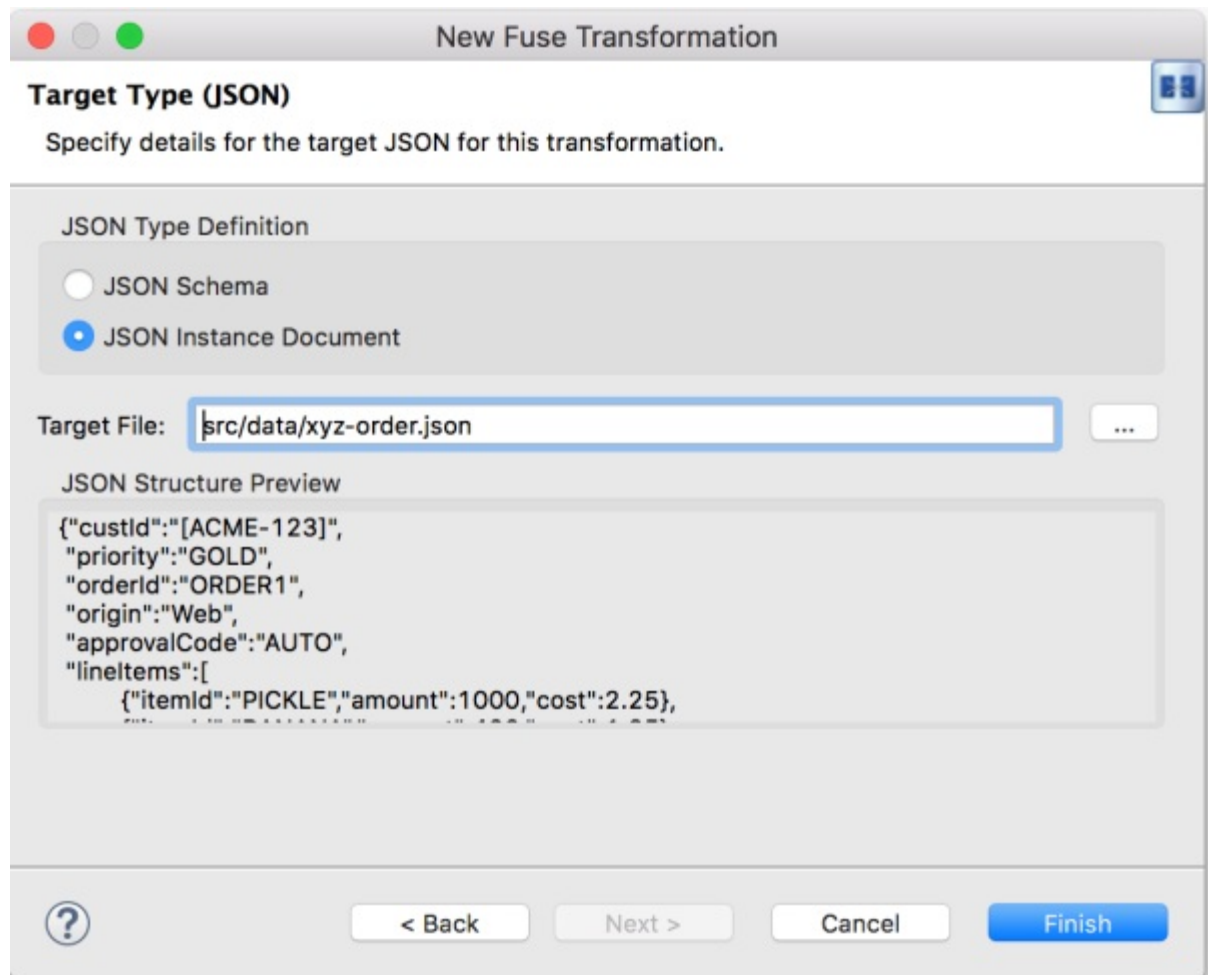
8. Click **Next** to open the **Target Type (JSON)** definition page. This is where you specify the type definition for the target data.



9. Click **JSON Instance Document**.

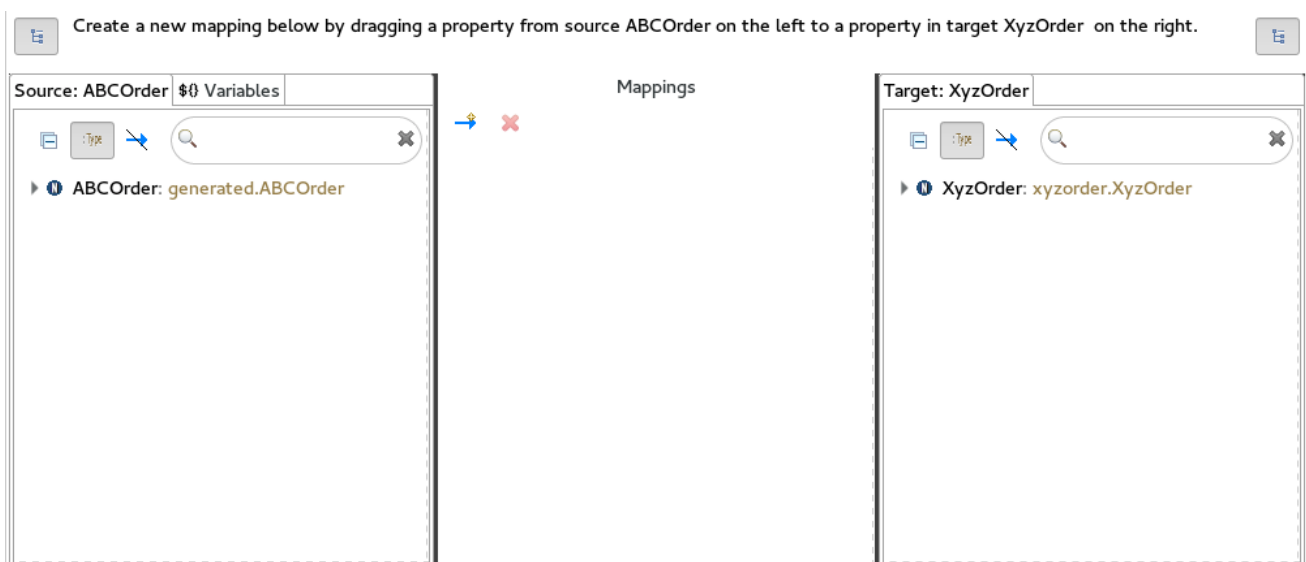
In the **Target File** field, enter the path to the **xyz-order.json** instance document, or browse to it. The **JSON Structure Preview** pane displays a preview of the JSON data structure:





10. Click **Finish**.

The transformation editor opens. This is where you can map data items in your XML source to data items in your JSON target.

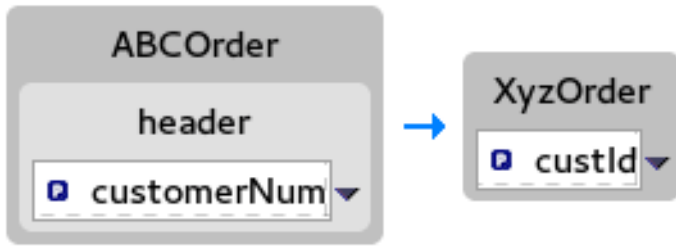


The transformation editor is composed of three panels:

- **Source** – lists the available data items of the source
- **Mappings** – displays the mappings between the source and target data items

- **Target** – lists the available data items of the target

In addition, the editor’s details pane, located just below the editor’s three panels (once the first mapping has been made), graphically displays the hierarchical ancestors for both the mapped source and target data items currently selected. For example:

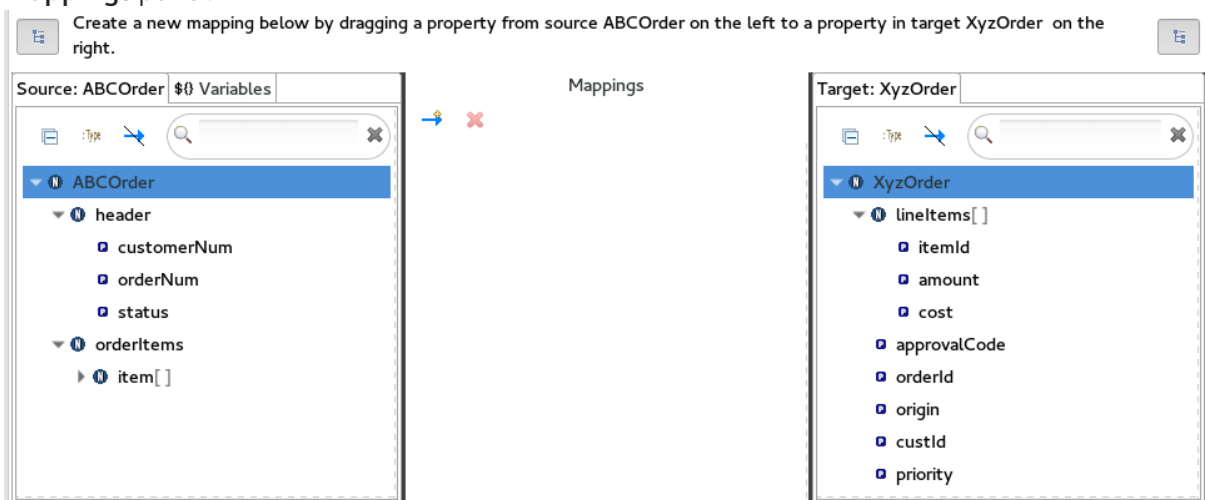


Using the details pane, you can customize the mapping for the selected source and target data items:

- **Set property** – Modify an existing mapping or map a simple data item to one in a collection (see [Section 8.8, “Mapping a simple data item to a data item in a collection”](#) ).
- **Set variable** – Specify a constant value for a data item (see [Section 8.5, “Mapping a constant variable to a data item”](#)).
- **Set expression** – Map a data item to the dynamic evaluation of a specified expression (see [Section 8.6, “Mapping an expression to a data item”](#) ).
- **Add transformation** – Modify the value of a mapped data item using a built-in function (see [Section 8.9, “Adding a built-in function to a mapped data item”](#) ).
- **Add custom transformation** – Modify the value of a mapped data item using the Java method you create or one you previously created (see [Section 8.7, “Adding a custom transformation to a mapped data item”](#)).

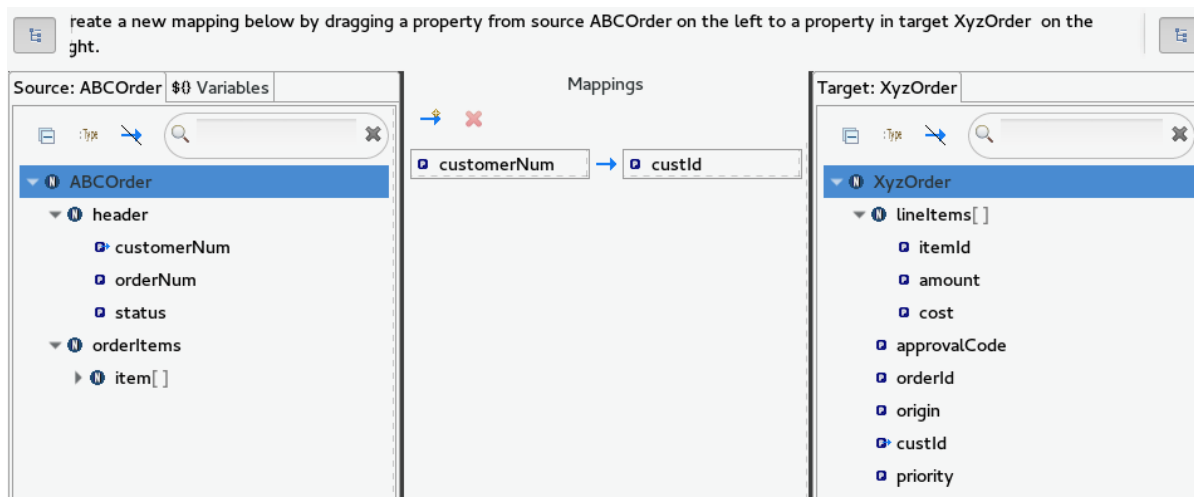
### 8.3. MAPPING SOURCE DATA ITEMS TO TARGET DATA ITEMS

1. Expand all items in the **Source** and **Target** panels located on left and right sides of the **Mappings** panel.



2. Drag a data item from the **Source** panel and drop it on its corresponding data item in the **Target** panel.

For example, drag the **customerNum** data item from the **Source** panel and drop it on the **custId** data item in the **Target** panel.



The mapping appears in the **Mappings** panel, and the details of both the **Source** and **Target** data items appear below in the details pane.


- Continue dragging and dropping source data items onto their corresponding target data items until you have completed all basic mappings. In the **starter** example, the remaining data items to map are:

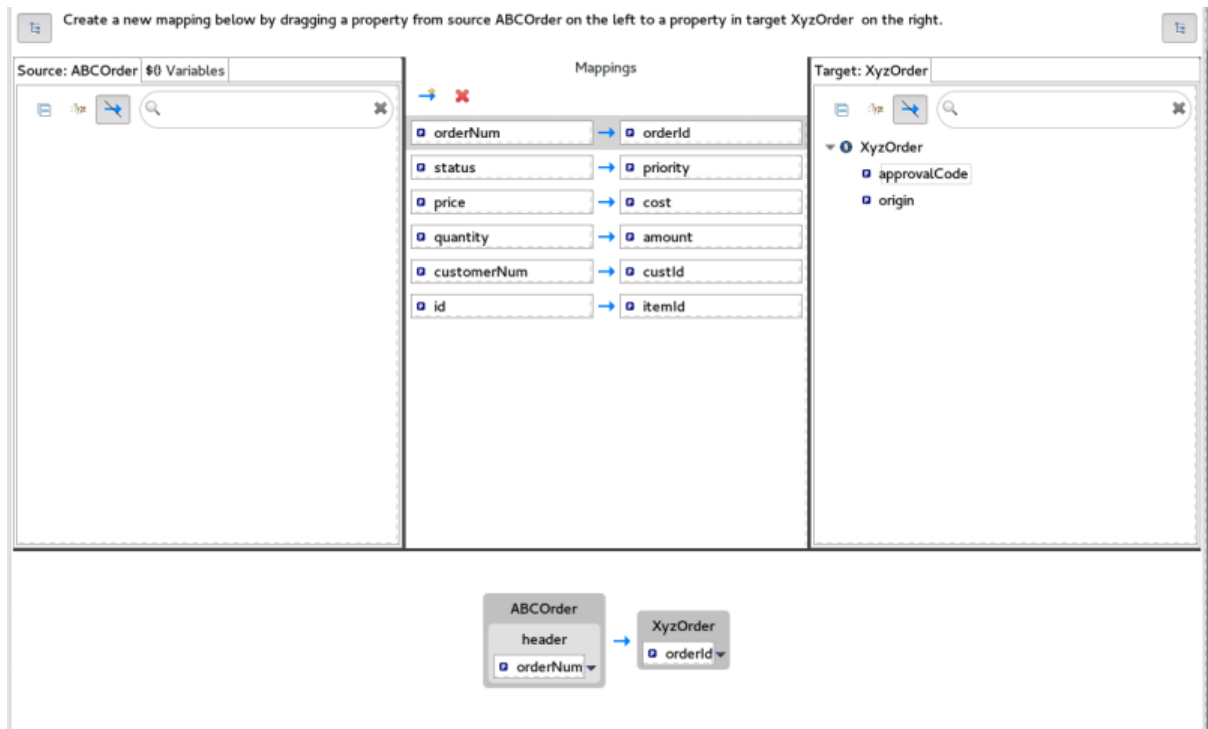
Source	Target
<b>orderNum</b>	<b>orderId</b>
<b>status</b>	<b>priority</b>
<b>id</b>	<b>itemId</b>
<b>price</b>	<b>cost</b>
<b>quantity</b>	<b>amount</b>



#### NOTE

You can map collections (data items containing lists or sets) to non-collection data items and vice versa, but you cannot map collections to other collections.

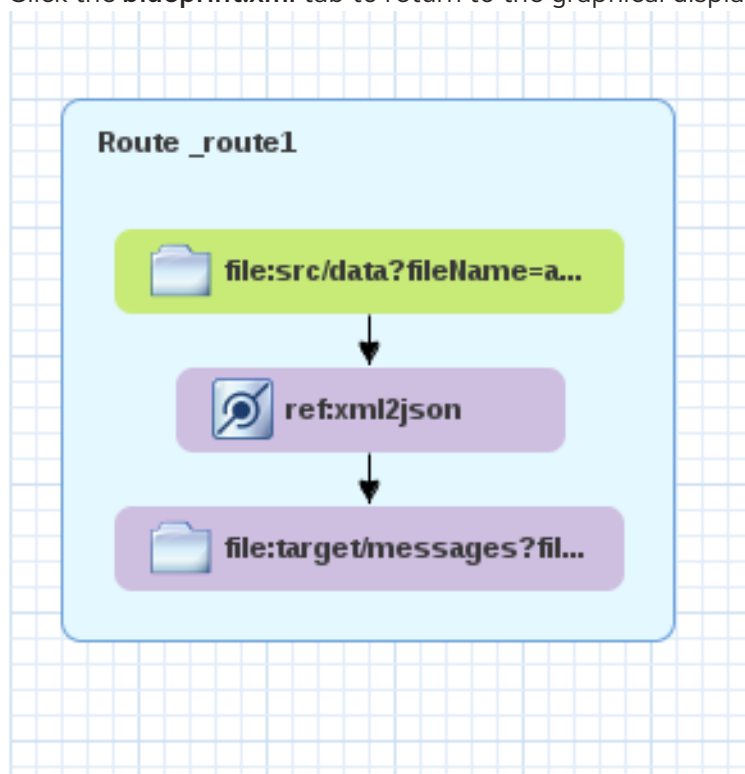
- Click  on both the **Source** and **Target** panels to quickly determine whether all data items have been mapped.



Only data items that have not been mapped are listed in the **Source** and **Target** panels.

In the **starter** example, the remaining unmapped **Target** attributes are **approvalCode** and **origin**.

5. Click the **blueprint.xml** tab to return to the graphical display of the route:



6. Click **File** → **Save**.

You can run a JUnit test on your transformation file after you create the transformation test. For details, see [Section 8.4, "Creating the transformation test file and running the JUnit test"](#). If you do so at this point, you will see this output in the **Console** view:

For the source XML data:

```
<?xml version="1.0" encoding="UTF-8"?>
<ABCOrder xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:java="http://java.sun.com">
  <header>
    <status>GOLD</status>
    <customer-num>ACME-123</customer-num>
    <order-num>ORDER1</order-num>
  </header>
  <order-items>
    <item id="PICKLE">
      <price>2.25</price>
      <quantity>1000</quantity>
    </item>
    <item id="BANANA">
      <price>1.25</price>
      <quantity>400</quantity>
    </item>
  </order-items>
</ABCOrder>
```

For the target JSON data:

```
{"custId":"ACME-123","priority":"GOLD","orderId":"ORDER1","lineItems":[{"itemId":"PICKLE",
"amount":1000,"cost":2.25},{"itemId":"BANANA","amount":400,"cost":1.25}
```

## 8.4. CREATING THE TRANSFORMATION TEST FILE AND RUNNING THE JUNIT TEST

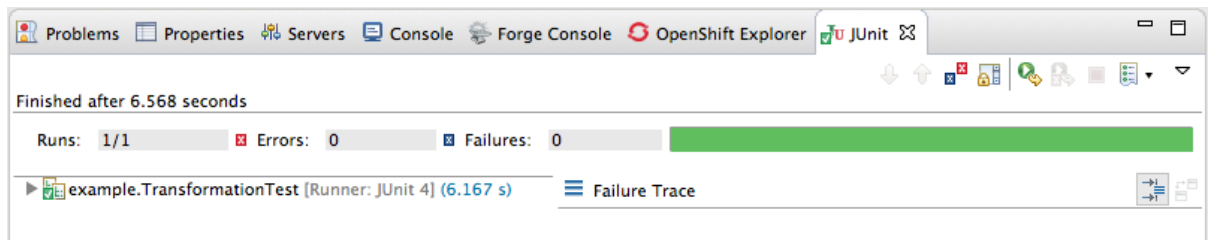
1. Right-click the **starter** project in the **Project Explorer** view, and select **New** → **Other** → **Fuse Tooling** → **Fuse Transformation Test**
2. Select **Next** to open the **New Transformation Test** wizard.
3. In the **New Transformation Test** wizard, set the following values:

Field	Value
Package	<b>example</b>
Camel File Path	<b>OSGI-INF/blueprint/blueprint.xml</b>
Transformation ID	<b>xml2json</b>

4. Click **Finish**.
5. In the **Project Explorer** view, navigate to **starter/src/test/java/example**, and open the **TransformationTest.java** file.
6. Add the following code to the **transform** method:

```
startEndpoint.sendBodyAndHeader(readFile("src/data/abc-order.xml"), "approvalID",
"AUTO_OK");
```

- Click **File** → **Save**.  
You can now run a JUnit test on your transformation file at any point in these tutorials.
- In the **Project Explorer** view, expand the **starter** project to expose the **/src/test/java/example/TransformationTest.java** file.
- Right click it to open the context menu, and select **Run as JUnit Test**  
The JUnit Test pane opens to display the status of the test. To avoid cluttering your workspace, drag and drop the pane in the bottom panel near the **Console** view.



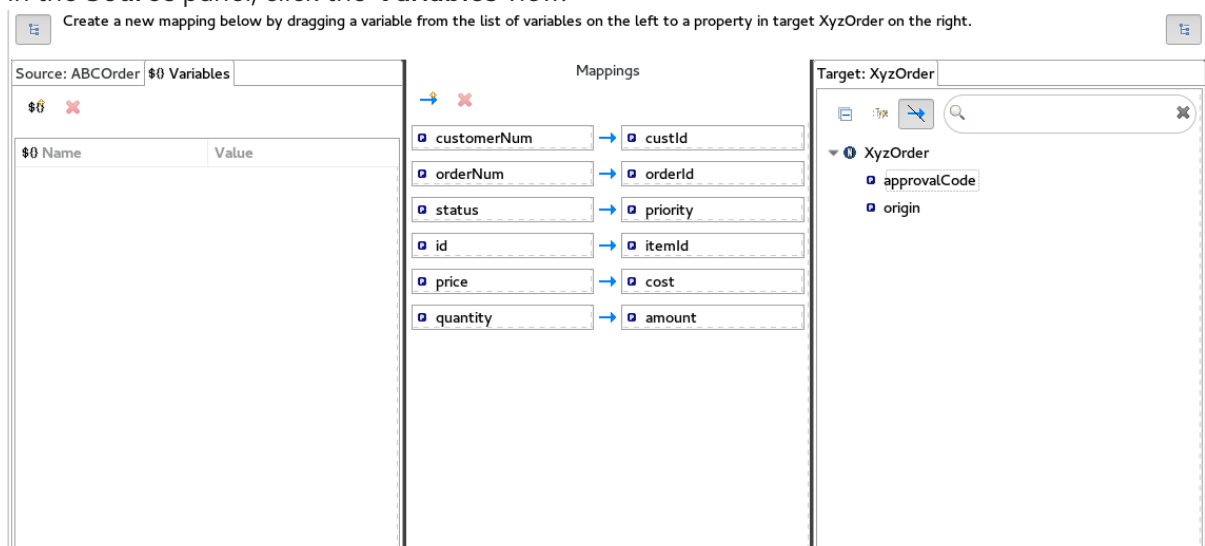
- Open the **Console** view to see the log output.

## 8.5. MAPPING A CONSTANT VARIABLE TO A DATA ITEM

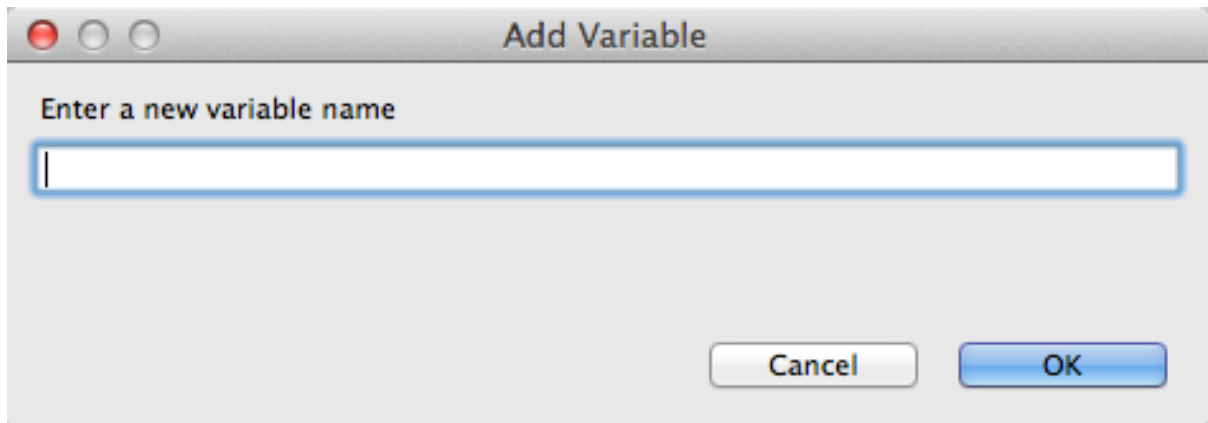
When a source/target data item has no corresponding target/source data item, you can map a constant variable to the existing data item.

In the **starter** example, the target data item **origin** does not have a corresponding source data item. To map the **origin** attribute to a constant variable:

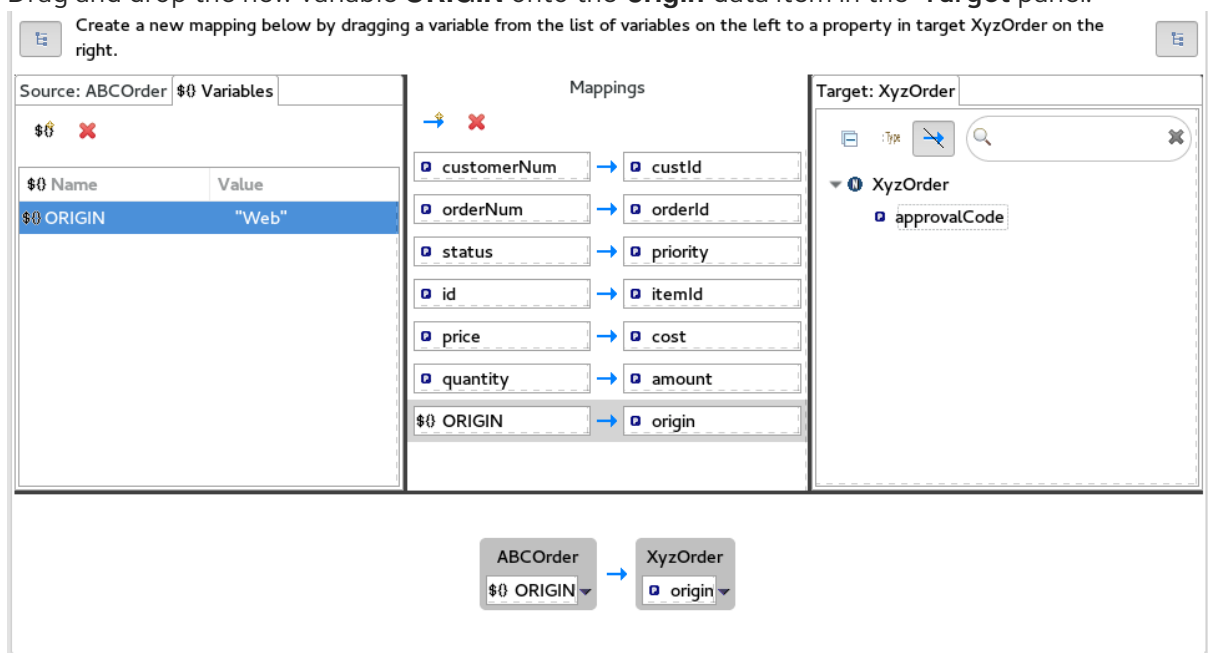
- In the **Source** panel, click the **Variables** view.



- In the **Variables** view, click  to open the **Enter a new variable name** dialog.



3. Enter a name for the variable you want to create.  
For the **starter** example, enter **ORIGIN**.
4. Click **OK**.  
The newly created variable **ORIGIN** appears in the **Variables** view in the **Name** column and the default value **ORIGIN** in the **Value** column.
5. Click the default value to edit it, and change the value to **Web**.
6. Press **Enter**.
7. Drag and drop the new variable **ORIGIN** onto the **origin** data item in the **Target** panel.



The new mapping of the variable **\$(ORIGIN)** appears in the **Mappings** panel and in the details pane.


8. Run a JUnit test on your **TransformationTest.java** file. For details, see [Section 8.4, "Creating the transformation test file and running the JUnit test"](#).  
The **Console** view displays the JSON-formatted output data:

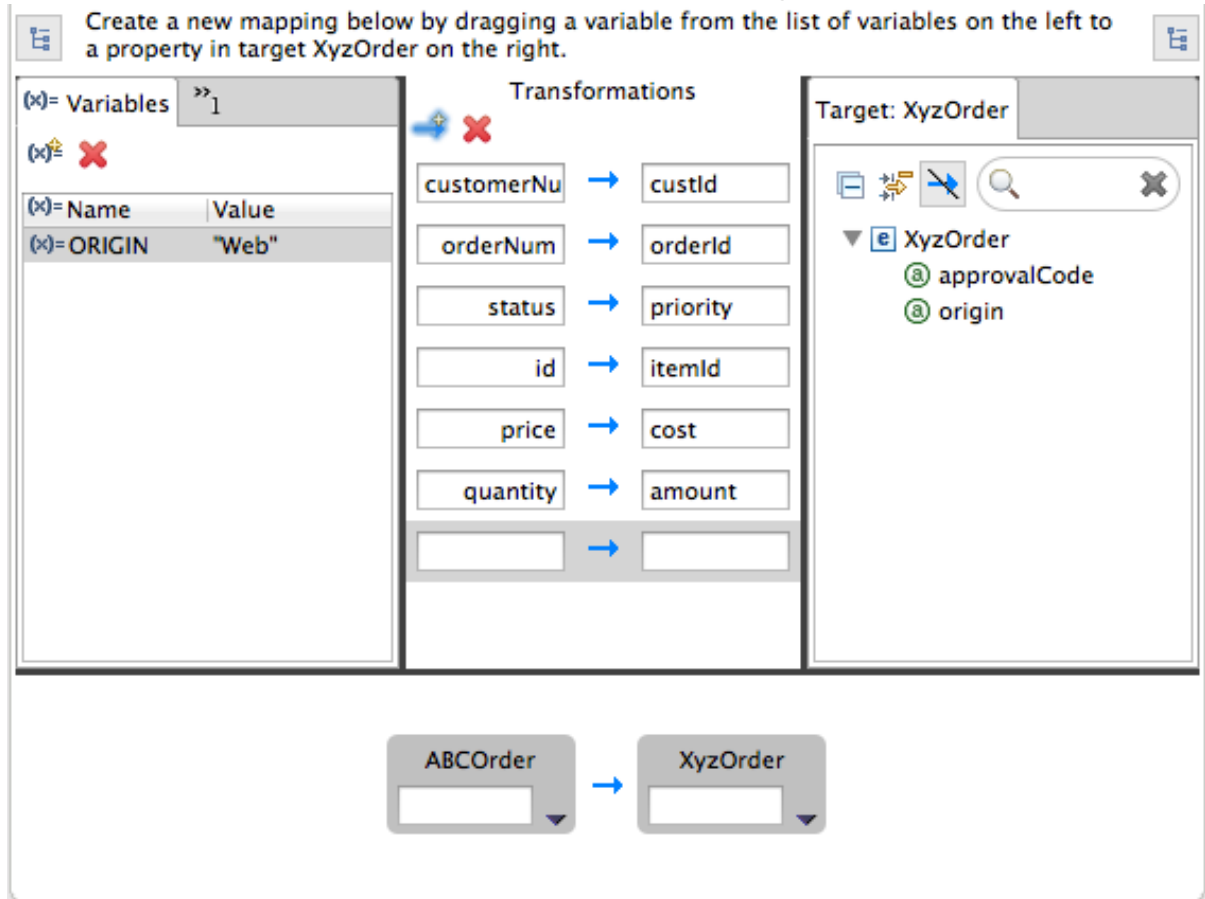
```
{
  "custId": "ACME-123",
  "priority": "GOLD",
  "orderId": "ORDER1",
  "origin": "Web",
  "approvalCode": "AUTO_OK",
  "lineItems": [
    {
      "itemId": "PICKLE",
      "amount": 1000,
      "cost": 2.25
    },
    {
      "itemId": "BANANA",
      "amount": 400,
      "cost": 1.25
    }
  ]
}
```

## 8.6. MAPPING AN EXPRESSION TO A DATA ITEM

This feature enables you, for example, to map a target data item to the dynamic evaluation of a Camel language expression.

Use the target **approvalCode** data item, which lacks a corresponding source data item:

1. Click  to add an empty transformation map to the **Mappings** panel.



The screenshot shows the mapping tool interface with the following components:

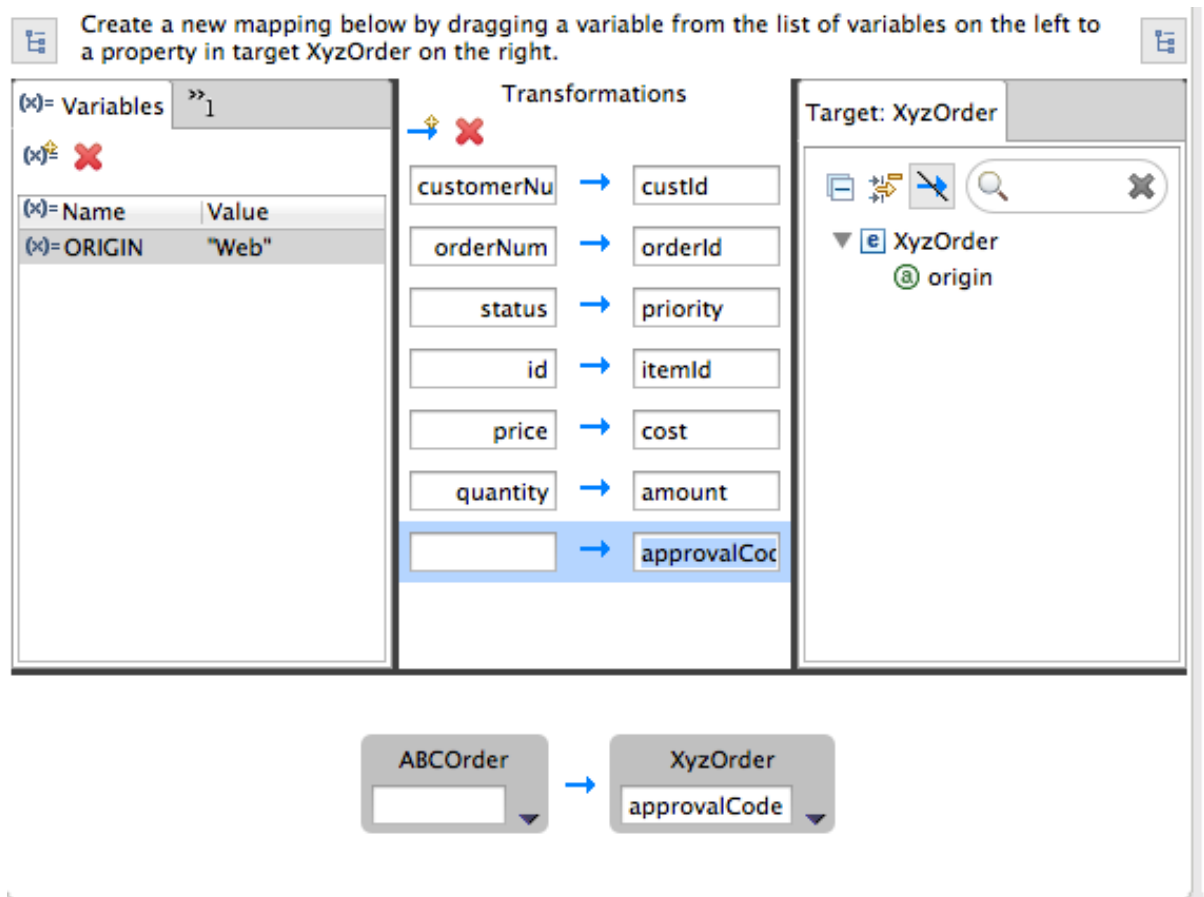
- Variables Panel:** A table with columns 'Name' and 'Value'. It contains one entry: 'ORIGIN' with the value 'Web'.
- Transformations Panel:** A list of source-to-target mappings:
 

customerNu	→	custId
orderNum	→	orderId
status	→	priority
id	→	itemId
price	→	cost
quantity	→	amount
	→	
- Target Panel:** Titled 'Target: XyzOrder', it shows a tree view with 'XyzOrder' expanded to reveal 'approvalCode' and 'origin'.
- Source/Target Selection:** At the bottom, two dropdown menus are shown: 'ABCOrder' on the left and 'XyzOrder' on the right, connected by a blue arrow.

At the top of the interface, a message reads: "Create a new mapping below by dragging a variable from the list of variables on the left to a property in target XyzOrder on the right."

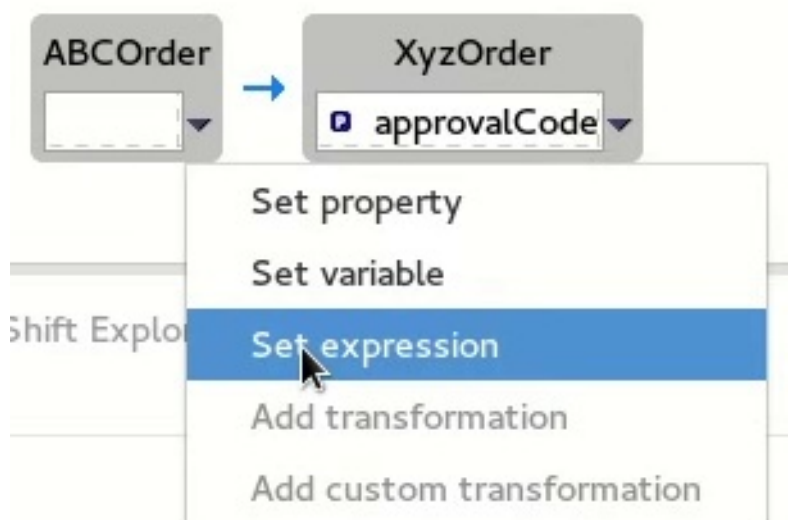
2. From the **Target** panel, drag and drop the **approvalCode** data item to the target field of the newly created mapping in the **Mappings** panel.





The **approvalCode** data item also appears in the details pane's target box.

- In the details pane, click ▼ on the **ABCOrder** source box to open the drop-down menu.



Menu options depend on the selected data item's data type. The available options are bolded.

- Select **Set expression** to open the **Expression** dialog.

**Expression**

Select the expression language, then specify details for the expression.

Language:

Details

Value

Expression:

Script

Source:

Path:

- In **Language**, select the expression language to use from the list of those available. Available options depend on the data item's data type. For the **starter** example, select **Header**.

- In the details pane, select the source of the expression to use. The options are **Value** and **Script**.

For the **starter** example, click **Value**, and then enter **ApprovalID**.

- Click **OK**.

Create a new mapping below by dragging a variable from the list of variables on the left to a property in target XyzOrder on the right.

(x)= Name	Value
(x)= ORIGIN	"Web"

Transformations

customerNu	→	custId
orderNum	→	orderId
status	→	priority
id	→	itemId
price	→	cost
quantity	→	amount
header	→	approvalCoc

Target: XyzOrder

- XyzOrder
  - @ origin

ABCOOrder → XyzOrder

header → approvalCode

Both the **Mappings** panel and the details pane display the new mapping for the target data item **approvalCode**.

- Run a JUnit test on your **TransformationTest.java** file. For details, see [Section 8.4, “Creating the transformation test file and running the JUnit test”](#).

The **Console** view displays the JSON-formatted output data:

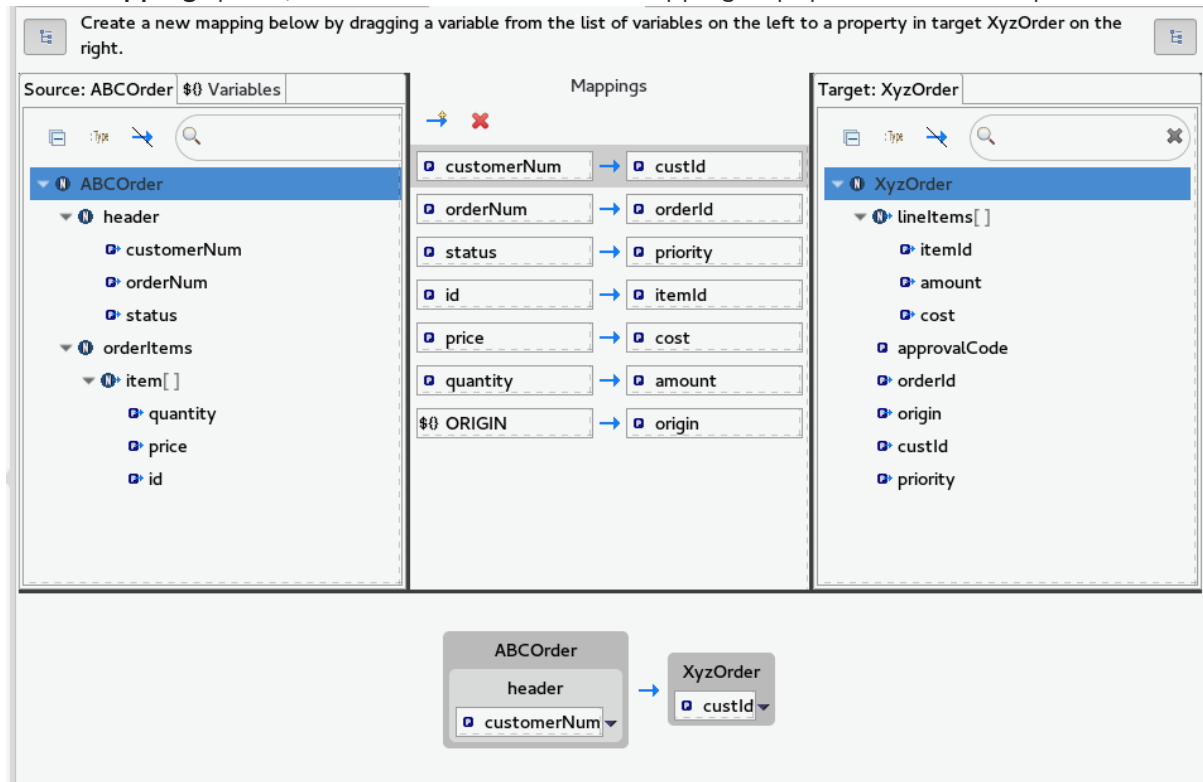
```
{ "custId": "ACME-123", "priority": "GOLD", "orderId": "ORDER1", "origin": "Web",
  "approvalCode": "AUTO_OK", "lineItems": [ { "itemId": "PICKLE", "amount": 1000, "cost": 2.25 },
  { "itemId": "BANANA", "amount": 400, "cost": 1.25 } ] }
```

## 8.7. ADDING A CUSTOM TRANSFORMATION TO A MAPPED DATA ITEM

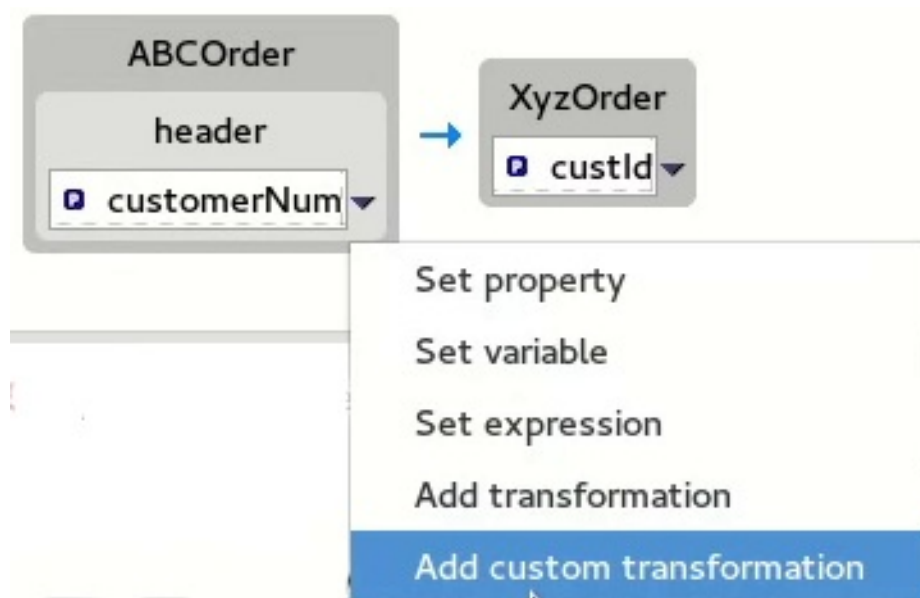
You may need to modify the formatting of source data items when they do not satisfy the requirements of the target system.

For example, to satisfy the target system’s requirement that all customer IDs be enclosed in brackets:

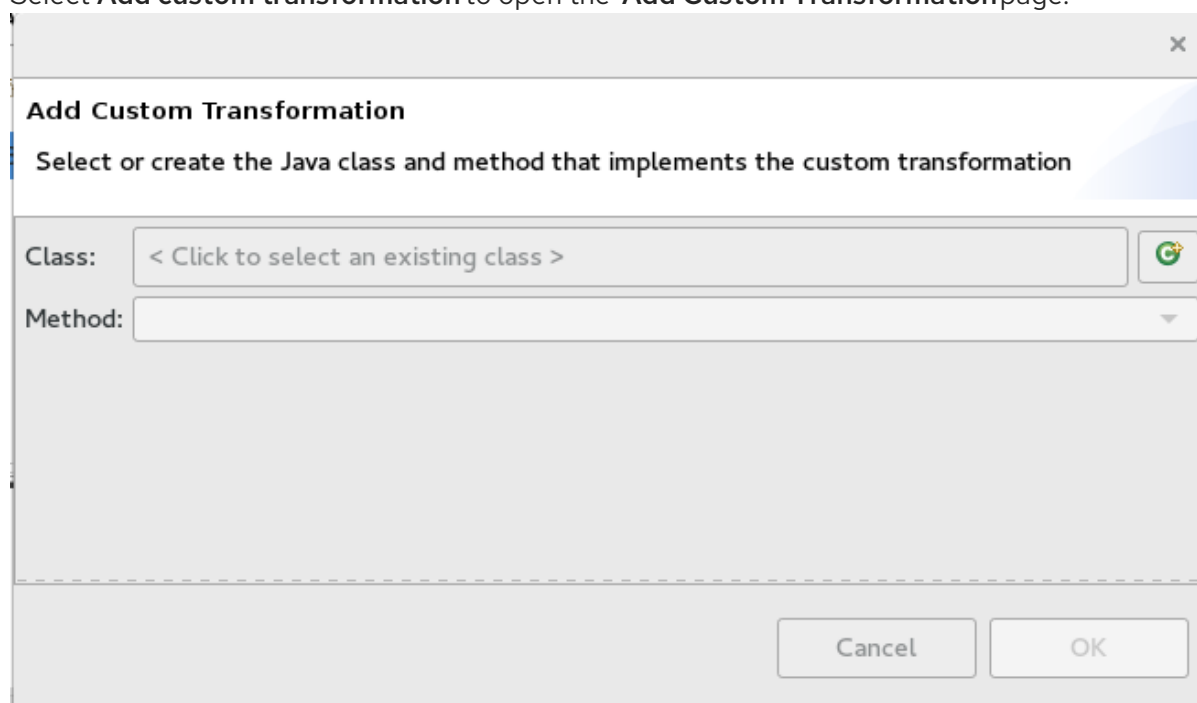
- In the **Mappings** panel, select the **customerNum** mapping to populate the details pane.



- In the details pane, click  on the **ABCOrder** source box to open the drop-down menu.



3. Select **Add custom transformation** to open the **Add Custom Transformation** page.



4. Click  next to the **Class** field to open the **Create a New Java Class** wizard.

**New Java Class**

Java Class

Create a new Java class.

Source folder:

Package:

Name:

Superclass:

Interfaces:

Custom Transformation

Return Type	Method Name	Parameter Type
<input type="text" value="java.lang.String"/>	<input type="text" value="map"/>	<input type="text" value="( java.lang.String input)"/>

Which method stubs would you like to create?

public static void main(String[] args)

Constructors from superclass

Inherited abstract methods

Do you want to add comments? (Configure templates and default value [here](#))

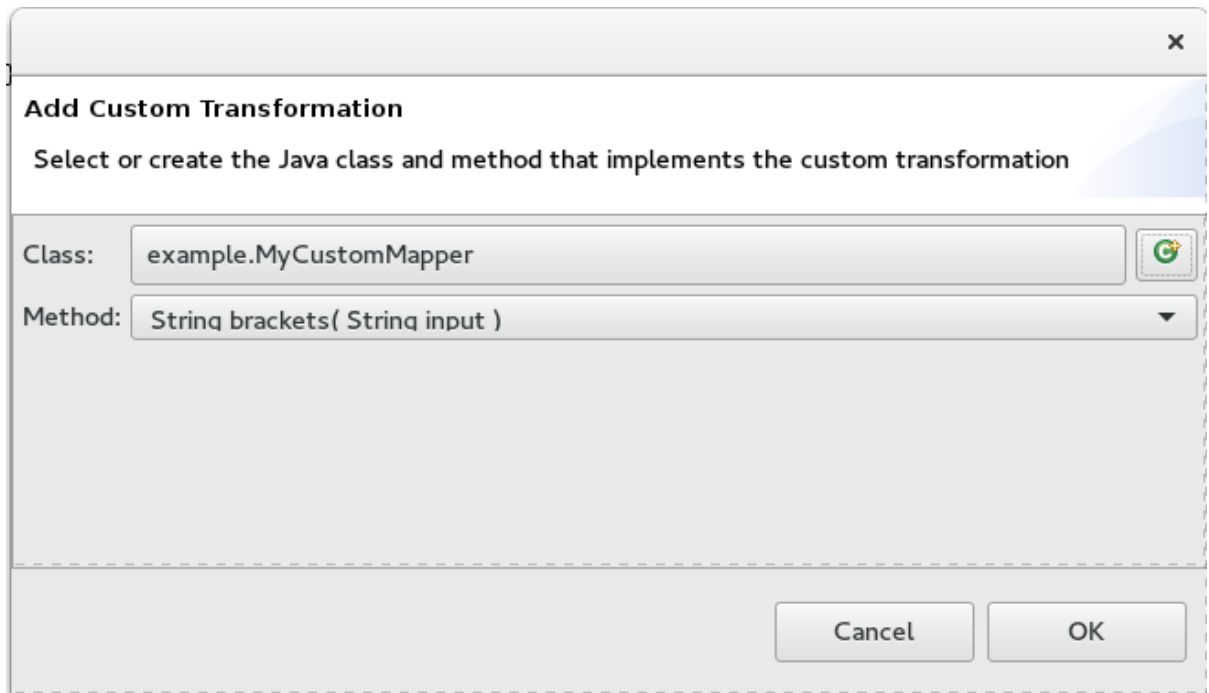
Generate comments

5. Modify the following fields:

- **Package** – Enter **example**.
- **Name** – Enter **MyCustomMapper**.
- **Method Name** – Change **map** to **brackets**.  
Leave all other fields as is.

6. Click **Finish**.

The **Add Custom Transformation** page opens with the **Class** and **Method** fields auto filled:



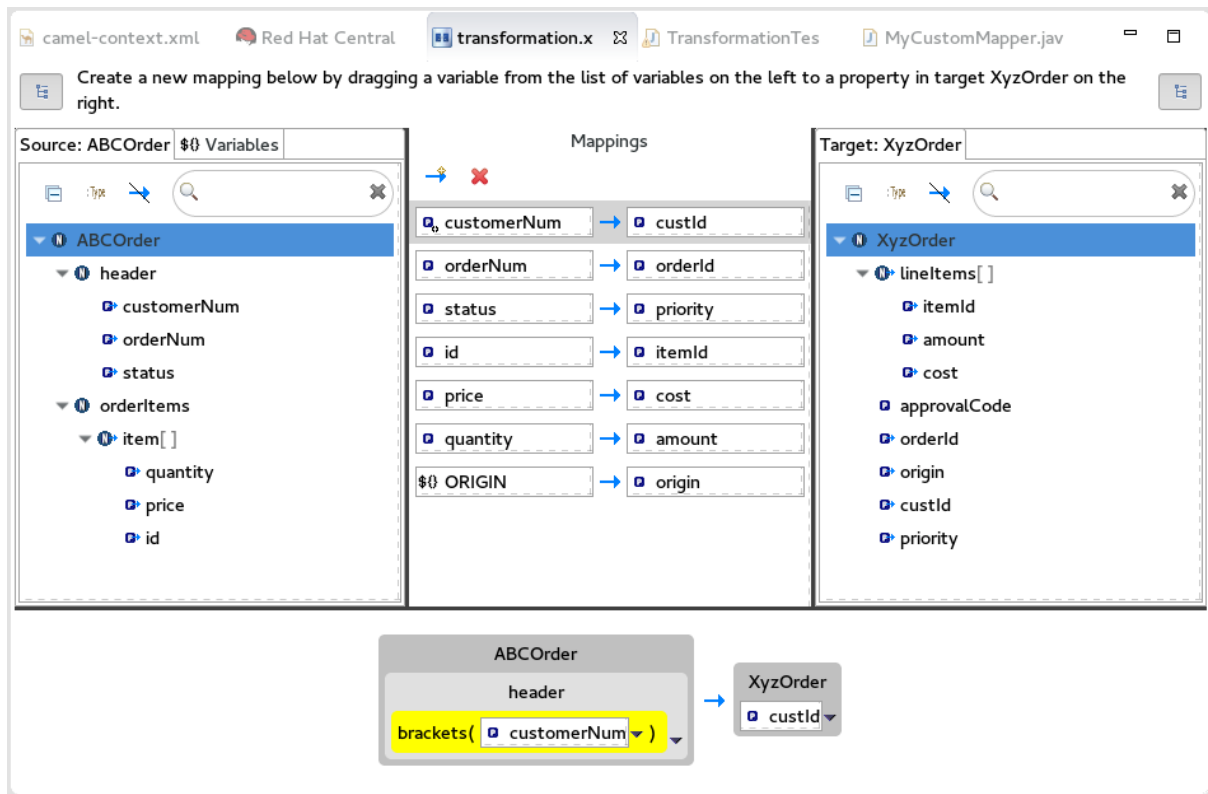
7. Click **OK** to open the **MyCustomMapper.java** file in the Java editor:

```
package example;  
  
public class MyCustomMapper {  
    public String brackets(String input) {  
        return null;  
    }  
}
```

8. Edit the **brackets** method to change the last line **return null;** to this:

```
return "[" + input + "];
```

9. Click the **transformation.xml** tab to switch back to the transformation editor.



The details pane shows that the **brackets** method has been associated with the **customerNum** data item.

The **brackets** method is executed on the source input before it is sent to the target system.

10. Run a JUnit test on your **TransformationTest.java** file. For details, see [Section 8.4, “Creating the transformation test file and running the JUnit test”](#).

The **Console** view displays the JSON-formatted output data:

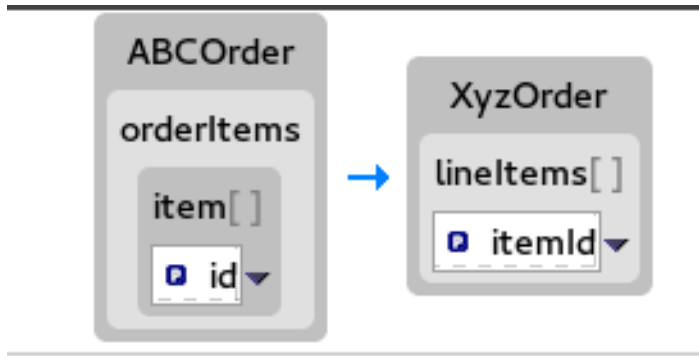
```
{
  "custId": "[ACME-123]",
  "priority": "GOLD",
  "orderId": "ORDER1",
  "origin": "Web",
  "approvalCode": "AUTO_OK",
  "lineItems": [
    {
      "itemId": "PICKLE",
      "amount": 1000,
      "cost": 2.25
    },
    {
      "itemId": "BANANA",
      "amount": 400,
      "cost": 1.25
    }
  ]
}
```

## 8.8. MAPPING A SIMPLE DATA ITEM TO A DATA ITEM IN A COLLECTION

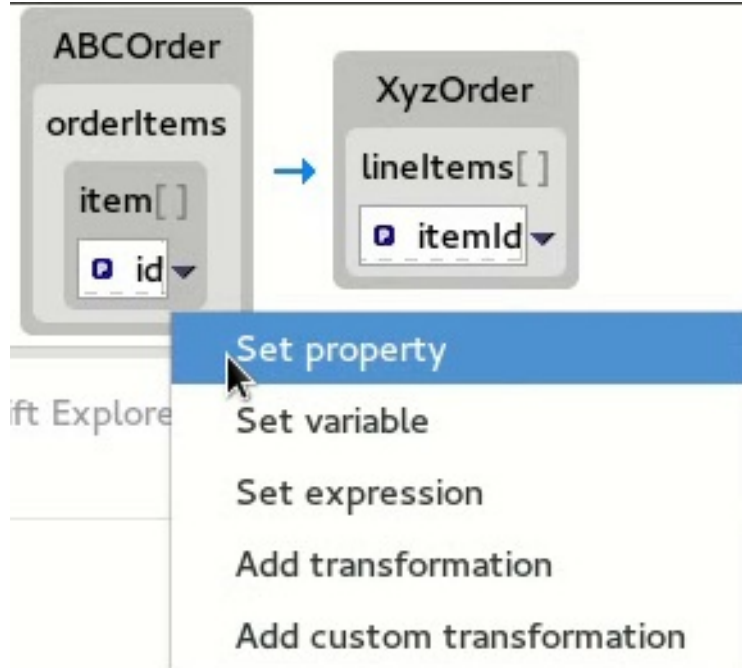
In this tutorial, you will modify an existing mapping that maps all **ids** in the Source to the **itemIds** in the Target. The new mapping will map the **customerNum** data item in the Source to the **itemId** of the second item in the **lineItems** collection in the Target.

With this change, no **ids** in the Source will be mapped to **itemIds** in the Target.

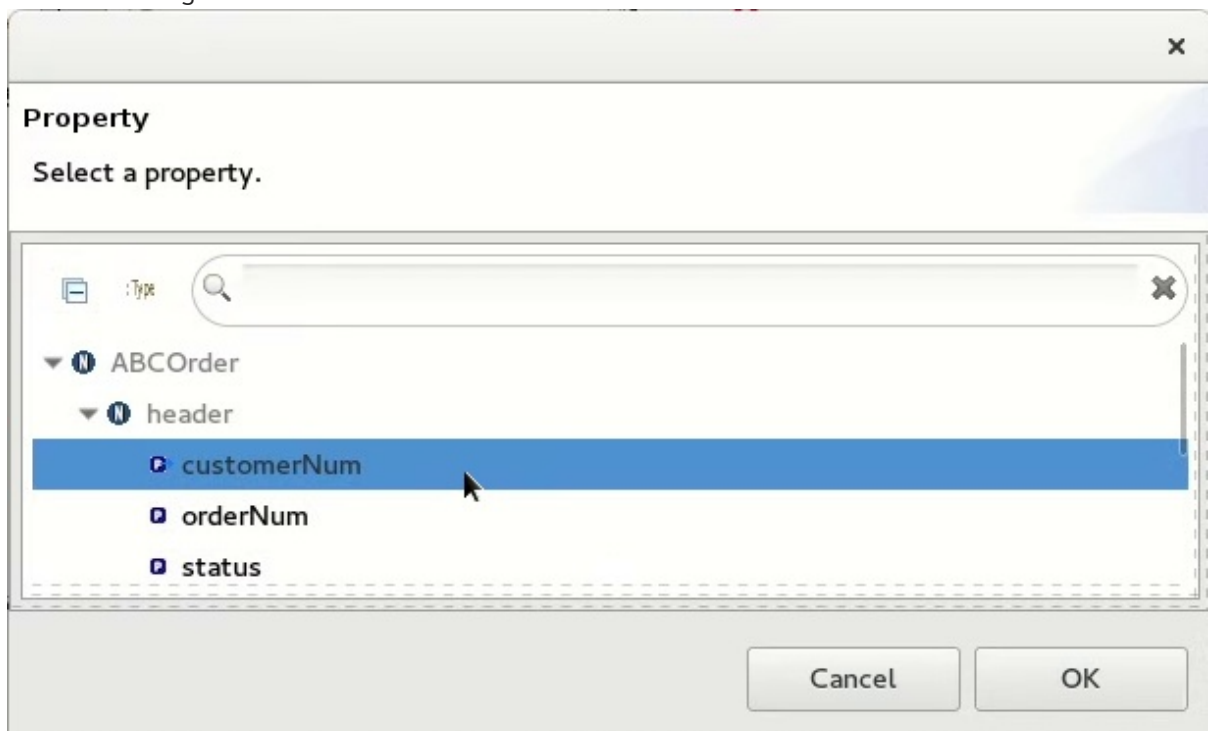
1. In the **Mappings** panel, select the mapping **id** –> **itemId** to display the mapping in the details pane.



2. On the Source box, click ▼ to open the drop-down menu, and select **Set property**.



3. In the **Select a property** page, expand the **header** node and select **customerNum**. Click **OK** to save the changes.



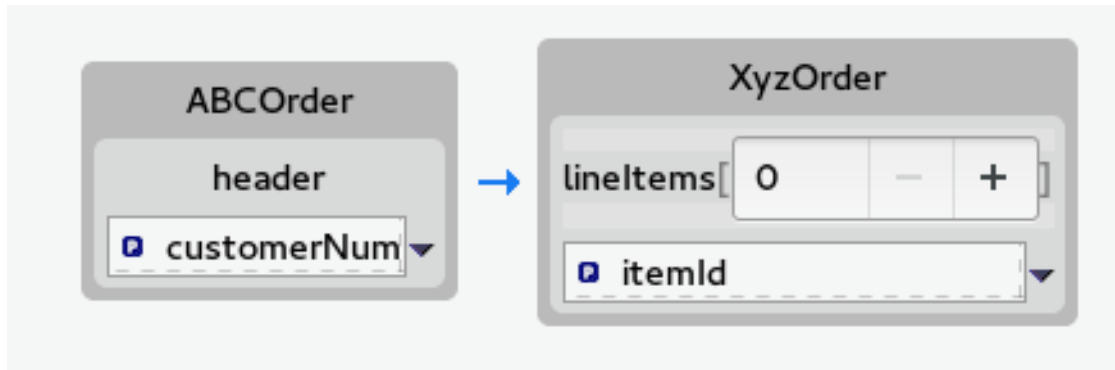


- The details pane now shows that **XYZOrder** has a **lineItems** field. Click the toggle button next to **lineItems** to increase its value to **1**.



#### NOTE

Indexes are zero-based, so a value of **1** selects the second instance of **itemId** in the collection.



Notice that the details pane shows **customerNum** mapped to the **itemId** of the second item in the **lineItems** collection.

- Run a JUnit test on your **TransformationTest.java** file. For details, see [Section 8.4, "Creating the transformation test file and running the JUnit test"](#).

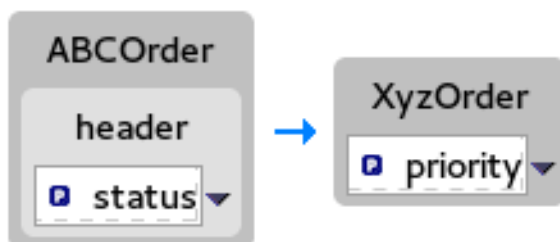
The **Console** view displays the JSON-formatted output data:

```
{ "custId": "[ACME-123]", "priority": "GOLD", "orderId": "ORDER1", "origin": "Web",
  "approvalCode": "AUTO_OK", "lineItems": [{"amount": 1000, "cost": 2.25},
  {"itemId": "ACME-123", "amount": 400, "cost": 1.25}] }
```

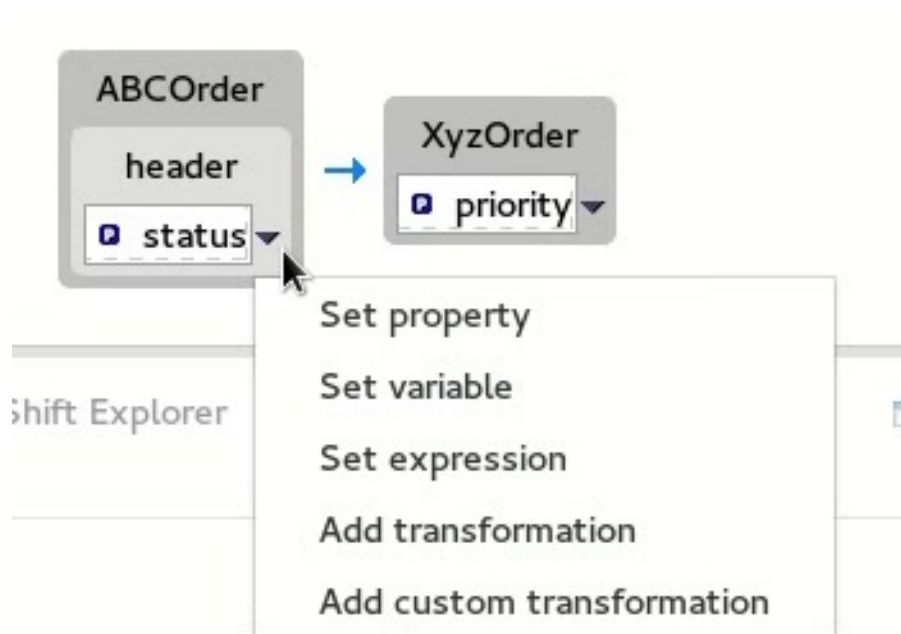
## 8.9. ADDING A BUILT-IN FUNCTION TO A MAPPED DATA ITEM

You can use the built-in string-related functions to apply transformations to mapped data items.

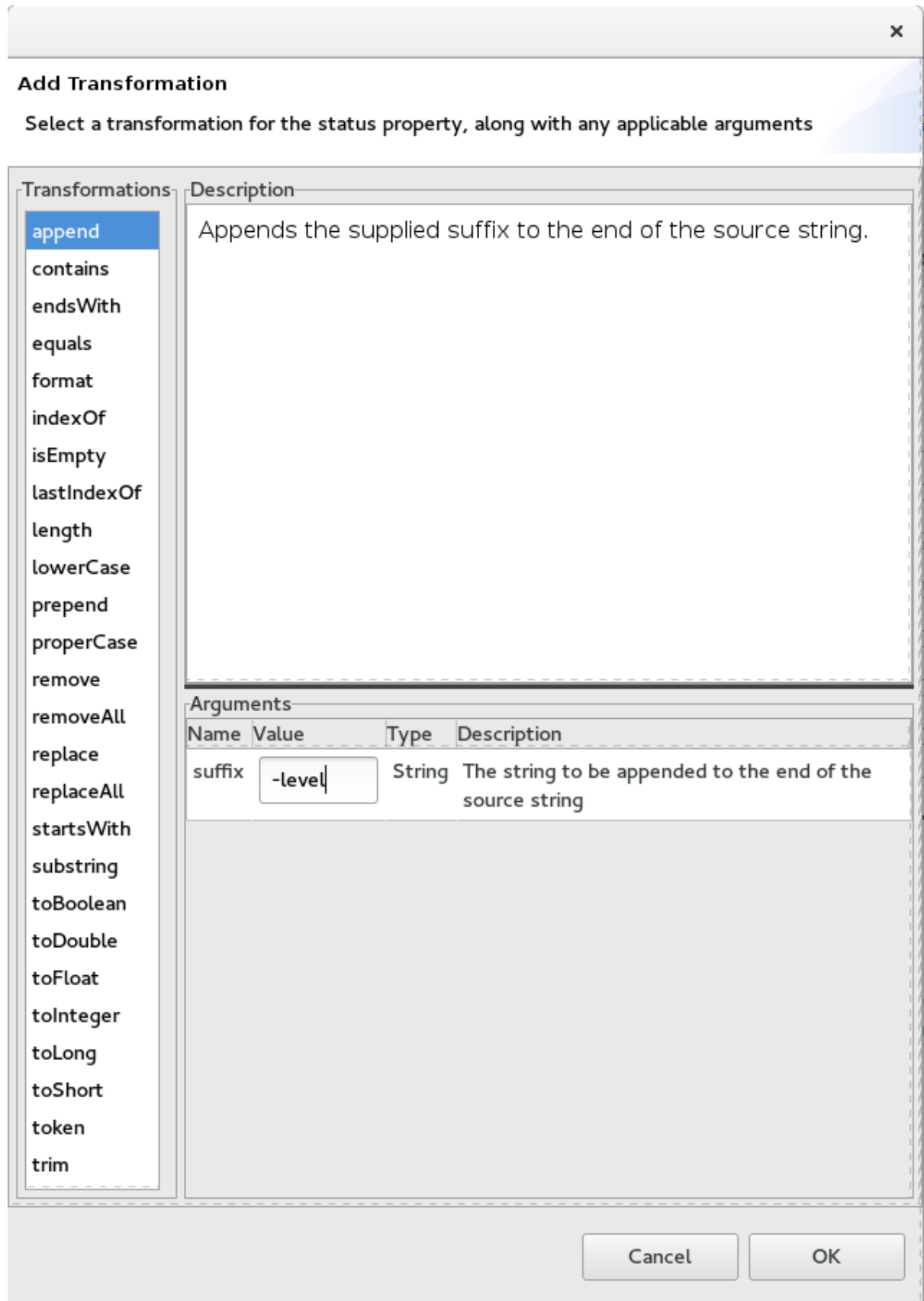
- In the **Transformations** panel, select the **status** to **priority** mapping to populate the details pane.



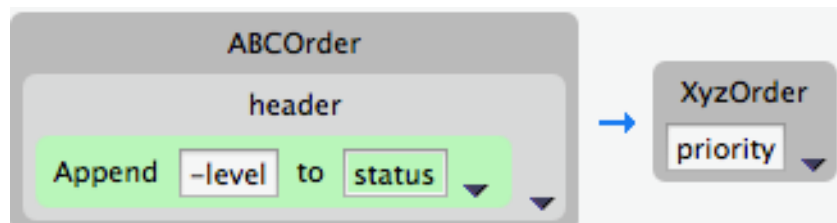
- In the Source box, click ▼ to open the drop-down menu, and select **Add transformation**.



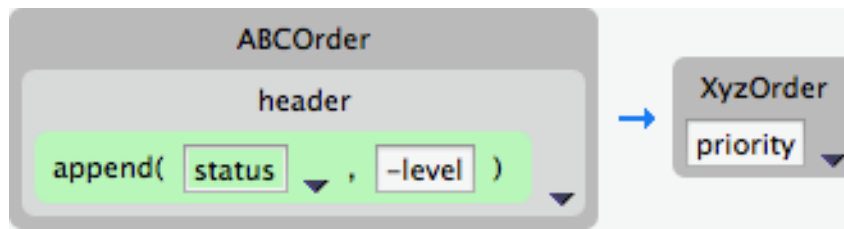
3. In the **Transformations** pane, select **append**, and in the **Arguments** pane, enter **-level** for the value of **suffix**.  
This **append** function adds the specified suffix to the end of the **status** string before mapping it to the target **priority** data item.



- Click OK.



By default, the details pane displays the results of adding the **append** function to the **status** data item in a user-friendly format. You can change this formatting by clicking the right-most ▼ on the Source box, and selecting **Show standard formatting**.



- Run a JUnit test on your **TransformationTest.java** file. For details, see [Section 8.4, “Creating the transformation test file and running the JUnit test”](#).

The **Console** view displays the JSON-formatted output data:

```
{ "custId": "[ACME-123]", "priority": "GOLD-level", "orderId": "ORDER1", "origin": "Web",
  "approvalCode": "AUTO_OK", "lineItems": [{"amount": 1000, "cost": 2.25}, {"itemId": "ACME-123",
  "amount": 400, "cost": 1.25}] }
```

## 8.10. PUBLISHING A FUSE INTEGRATION PROJECT WITH DATA TRANSFORMATION TO A RED HAT FUSE SERVER

Before you publish your data transformation project to a Fuse server (see [Chapter 28, Publishing Fuse Integration Projects to a Server](#)), you need to install the following features in the Fuse runtime:

- **camel-dozer**
- **camel-jackson**
- **camel-jaxb**

To install the required features on the Fuse runtime:

- If not already there, switch to the **Fuse Integration** perspective.
- If necessary, add the Fuse server to the **Servers** list (see [Section 27.1, “Adding a Server”](#)).
- Start the Fuse Server (see [Section 27.2, “Starting a Server”](#)), and wait for the JBoss Fuse shell to appear in the **Terminal** view.
- For each of the required **camel-** features, at the **JBossFuse:admin@root>** prompt type: **features:install camel-<featureName>**

Where *featureName* is one of **dozer**, **jackson**, or **jaxb**.

- To verify that each of the features was successfully installed, at the **JBossFuse:admin@root>** prompt type: **features:list --ordered --installed**

You should see the camel features you just installed in the output listing:

```
[installed ] [2.17.0.redhat-630159] camel-dozer camel-2.17.0.redhat-630159
[installed ] [2.17.0.redhat-630159] camel-exec camel-2.17.0.redhat-630159
[installed ] [2.17.0.redhat-630159] camel-ftp camel-2.17.0.redhat-630159
[installed ] [2.17.0.redhat-630159] camel-jackson camel-2.17.0.redhat-630159
[installed ] [2.17.0.redhat-630159] camel-jasypt camel-2.17.0.redhat-630159
[installed ] [2.17.0.redhat-630159] camel-jaxb camel-2.17.0.redhat-630159
```

## CHAPTER 9. DEVELOPING EXTENSIONS FOR FUSE ONLINE INTEGRATIONS

Fuse Online is a Red Hat Fuse feature that provides a web interface for integrating applications. Without writing code, a business expert can use Fuse Online to connect to applications and optionally operate on data between connections to different applications. If Fuse Online does not provide a feature that an integrator needs, then a developer can create an extension that defines the needed behavior.

You can use Fuse Tooling to develop extensions that provide features for use in Fuse Online. An extension defines:

- One or more custom **steps** that operate on data between connections in an integration or
- One custom **connector**

In Fuse Online, a **connector** represents a specific application to obtain data from or send data to. Each connector is a template for creating a connection to that specific application. For example, the Salesforce connector is the template for creating a connection to Salesforce. If Fuse Online does not provide a connector that the Fuse Online user needs, you can develop an extension that defines a custom connector.

In Fuse Online, a data operation that happens between connections in an integration is referred to as a **step**. Fuse Online provides steps for operations such as filtering and mapping data. To operate on data between connections in ways that are not provided by Fuse Online built-in steps, you can develop a Fuse Online extension that defines one or more custom steps.



### NOTE

You might prefer to develop an extension in the IDE of your choice. Whether you use Fuse Tooling or another IDE is entirely a matter of personal preference. Information about developing an extension in any IDE is in [Integrating Applications with Fuse Online](#).

## 9.1. OVERVIEW OF TASKS

Here is an overview of the tasks for developing a Fuse Online extension:

1. Create a Fuse Online extension project and select **Custom Connector** or **Custom Step** as the extension type.
2. Depending on the extension type, write the code for the extension:
  - For a **Custom Connector**: Define the base Camel component, the connector icon, global connector properties, and the connector actions.
  - For a **Custom Step**: Add routes, define actions, and specify any dependencies.
3. Build a **.jar** file.
4. Provide the **.jar** file to the Fuse Online user.

The Fuse Online user uploads the **.jar** file to Fuse Online, which makes the custom connector or custom step(s) available for use. For information about Fuse Online and how to create integrations, see [Integrating Applications with Fuse Online](#).

## 9.2. PREREQUISITES

Before you begin, you need the following information and knowledge:

- A description of the required functionality for the Fuse Online custom connector or step (from the Fuse Online user).
- The Fuse Online version number for the extension.
- For a custom connector, an icon image file in PNG or SVG format. Fuse Online uses this icon when it displays the flow of an integration. If you do not provide an icon, then Fuse Online generates one when the .jar that contains the extension is uploaded.
- You should be familiar with:
  - Fuse Online
  - Spring Boot XML or Java
  - Apache Camel routes (if you want to create a route-based step extension)
  - JSON
  - Maven

## 9.3. CREATING A CUSTOM CONNECTOR

In Fuse Online, a custom connector consists of one or more connection configuration parameters, one or more connection actions, and optional configuration parameters for each action.

Here is an overview of the tasks for developing a custom connector:

1. Create a Fuse Online extension project and select **Custom Connector** as the extension type.
2. Write the code for the extension. Define the base Camel component, the connector icon, global connector properties, and the connector actions.

### 9.3.1. Writing code for the custom connector

After you create the Fuse Online extension project, you write the code that defines the custom connector elements based on the description of the required functionality provided to you by the Fuse Online user. The [Table 9.1, "Custom connector elements"](#) table shows how the elements of the custom connector that you create in Fuse Tooling correspond to elements in Fuse Online.

**Table 9.1. Custom connector elements**

Fuse Tooling element	Fuse Online element	Description
Global (top-level) property	Connection configuration parameter	When a Fuse Online user creates a connection from this connector, the user specifies a value for this property as part of the configuration of the connection.

Fuse Tooling element	Fuse Online element	Description
Action	Connection action	In Fuse Online, for a connection created from this connector, a Fuse Online user selects one of these actions.
Property defined in an action	An action configuration parameter	When a Fuse Online user configures the action that the connection performs, the Fuse Online user specifies a value for this property as part of the configuration of the action.

To write the code that implements a custom connector for Fuse Online:

1. Open the `syndesis-extension-definition.json` file in the Editor view and write the code that defines the global properties, the actions that the custom connector can perform, and each action's properties.

Each **global property** corresponds to a connection configuration parameter in Fuse Online. Each action property corresponds to a Fuse Online connection action configuration parameter. In Fuse Online, when the user selects a custom connector, Fuse Online prompts for values for each connection configuration parameter. A custom connector can be for an application that uses the OAuth protocol. In this case, be sure to specify a global property for the OAuth client ID and another global property for the OAuth client secret. The Fuse Online user will need to specify values for these parameters for a connection created from this connector to work.

Each **connector action** declares a base Camel component scheme.

The example provided by the New Fuse Online Extension Project wizard uses the **telegram** Camel component scheme:

```
{
  "schemaVersion" : "v1",
  "name" : "Example Fuse Online Extension",
  "extensionId" : "fuse.online.extension.example",
  "version" : "1.0.0",
  "actions" : [ {
    "id" : "io.syndesis:telegram-chat-from-action",
    "name" : "Chat Messages",
    "description" : "Receive all messages sent to the chat bot",
    "descriptor" : {
      "componentScheme" : "telegram",
      "inputDataShape" : {
        "kind" : "none"
      },
      "outputDataShape" : {
        "kind" : "java",
        "type" : "org.apache.camel.component.telegram.model.IncomingMessage"
      }
    },
    "configuredProperties" : {
```



```

        "type" : "bots"
    }
},
"actionType" : "connector",
"pattern" : "From"
}, {
    "id" : "io.syndesis:telegram-chat-to-action",
    "name" : "Send a chat Messages",
    "description" : "Send messages to the chat (through the bot).",
    "descriptor" : {
        "componentScheme" : "telegram",
        "inputDataShape" : {
            "kind" : "java",
            "type" : "java.lang.String"
        },
        "outputDataShape" : {
            "kind" : "none"
        },
        "propertyDefinitionSteps" : [ {
            "description" : "Chat id",
            "name" : "chatId",
            "properties" : {
                "chatId" : {
                    "kind" : "parameter",
                    "displayName" : "Chat Id",
                    "type" : "string",
                    "javaType" : "String",
                    "description" : "The telegram's Chat Id, if not set will use CamelTelegramChatId from
the incoming exchange."
                }
            }
        } ],
        "configuredProperties" : {
            "type" : "bots"
        }
    },
    "actionType" : "connector",
    "pattern" : "To"
} ],
"properties" : {
    "authorizationToken" : {
        "kind" : "property",
        "displayName" : "Authorization Token",
        "group" : "security",
        "label" : "security",
        "required" : true,
        "type" : "string",
        "javaType" : "java.lang.String",
        "secret" : true,
        "description" : "Telegram Bot Authorization Token"
    }
}
}
}

```

- If the custom connector requires additional dependencies, add them to the project's **pom.xml** file. The default scope for dependencies is runtime. If you add a dependency that Red Hat ships, define its scope as provided, for example:

```
<dependencies>
  <dependency>
    <groupId>org.apache.camel</groupId>
    <artifactId>camel-telegram</artifactId>
    <scope>provided</scope>
  </dependency>
</dependencies>
```

When you finish writing the code for the custom connector, build the **.jar** file as described in [Section 9.5, "Building the Fuse Online extension JAR file"](#).

## 9.4. CREATING CUSTOM STEPS

After you create the Fuse Online extension project, you write the code that defines the custom steps based on the description of the required functionality provided to you by the Fuse Online user. Within a single extension, you can define more than one custom step and you can define each custom step with Camel routes or with Java beans.

### 9.4.1. Writing code for the custom step

After you create the Fuse Online extension project, you write the code that defines the custom step(s) based on the description of the required functionality provided to you by the Fuse Online user.

[Table 9.2, "Custom step elements"](#) shows how the elements of the custom step that you create in Fuse Tooling correspond to elements in Fuse Online.

**Table 9.2. Custom step elements**

Fuse Tooling element	Fuse Online element	Description
Action	Custom Step	In Fuse Online, after the user imports the step extension, the custom step(s) appear(s) on the <b>Choose a step</b> page.
Property defined in an action	A custom step configuration parameter	In Fuse Online, when the user selects a custom step, Fuse Online prompts for values for configuration parameters.

To write the code that implements a custom step for Fuse Online:

- For a Camel route-based step, in the **extension.xml** file, create routes that address the purpose of the extension. The entrypoint of each route must match the entrypoint that you define in the **syndesis-extension-definition.json** file, as described in Step 2.  
For a Java bean-based step, edit the **java** file.
- In the **syndesis-extension-definition.json** file, write the code that defines the actions and their properties. You need a new action for each entrypoint.

Each action that you create corresponds to a custom step in Fuse Online. You can use different types of code for each action. That is, you can use a Camel route for one action and a Java bean for another action.

Each property corresponds to a Fuse Online step configuration parameter. In Fuse Online, when the user selects a custom step, Fuse Online prompts for values for configuration parameters. For example, a custom log step might have a level parameter that indicates how much information to send to the log.

Here is the template for the **.json** file that contains the extension metadata, including properties that will be filled in by the user in Fuse Online after uploading the extension and adding its custom step to an integration:

```
{
  "actions": [
    {
      "actionType": "extension",
      "id": "${actionId}",
      "name": "Action Name",
      "description": "Action Description",
      "tags": [
        "xml"
      ],
      "descriptor": {
        "kind": "ENDPOINT|BEAN|STEP",
        "entrypoint": "direct:${actionId}",
        "inputDataShape": {
          "kind": "any"
        },
        "outputDataShape": {
          "kind": "any"
        },
        "propertyDefinitionSteps": []
      }
    }
  ],
  "tags": [
    "feature",
    "experimental"
  ]
}
```



#### NOTE

The tags are ignored in this release. They are reserved for future use.

- To edit the extension dependencies, open the `pom.xml` file in the editor. If you add a dependency, you must define its scope.

When you finish writing the code for the custom step(s), build the **.jar** file as described in [Section 9.5, "Building the Fuse Online extension JAR file"](#).

## 9.5. BUILDING THE FUSE ONLINE EXTENSION JAR FILE

To build the **.jar** file for the extension:

1. In the **Project Explorer** view, right-click the project.
2. From the context menu, select **Run As → Maven clean verify**.
3. In the **Console** view, you can monitor the progress of the build.
4. When the build is complete, refresh the target folder in the **Project Explorer** view (select the project and then press **F5**).
5. In the **Project Explorer** view, open the target folder to see the generated **.jar** file:  
The name of the .jar file follows Maven defaults: **\${artifactId}-\${version}.jar**

For example: **custom:step-camel-1.0.0.jar**

This **.jar** file defines the extension, its required dependencies, and its metadata: Extension Id, Name, Version, Tags, and Description. For example:

```
{
  "schemaVersion" : "v1",
  "name" : "Example Fuse Online Extension",
  "description" : "Logs a message body with a prefix",
  "extensionId" : "fuse.online.extension.example",
  "version" : "1.0.0",
  "actions" : [ {
    "id" : "Log-body",
    "name" : "Log Body",
    "description" : "A simple xml Body Log with a prefix",
    "descriptor" : {
      "kind" : "ENDPOINT",
      "entrypoint" : "direct:log-xml",
      "resource" : "classpath:META-INF/syndesis/extensions/log-body-action.xml",
      "inputDataShape" : {
        "kind" : "any"
      },
      "outputDataShape" : {
        "kind" : "any"
      },
    },
    "propertyDefinitionSteps" : [ {
      "description" : "Define your Log message",
      "name" : "Log Body",
      "properties" : {
        "prefix" : {
          "componentProperty" : false,
          "deprecated" : false,
          "description" : "The Log body prefix message",
          "displayName" : "Log Prefix",
          "javaType" : "String",
          "kind" : "parameter",
          "required" : false,
          "secret" : false,
          "type" : "string"
        }
      }
    }
  ]
}
```

```
    },  
    "tags" : [ "xml" ],  
    "actionType" : "step"  
  } ],  
  "dependencies" : [ {  
    "type" : "MAVEN",  
    "id" : "io.syndesis.extension:extension-api:jar:1.3.0.fuse-000014"  
  } ],  
  "extensionType" : "Steps"  
}
```

## 9.6. PROVIDING THE JAR FILE TO THE FUSE ONLINE USER

Provide the following to the Fuse Online user:

- The **.jar** file
- A document that describes the extension. For a step extension, include information about data shapes that each action in the step extension requires as input or provides as output (for data mapping).

In Fuse Online, the user uploads the **.jar** file as described in [Integrating Applications with Fuse Online](#).

## CHAPTER 10. CREATING A NEW CAMEL XML FILE

### OVERVIEW

Apache Camel stores routes in an XML file that contains a camelContext element. When you create a new Fuse Integration project, the tooling provides an Apache Camel context (XML) file as part of the project by default.

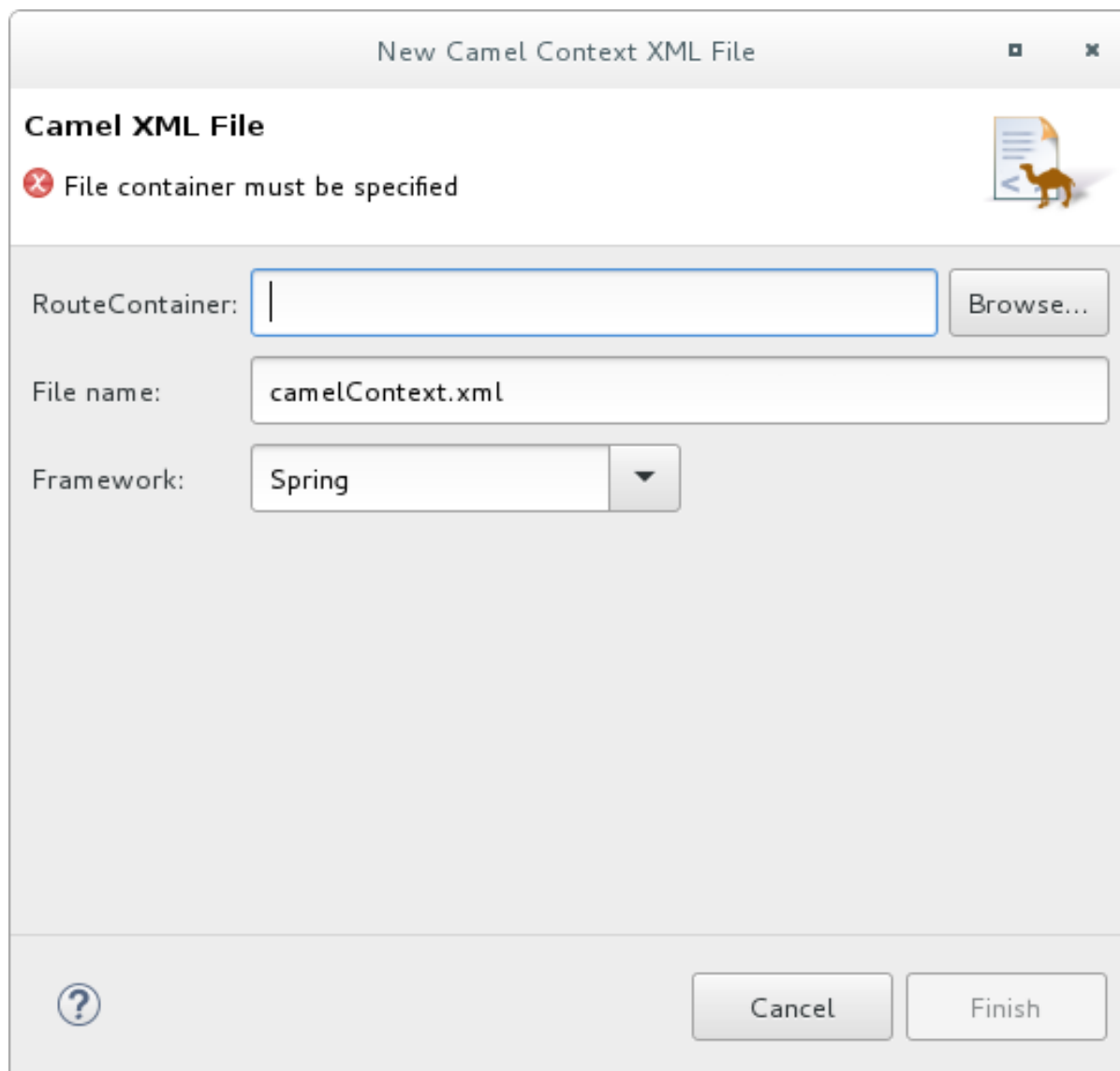
You can also add a new Camel XML file that includes all of the required namespaces preconfigured and a template camelContext element.

### PROCEDURE

To add a new Apache Camel context file to your project:

1. Select **File** → **New** → **Camel XML File** from the main menu to open the **Camel XML File** wizard, as shown in [Figure 10.1, “Camel XML File wizard”](#).

Figure 10.1. Camel XML File wizard



2. In **RouteContainer**, enter the location for the new file, or accept the default.

You can click  to search for an appropriate location.



### IMPORTANT

The Spring framework and the OSGi Blueprint framework require that all Apache Camel files be placed in specific locations under the project's **META-INF** or **OSGI-INF** folder:

- Spring - **projectName/src/main/resources/META-INF/spring/**
- OSGi Blueprint - **projectName/src/main/resources/OSGI-INF/blueprint/**

3. In **File Name**, enter a name for the new context file, or accept the default ( **camelContext.xml**). The file's name cannot contain spaces or special characters, and it must be unique within the JVM.
4. In **Framework**, accept the default, or select which framework the routes will use:
  - **Spring** – [default] for routes that will be deployed in Spring containers, non-OSGi containers, or as standalone applications
  - **OSGi Blueprint** – for routes that will be deployed in OSGi containers
  - **Routes** – for routes that you can load and add into existing **camelContexts**
5. Click **Finish**.  
The new context file is added to the project and opened in the route editor.

## CHAPTER 11. CHANGING THE CAMEL VERSION

As you work with a Fuse tooling project, you might want to change the Camel version that it uses. This can be helpful, for example, if you want to use a feature supported in a more recent Camel version or if you want to use a community version.

To change the Camel version that a project uses:

1. In **Project Explorer**, right-click the project for which you want to change the Camel version and select **Configure** → **Change Camel Version**.
2. In the **Change Camel Version** window, to the right of the **Camel Version** field, click the down caret to display available Camel versions.  
To use a community version of Apache Camel, you enter its version number, for example, **2.19.2**.
3. Select or enter the version you want and click **Finish**.

Fuse Tooling checks whether the version you selected is available and supported by Fuse Tooling. If it is then Fuse Tooling changes the Camel version and saves the project's updated **pom.xml** file. You receive an error message if the Camel version that you select is not available or not supported.

You can check the project's Camel version in its **pom.xml** file, in the **<camel.version>** element.



## CHAPTER 12. IMPORTING AN EXISTING MAVEN PROJECT

### OVERVIEW

You might want to import an existing project, for example, to use as a template or starting point for developing an application.

For example, the New Fuse Integration Project wizard points to the following Github repositories as sources for examples:

- <https://github.com/apache/camel/tree/master/examples>
- <https://github.com/fabric8-quickstarts>
- <https://github.com/wildfly-extras/wildfly-camel-examples>
- <https://github.com/jboss-fuse/quickstarts>

### PROCEDURE

To import an existing Maven project:

1. Select **File** → **Import** → **Maven** → **Existing Maven Projects**, and then click **Next**.
2. For the Root Directory, select the folder that contains the downloaded example projects.
3. In the list of Projects, check the projects that you want to import and then click **Finish**.

## PART II. DEBUGGING ROUTING CONTEXTS

The Camel debugger includes many features for debugging locally and remotely running routing contexts:

- Setting conditional and unconditional breakpoints on nodes in the route editor
- Autolaunching the debugger and switching to the **Debug** perspective
- Interacting with the running routing context:
  - Switch between breakpoints to quickly compare variable values of message instances
  - Examine and change the value of variables of interest
  - Add variables of interest to the watch list to track them throughout the debug session
  - Disable and re-enable breakpoints on-the-fly
  - Track message flow graphically in the routing context runtime
  - Examine console logs to track Camel and debugger actions



### NOTE

Before you can run the Camel debugger, you must set breakpoints on the nodes of interest displayed on the route editor's canvas. Then you can run the Camel debugger on a project's routing context **.xml** file to find the logic errors in it and fix them. Invoking the Camel debugger runs the routing context in debug mode and opens the [Debug Perspective](#).

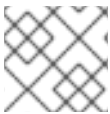
## CHAPTER 13. SETTING BREAKPOINTS

### OVERVIEW

To set breakpoints, your project's routing context **.xml** file must be open in the route editor's **Design** tab.

The Camel debugger supports two types of breakpoints:

- Unconditional breakpoints – triggered whenever one is encountered during a debugging session
- Conditional breakpoints – triggered only when the breakpoint's specified condition is met during a debugging session




#### NOTE

You cannot set breakpoints on consumer endpoints or on **when** or **otherwise** nodes.


### SETTING UNCONDITIONAL BREAKPOINTS

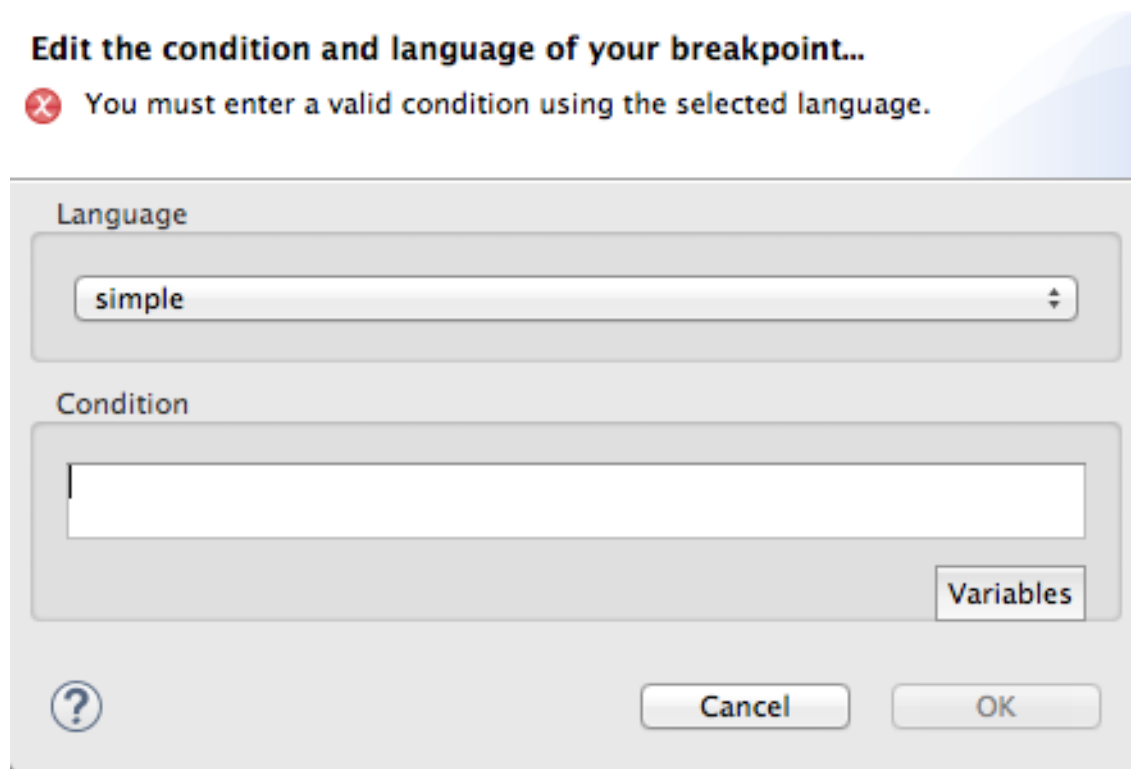
With your routing context displayed on the canvas in the **Design** tab:

1. Select a node whose state you want to examine during the debugging session.
2. Click its  icon to set an unconditional breakpoint.
3. Repeat these steps for each node on which you want to set an unconditional breakpoint.

### SETTING CONDITIONAL BREAKPOINTS

With your routing context displayed on the canvas in the **Design** tab:

1. Select a node whose state you want to examine during the debugging session.
2. Click its  icon to set a conditional breakpoint and to open the **Edit the condition and language of your breakpoint...** dialog:





3. Click the **Language** drop-down menu and select the expression language to use to create the condition that will trigger the breakpoint.  
Fuse Tooling supports twenty-four expression languages. Some of these languages provide variables for creating conditional expressions, while others do not.
4. Click **Variables** to display a list of the selected language's supported variables.  
If a list appears, select in sequence one or more of the variables to create the condition for triggering the breakpoint. The variables you select appear in the **Condition** text box.


If **<nothing available>** appears, enter the expression directly into the **Condition** text box.

5. Repeat steps [condBpFirst] through [condBpLast] for each node on which you want to set a conditional breakpoint.

## DISABLING BREAKPOINTS

You can temporarily disable a breakpoint, leaving it in place, then enable it again later. The  button skips over disabled breakpoints during debugging sessions.

To disable a breakpoint, select the node on the canvas and click its  icon. The breakpoint turns gray, indicating that it has been disabled.

To enable a disabled breakpoint, select the node on the canvas and click its  icon. Depending on whether the disabled breakpoint is conditional or unconditional, it turns yellow or red, respectively, to indicate that it has been re-enabled.






## NOTE

You can also disable and re-enable breakpoints during debugging sessions. For details, see [Chapter 18, \*Disabling Breakpoints in a Running Context\*](#).

## DELETING BREAKPOINTS

You can delete individual breakpoints or all breakpoints.

- To delete individual breakpoints – in a route container, select the node whose breakpoint you want to delete, and click its  icon.
- To delete all breakpoints in a particular route – right-click the target route’s container, and select  **Delete all breakpoints.**
- To delete all breakpoints in all routes – right-click the canvas, and select  **Delete all breakpoints.**

## RELATED TOPICS

- [Chapter 14, \*Running the Camel Debugger\*](#)

## CHAPTER 14. RUNNING THE CAMEL DEBUGGER

You can run the Camel debugger on locally running routing contexts.



### NOTE

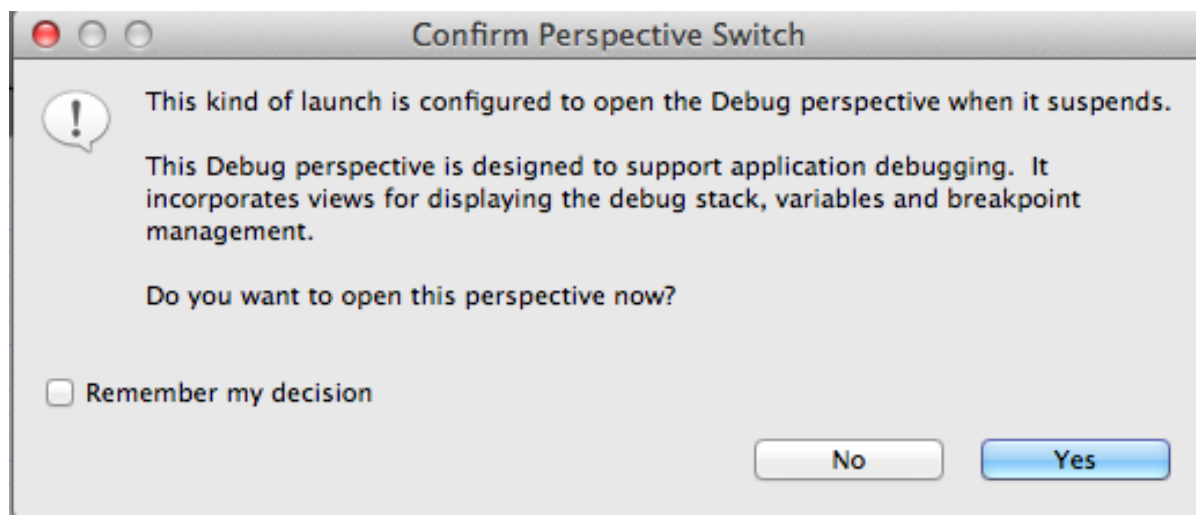
- Remote debugging is no longer supported. For remote debugging, you must configure Jolokia and create a specific JMX connection through Jolokia.
- If your project contains Java code, you can use the standard Eclipse Java debugging tools to debug it.

You must set breakpoints in your routing context file before you can start the Camel debugger.

### PROCEDURE

1. In the **Project Explorer** view, select the routing context file you want to debug.
2. Right-click the selected file to open the context menu, and then select **Debug As → Local Camel Context**.  
Fuse Tooling builds the Camel route, starts Apache Camel, starts the routing context, enables JMX, starts the route(s) in the routing context, adds the breakpoints to the nodes, and enables the Camel debugger.

The Camel debugger suspends execution of the routing context at the first breakpoint hit (received a message), and prompts you to indicate whether you want it to open the **Debug** perspective.



3. Click **Yes** to open the **Debug** perspective.  
The **Debug** perspective opens with the routing context suspended at the first breakpoint encountered in the running routing context.



### IMPORTANT

Breakpoints are held for a maximum of five minutes, after which debugging automatically resumes, moving on to the next breakpoint or to the end of the routing context.

The screenshot displays the Camel IDE interface in the Debug perspective. The top-left pane shows a list of running threads and the Camel Context. The top-right pane shows the Breakpoints view with a breakpoint set on the '\_choice1' node. The main workspace shows a routing diagram with two choice nodes, 'choice1' and 'choice2', each with 'when' and 'otherwise' branches. The bottom pane shows the Console view with log messages from the debugger.



## NOTE



To see the console output, open the **Console** view if it was not open when you switched perspectives.



## NOTE

By default, the **Debug** perspective displays the **Outline** view, which provides the means to switch between separate routes in a running routing context. If your routing context contains a single route, closing the **Outline** view frees space to expand the other views, making it easier to access and examine debugger output.

## WATCHING MESSAGE EXCHANGES PROGRESS THROUGH THE ROUTING CONTEXT

Click  (Step Over) to jump to the next node of execution in the routing context. Click  (Resume) to continue execution at the next active breakpoint in the routing context.

The screenshot displays the Red Hat Fuse IDE's Camel Debugger. The top-left pane shows the 'Servers' tree with the Camel Context at service:jmx:rmi://jndi/rmi://localhost:1099/jmxrmi/camel selected. The top-right pane shows the 'Breakpoints' table with variables like CamelDebugger, Endpoint, Processor, Exchange, ExchangeId, NodeId, RouteId, Timestamp, UID, and Message. The main workspace shows a BPMN diagram of a blueprint.xml with two routes: Route1 and Route2. Route1 has a choice node with 'when' and 'otherwise' branches, each containing a log and a setHeader node. Route2 has a choice node with 'when' and 'otherwise' branches, each containing a setHeader, log, and setHeader node. The bottom pane shows the console output with logs from the Camel context.

Name	Value
CamelDebugger	CamelDebuggerSettings (id=-2025998969)
Endpoint	_choice2
Processor	CamelProcessor (id=-1185022606)
Exchange	CamelExchange (id=-1732430247)
ExchangeId	ID-janemurpheysmbp-home-53332-1471280054270-0-2
NodeId	_choice2
RouteId	Route2
Timestamp	1471280242608
UID	5
Message	CamelMessage (id=-1732430247)
MessageBody	<?xml version="1.0" encoding="UTF-8"?>\n\n<order>\n <customer>\n <name>
MessageHeaders	CamelFileAbsolute = false\nCamelFileAbsolutePath = /Users/jmurphey/workspace08

```

Run blueprint.xml as Local CamelContext (2) [Local Camel Context] /Library/Java/JavaVirtualMachines/jdk1.8.0_45.jdk/Contents/Home/bin/java (Aug 15, 2016, 12:53:47 PM)
[ TCP Connection(8)-192.168.1.3] BacklogDebugger INFO Resume breakpoint _Fulfill
[1] thread #2 - file://src/data] BacklogDebugger INFO NodeBreakpoint at node _Fulfill is continued exchangeId: ID-janemurpheysmbp-home-53332-1471280054270-0-2
[1] thread #2 - file://src/data] BacklogDebugger INFO NodeBreakpoint at node _choice2 is waiting to continue for exchangeId: ID-janemurpheysmbp-home-53332-1471280054270-0-2
[ TCP Connection(8)-192.168.1.3] BacklogDebugger INFO Dump trace message from breakpoint _choice2
[ TCP Connection(8)-192.168.1.3] BacklogDebugger INFO Dump trace message from breakpoint _choice2

```


## RELATED TOPICS


- [Chapter 15, Stopping the Camel Debugger](#)



## CHAPTER 15. STOPPING THE CAMEL DEBUGGER

### OVERVIEW


To stop the Camel debugger, click  on the menu bar once if the debugging session has ended.

Otherwise, click  twice: once to terminate the currently running node thread and once to terminate the **Camel Context** thread (both displayed in the **Debug** view).

+



#### NOTE

Terminating the Camel debugger also terminates the console but does not clear its output. To clear the output, click  (Clear Console) on the **Console** view's menu bar.

### CLOSING THE CAMEL DEBUGGER

After you have finished debugging your project, you may want to close the **Debug** perspective to make more space for your workbench.

To do so, right-click  on the toolbar, and then select **Close**.

### RELATED TOPICS

- [Chapter 14, \*Running the Camel Debugger\*](#)

## CHAPTER 16. CHANGING VARIABLE VALUES

### OVERVIEW

When the Camel debugger hits a breakpoint, the **Variables** view displays the values of all variables available at that point in the routing context. Some variables are editable, allowing you to change their value. This enables you to see how the application handles changes in program state.



#### NOTE

Not all variables are editable. The context menu of editable variables displays the **Change Value...** option.

### PROCEDURE

To change the value of a variable:

1. If necessary, start the debugger. See [Chapter 14, Running the Camel Debugger](#).
2. In the **Variables** view, select a variable whose value you want to change, and then click its **Value** field.

Name	Value
▼ Message	CamelMessage (id=-1022523207)
MessageBody	<?xml version="1.0" encoding="UTF-8"?>\n\n<order>\n
▼ MessageHeaders	CamelFileAbsolute = false\nCamelFileAbsolutePath = /Users
CamelFileAbsolute	false
CamelFileAbsolute...	/Users/jmurphey/workspaceCR1a/CBRroute/src/data/messa
CamelFileContentT...	
CamelFileLastModi...	1462293513000
CamelFileLength	315
CamelFileName	message1.xml
CamelFileNameCo...	message1.xml
CamelFileNameOnly	message1.xml
CamelFileParent	src/data
CamelFilePath	src/data/message1.xml
CamelFileRelativePath	message1.xml
Destination	UNITED KINGDOM
breadcrumbId	ID-janemurpheysmbp-home-53698-1464377746074-0-1
MessageId	ID-janemurpheysmbp-home-53698-1464377746074-0-2

The variable's **value** field turns a lighter shade of blue, indicating that it is in edit mode.



#### NOTE

Alternatively, you can right-click the variable to open its context menu, and select **Change Value...** to edit its value.

3. Enter the new value and then click **Enter**.  
The **Console** view displays an **INFO** level log entry noting the change in the variable's value (for

example, **Breakpoint at node to1 is updating message header on exchangeId: ID-dhcp-97-16-bos-redhat-com-52574-1417298894070-0-2 with header: Destination and value: UNITED KINGDOM**).

4. Continue stepping through the breakpoints and check whether the message is processed as expected. At each step, check the **Debug** view, the **Variables** view, and the **Console** output.

## RELATED TOPICS

- [Chapter 18, \*Disabling Breakpoints in a Running Context\*](#)
- [Chapter 17, \*Adding Variables to the Watch List\*](#)

## CHAPTER 17. ADDING VARIABLES TO THE WATCH LIST

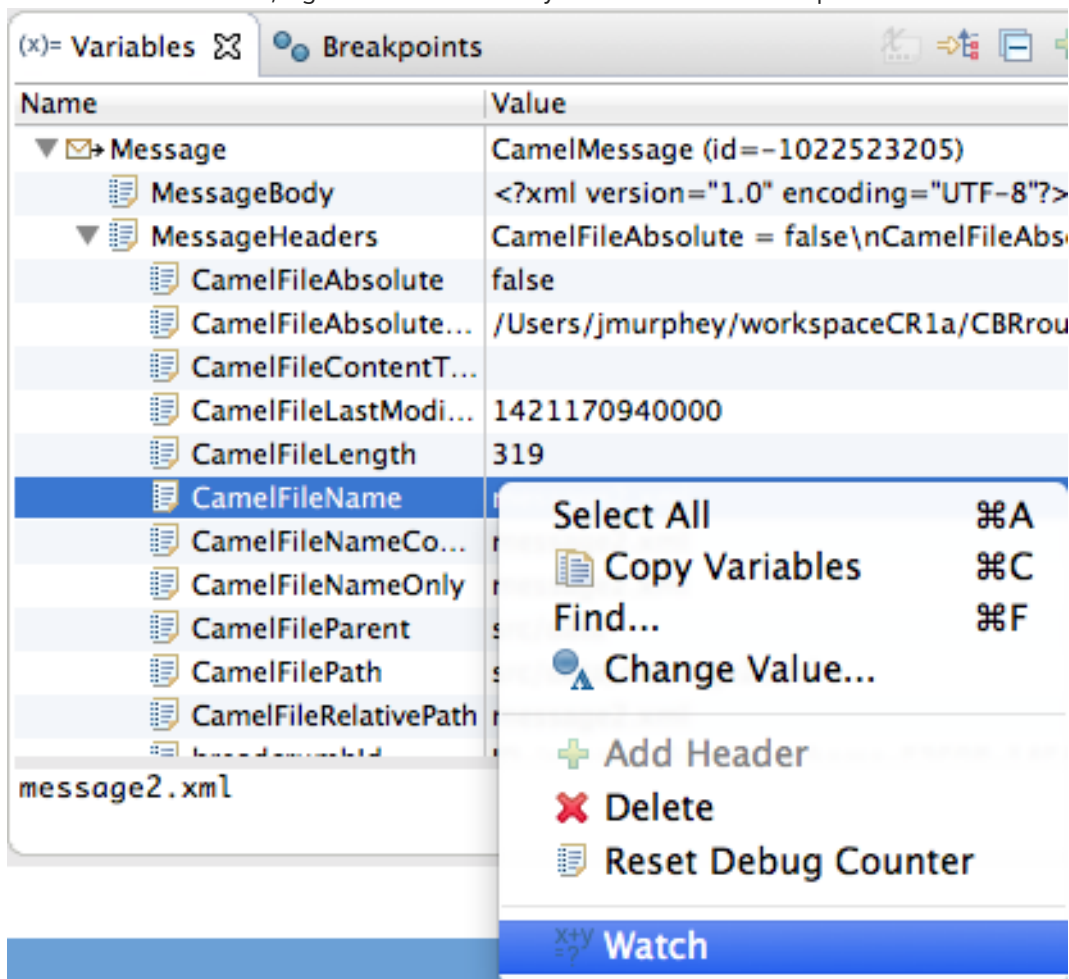
### OVERVIEW

By adding variables to the watch list, you can focus on particular variables to see whether their values change as expected as they flow through the routing context.

### PROCEDURE

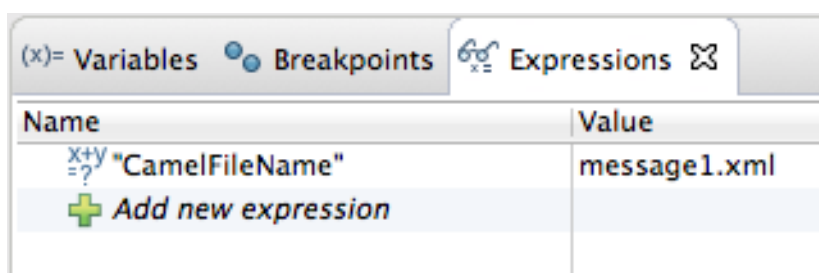
To add a variable to the watch list:

1. If necessary, start the debugger. See [Chapter 14, Running the Camel Debugger](#).
2. In the **Variables** view, right-click a variable you want to track to open the context menu.

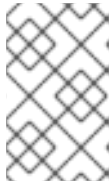


3. Select **Watch**.

A new view, **Expressions**, opens next to the **Breakpoints** view. The **Expressions** view displays the name of the variable being watched and its current value, for example:



- Repeat [\[watch1\]](#) and [\[watch2\]](#) to add additional variables to the watch list.

**NOTE**

The variables you add remain in the watch list until you remove them. To stop watching a variable, right-click it in the list to open the context menu, and then click **Remove**.

- With the **Expressions** view open, step through the routing context to track how the value of each variable in the watch list changes as it reaches each step in the route.


**RELATED TOPICS**

- [Chapter 16, \*Changing Variable Values\*](#)

# CHAPTER 18. DISABLING BREAKPOINTS IN A RUNNING CONTEXT

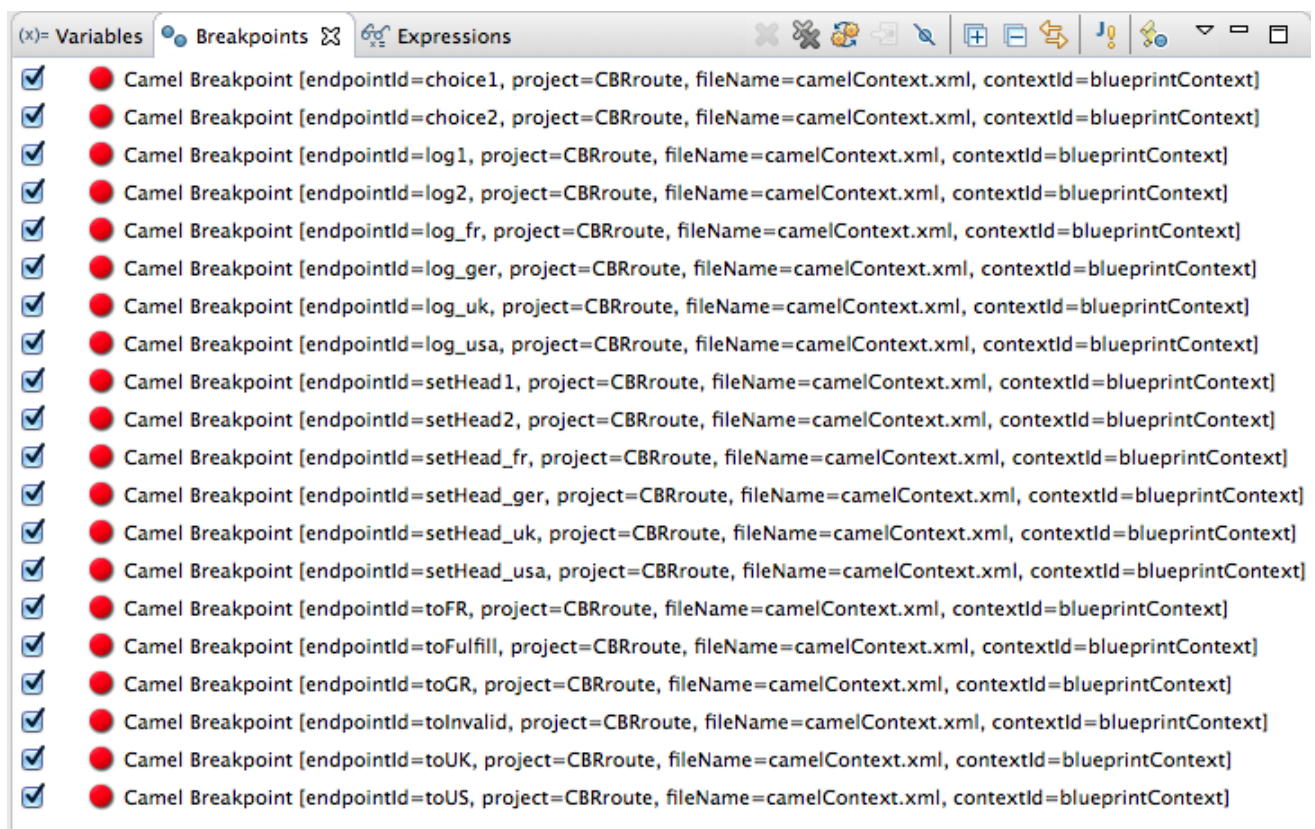
## OVERVIEW

You can disable and re-enable breakpoints in a running routing context in the **Breakpoints** view.

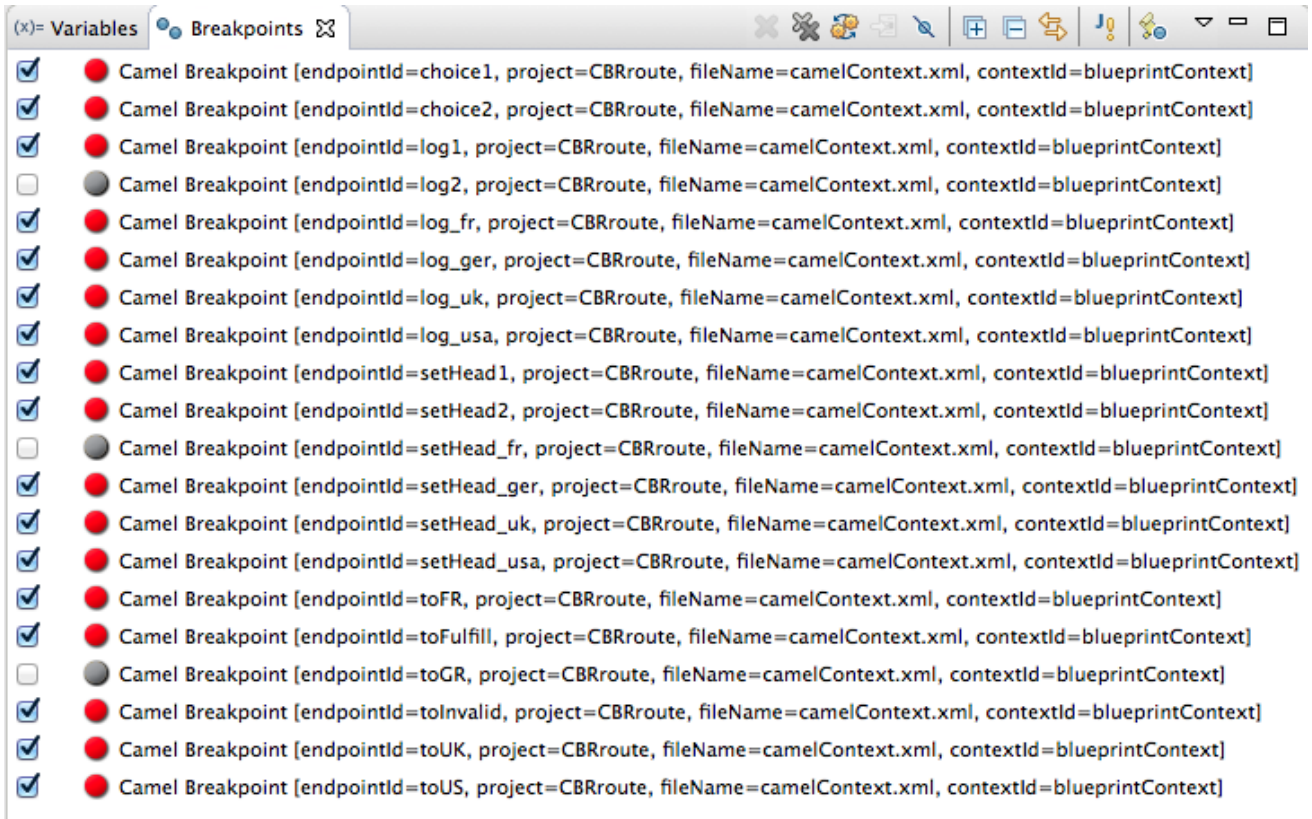
When a breakpoint is disabled, the  button causes the debugger to skip over it during the debugging session.

## DISABLING AND ENABLING BREAKPOINTS IN BREAKPOINTS VIEW

The **Breakpoints** view opens with all set breakpoints enabled.



To disable a breakpoint, clear its check box.



For each breakpoint you disable, the **Console** view displays an **INFO** level log entry noting that it has been disabled (for example, **Removing breakpoint log2**). Likewise, for each breakpoint you re-enable, the **Console** view displays an **INFO** level log entry noting that it has been enabled (for example, **Adding breakpoint log2**).



#### NOTE

To re-enable a disabled breakpoint, click its check box. The **Console** view displays an **INFO** level log entry noting that the breakpoint has been added to the selected node.

## PART III. MONITORING AND TESTING APPLICATIONS

The **JMX Navigator** view provides numerous ways to monitor and test your Fuse applications.



### NOTE

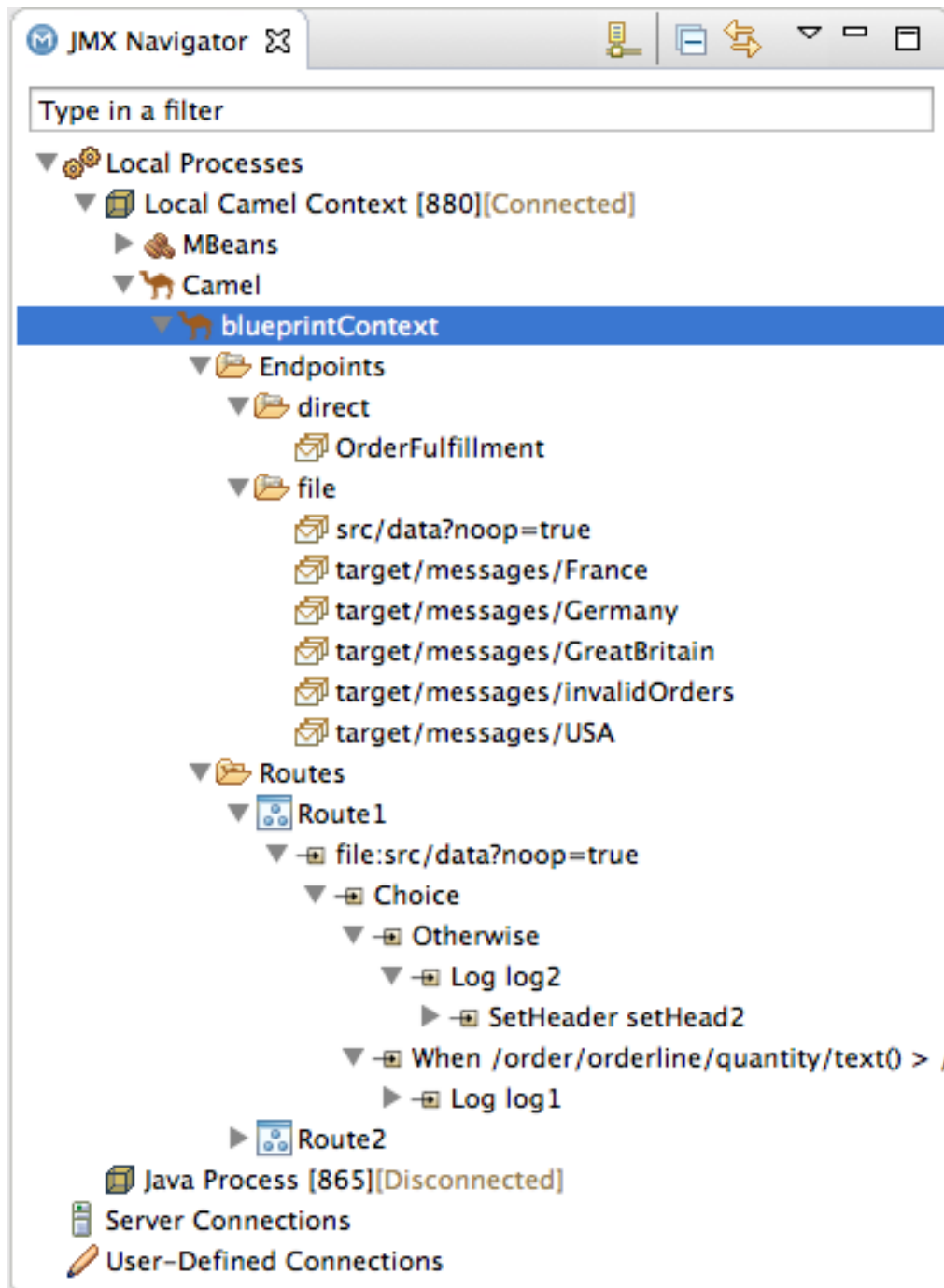
You can also monitor your Fuse applications with the Fuse Console as described in [Managing Fuse](#).



## CHAPTER 19. JMX NAVIGATOR

The **JMX Navigator** view, shown in [Figure 19.1, “JMX Navigator view”](#), displays all processes that are running in your application and it drives all interactions with the monitoring and testing features. Other areas of the **Fuse Integration** perspective adapt to display information related to the node selected in the **JMX Navigator** view. In the **JMX Navigator** view, its context menu provides the commands needed to activate route tracing and to add JMS destinations.

Figure 19.1. JMX Navigator view



By default, the **JMX Navigator** view discovers all JMX servers running on the local machine and lists them under the following categories:

- Local Processes
- Server Connections

- User-Defined Connections



## NOTE

You can add other JMX servers by using a server's JMX URL. For details, see [Section 19.2, "Adding a JMX server"](#).

## 19.1. VIEWING PROCESSES IN JMX


### Overview

The **JMX Navigator** view lists all known processes in a series of trees. The root for each tree is a JMX server.

The first tree in the list is a special **Local Processes** tree that contains all JMX servers that are running on the local machine. You must connect to one of the JMX servers to see the processes it contains.


### Viewing processes in a local JMX server

To view information about processes in a local JMX server:

1. In the **JMX Navigator** view, expand **Local Processes**.
2. Under **Local Processes**, double-click one of the top-level entries to connect to it.
3. Click the  icon that appears next to the entry to display a list of its components that are running in the JVM.

### Viewing processes in alternate JMX servers

To view information about processes in an alternate JMX server:

1. [Section 19.2, "Adding a JMX server"](#) the JMX server to the **JMX Navigator** view.
2. In the **JMX Navigator** view, expand the server's entry by using the  icon that appears next to the entry. This displays a list of that JMX server's components that are running in the JVM.

## 19.2. ADDING A JMX SERVER

### Overview

In the **JMX Navigator** view, under the **Local Processes** branch of the tree, you can see a list of all local JMX servers. You may need to connect to specific JMX servers to see components deployed on other machines.

To add a JMX server, you must know the JMX URL of the server you want to add.

### Procedure

To add a JMX server to the **JMX Navigator** view:

1. In the **JMX Navigator** view, click **New Connection** .

2. In the **Create a new JMX connection**wizard, select **Default JMX Connection**.
3. Click **Next**.
4. Select the **Advanced** tab.
5. In the **Name** field, enter a name for the JMX server.  
The name can be any string. It is used to label the entry in the **JMX Navigator** tree.
6. In the **JMX URL** field, enter the JMX URL of the server.
7. If the JMX server requires authentication, enter your user name and password in the **Username** and **Password** fields.
8. Click **Finish**.  
The new JMX server appears as a branch in the **User-Defined Connections** tree.

## CHAPTER 20. VIEWING A COMPONENT'S JMX STATISTICS

### OVERVIEW

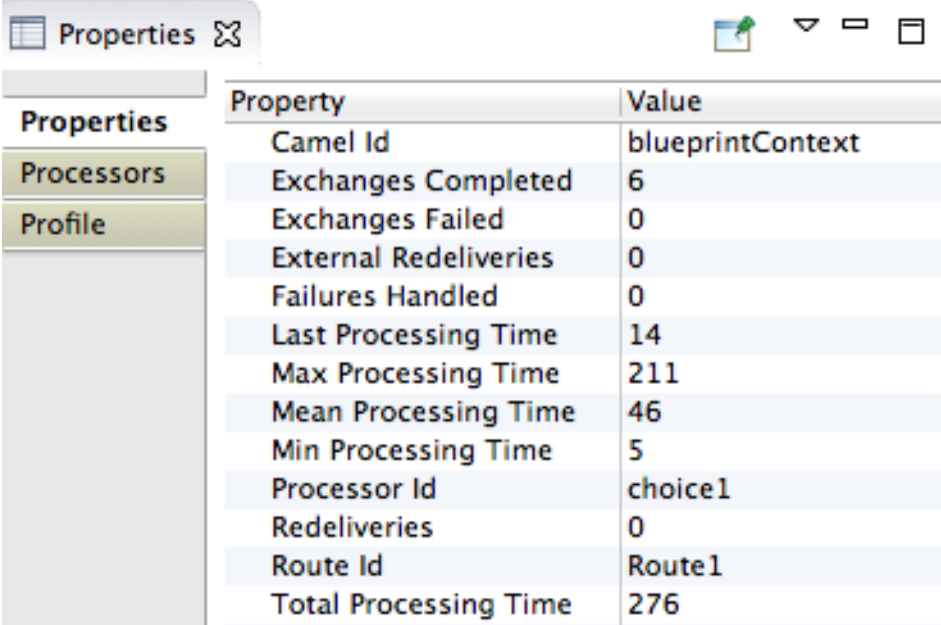
The tooling collects all JMX statistics reported by Fuse components and displays them in the **Properties** view. This statistical information can provide significant insight into what is happening in your integration application.

JMX statistics are grouped into three categories: **Properties**, **Processor**, and **Profile**.

### PROCEDURE

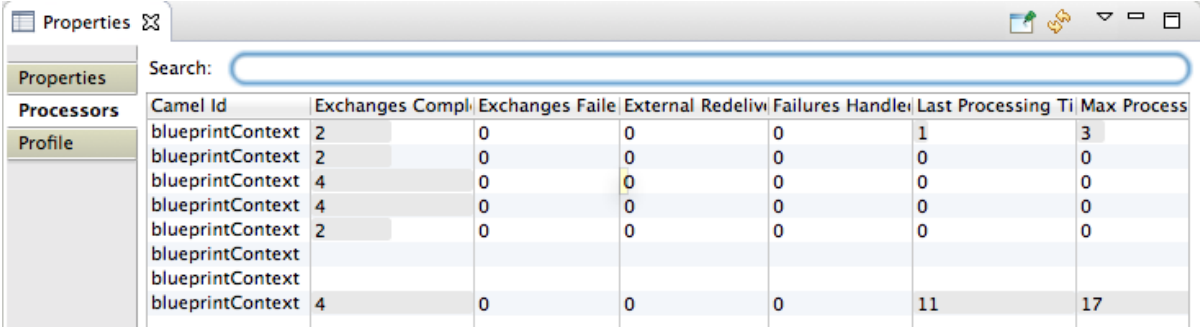
To see a Fuse component's statistics:

1. In the **JMX Navigator** view, locate the node for the component.  
You may have to expand nodes on the tree to locate low-level components.
2. Select the node of the Fuse component whose statistics you want to review.
3. Open the **Properties** view.
4. The **Properties** page displays the JMX properties for the selected component:



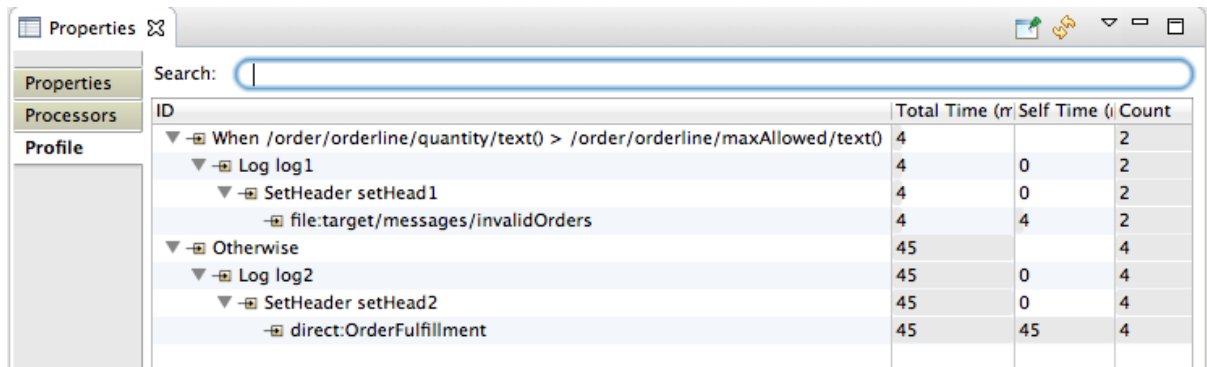
Property	Value
Camel Id	blueprintContext
Exchanges Completed	6
Exchanges Failed	0
External Redeliveries	0
Failures Handled	0
Last Processing Time	14
Max Processing Time	211
Mean Processing Time	46
Min Processing Time	5
Processor Id	choice1
Redeliveries	0
Route Id	Route1
Total Processing Time	276

5. Click **Processors** to check exchange metrics for the selected component:



Camel Id	Exchanges Compl	Exchanges Fail	External Redeliv	Failures Handle	Last Processing Ti	Max Process
blueprintContext	2	0	0	0	1	3
blueprintContext	2	0	0	0	0	0
blueprintContext	4	0	0	0	0	0
blueprintContext	4	0	0	0	0	0
blueprintContext	2	0	0	0	0	0
blueprintContext						
blueprintContext						
blueprintContext	4	0	0	0	11	17

6. Click **Profile** to check message metrics for the selected node and its subnodes:



The screenshot shows a window titled "Properties" with a search bar and a table of JMX statistics. The table has three columns: "ID", "Total Time (m)", "Self Time (i)", and "Count". The data is organized into a tree structure with expandable nodes.

ID	Total Time (m)	Self Time (i)	Count
▼ When /order/orderline/quantity/text() > /order/orderline/maxAllowed/text()	4		2
▼ Log log1	4	0	2
▼ SetHeader setHead1	4	0	2
file:target/messages/invalidOrders	4	4	2
▼ Otherwise	45		4
▼ Log log2	45	0	4
▼ SetHeader setHead2	45	0	4
direct:OrderFulfillment	45	45	4

## CHAPTER 21. BROWSING MESSAGES

### OVERVIEW

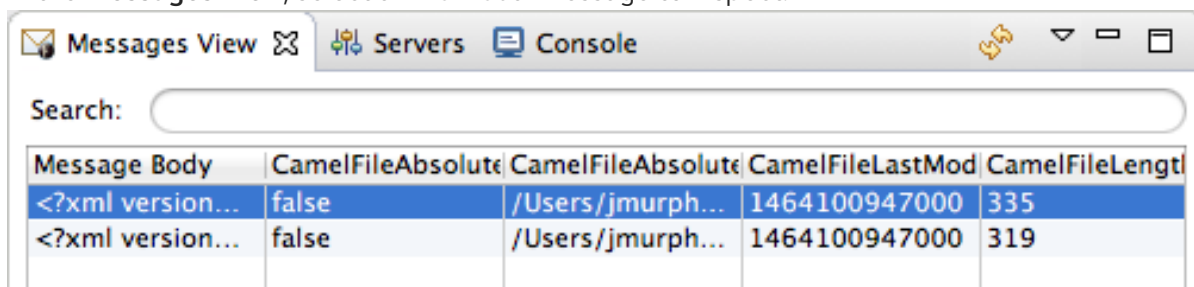
A key tool in debugging applications in a distributed environment is seeing all of the messages stored in the JMS destinations and route endpoints in the application. The tooling can browse the following:

- JMS destinations
- JMS routing endpoints
- Apache Camel routing endpoints
- SEDA routing endpoints
- Browse routing endpoints
- Mock routing endpoints
- VM routing endpoints
- DataSet routing endpoints

### PROCEDURE


To browse messages:

1. In the **JMX Navigator** view, select the JMS destination or endpoint you want to browse. The list of messages appears in the **Messages View**.
2. In the **Messages View**, select an individual message to inspect.



Message Body	CamelFileAbsolute	CamelFileAbsolute	CamelFileLastMod	CamelFileLengt
<?xml version...	false	/Users/jmurph...	1464100947000	335
<?xml version...	false	/Users/jmurph...	1464100947000	319

Message details and content are displayed in the **Properties** view:

Properties 

### Message Details

Name	Value
CamelFileAbsolute	false
CamelFileAbsolutePath	/Users/jmurphey/workspaceCR1a/CBRroute/target/mess...
CamelFileLastModified	1464100947000
CamelFileLength	335
CamelFileName	message4.xml
CamelFileNameConsumed	message4.xml
CamelFileNameOnly	message4.xml
CamelFileParent	target/messages/invalidOrders
CamelFilePath	target/messages/invalidOrders/message4.xml
CamelFileRelativePath	message4.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<order>
  <customer>
    <name>Bristol Zoological Gardens</name>
    <city>Bristol</city>
    <country>Great Britain</country>
  </customer>
  <orderline>
    <animal>emu</animal>
    <quantity>5</quantity>
    <maxAllowed>4</maxAllowed>
  </orderline>
</order>
```

## RELATED TOPICS

- [Section 22.3, "Tracing messages through a routing context"](#)

## CHAPTER 22. TRACING ROUTES

Debugging a route often involves solving one of two problems:

- A message was improperly transformed.
- A message failed to reach its destination endpoint.

Tracing one or more test messages through the route is the easiest way to discover the source of such problems.

The tooling's route tracing feature enables you to monitor the path a message takes through a route and see how the message is transformed as it passes from processor to processor.

The **Diagram View** displays a graphical representation of the route, which enables you to see the path a message takes through it. For each processor in a route, it also displays the average processing time, in milliseconds, for all messages processed since route start-up and the number of messages processed since route start-up.

The **Messages View** displays the messages processed by a JMS destination or route endpoint selected in the **JMX Navigator** tree. Selecting an individual message trace in the **Messages View** displays the full details and content of the message in the **Properties** view and highlights the corresponding node in the **Diagram View**.

Tracing messages through a route involves the following steps:

1. [Section 22.1, "Creating test messages for route tracing"](#)
2. [Section 22.2, "Activating route tracing"](#)
3. [Section 22.3, "Tracing messages through a routing context"](#)
4. [Section 22.4, "Deactivating route tracing"](#)

### 22.1. CREATING TEST MESSAGES FOR ROUTE TRACING

#### Overview

Route tracing works with any kind of message structure. The **Fuse Message** wizard creates an empty **.xml** message, leaving the structuring of the message entirely up to you.



#### NOTE

If the folder where you want to store the test messages does not exist, you need to create it before you create the messages.

#### Creating a new folder to store test messages

To create a new folder:

1. In the **Project Explorer** view, right-click the project root to open the context menu.
2. Select **New → Folder** to open the **New Folder** wizard.  
The project root appears in the **Enter or select the parent folder** field.



3. Expand the nodes in the graphical representation of the project's hierarchy, and select the node you want to be the parent folder.
4. In the **Folder name** field, enter a name for the new folder.
5. Click **Finish**.  
The new folder appears in the **Project Explorer** view, under the selected parent folder.

**NOTE**

If the new folder does not appear, right-click the parent folder and select **Refresh**.

## Creating a test message

To create a test message:

1. In the **Project Explorer** view, right-click the project to open the context menu.
2. Select **New → Fuse Message** to open the **New File** wizard.
3. Expand the nodes in the graphical representation of the project's hierarchy, and select the folder in which you want to store the new test message.
4. In the **File name** field, enter a name for the message, or accept the default ( **message.xml**).
5. Click **Finish**.  
The new message opens in the XML editor.
6. Enter the message contents, both body and header text.

**NOTE**

You may see the warning, **No grammar constraints (DTD or XML Schema) referenced in the document**, depending on the header text you entered. You can safely ignore this warning.

## Related topics

- [Section 22.3, "Tracing messages through a routing context"](#)

## 22.2. ACTIVATING ROUTE TRACING

### Overview

You must activate route tracing for the routing context before you can trace messages through that routing context.

### Procedure

To activate tracing on a routing context:

1. In the **JMX Navigator** view, select the running routing context on which you want to start tracing.

**NOTE**

You can select any route in the context to start tracing on the entire context.

2. Right-click the selected routing context to open the context menu, and then select **Start Tracing** to start the trace.  
If **Stop Tracing Context** is enabled on the context menu, then tracing is already active.

**Related topics**

- [Section 22.3, "Tracing messages through a routing context"](#)
- [Section 22.4, "Deactivating route tracing"](#)

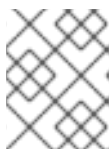
**22.3. TRACING MESSAGES THROUGH A ROUTING CONTEXT****Overview**

The best way to see what is happening in a routing context is to watch what happens to a message at each stop along the way. The tooling provides a mechanism for dropping messages into a running routing context and tracing the path the messages take through it.

**Procedure**

To trace messages through a routing context:

1. Create one or more test messages as described in [Section 22.1, "Creating test messages for route tracing"](#).
2. In the **Project Explorer** view, right-click the project's Camel context file to open the context menu, and select **Run As → Local Camel Context (without Tests)**.

**NOTE**

Do not run it as **Local Camel Context** unless you have created a comprehensive JUnit test for the project.

3. Activate tracing for the running routing context as described in [Section 22.2, "Activating route tracing"](#).
4. Drag one of the test messages from the **Project Explorer** view onto the routing context's starting point in the **JMX Navigator** view.
5. In the **JMX Navigator** view, select the routing context being traced.  
The tooling populates the **Messages View** with message instances that represent the message at each stage in the traced context.

The **Diagram View** displays a graphical representation of the selected routing context.

6. In the **Messages View**, select one of the message instances.  
The **Properties** view displays the details and content of the message instance.

In the **Diagram View**, the route step corresponding to the selected message instance is highlighted. If the route step is a processing step, the tooling tags the exiting path with timing and processing metrics.

7. Repeat this procedure as needed.

## Related topics

- [Section 22.1, "Creating test messages for route tracing"](#)
- [Section 22.2, "Activating route tracing"](#)
- [Section 22.4, "Deactivating route tracing"](#)

## 22.4. DEACTIVATING ROUTE TRACING

### Overview

When you are finished debugging the routes in a routing context, you should deactivate tracing.



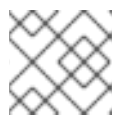
#### IMPORTANT

Deactivating tracing stops tracing and flushes the trace data for all of the routes in the routing context. This means that you cannot review any past tracing sessions.

### Procedure

To stop tracing for a routing context:

1. In the **JMX Navigator** view, select the running routing context for which you want to deactivate tracing.



#### NOTE

You can select any route in the context to stop tracing for the context.

2. Right-click the selected routing context to open the context menu, and then select **Stop Tracing Context**.  
If **Start Tracing** appears on the context menu, tracing is not activated for the routing context.

## Related topics

- [Section 22.2, "Activating route tracing"](#)
- [Section 22.3, "Tracing messages through a routing context"](#)

## CHAPTER 23. MANAGING JMS DESTINATIONS

The **JMX Navigator** view lets you add or delete JMS destinations in a running instance of Red Hat Fuse.



### IMPORTANT

These changes are not persistent across broker restarts.

### 23.1. ADDING A JMS DESTINATION

#### Overview

When testing a new scenario, it is convenient to add a new JMS destination to one of your brokers.

#### Procedure

To add a JMS destination to a broker:

1. In the **JMX Navigator** view, under the broker node for which you want to add a destination, select either the **Queues** child or the **Topics** child.
2. Right-click the selected node to open the context menu, and then select either **Create Queue** or **Create Topic**.
3. In either the **Create Queue** or **Create Topic** dialog, enter a name for the new destination.
4. Click **OK**.
5. Right-click either the **Queues** or the **Topics** child, and then select **Refresh**.  
The new destination appears in the **JMX Navigator** view under the **Queues** child or the **Topics** child.

#### Related topics

- [Section 23.2, "Deleting a JMS destination"](#)

### 23.2. DELETING A JMS DESTINATION

#### Overview

When testing failover scenarios or other scenarios that involve handling failures, it is helpful to be able to easily remove a JMS destination.

#### Procedure

To delete a JMS destination:

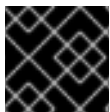
1. In the **JMX Navigator** view, under the **Queues** child or the **Topics** child, select the JMS destination you want to delete.
2. Right-click the selected destination to open the context menu, and then select **Delete Queue/Topic**.

## Related topics

- [Section 23.1, "Adding a JMS destination"](#)

## CHAPTER 24. MANAGING ROUTING ENDPOINTS

The **JMX Navigator** view lets you add or delete routing endpoints.



### IMPORTANT

These changes are not persistent across routing context restarts.

### 24.1. ADDING A ROUTING ENDPOINT

#### Overview

When testing a new scenario, you might want to add a new endpoint to a routing context.

#### Procedure

To add an endpoint to a routing context:

1. In the **JMX Navigator** view, under the routing context node, select the **Endpoints** child to which you want to add an endpoint.
2. Right-click the selected node to open the context menu, and then select **Create Endpoint**.
3. In the **Create Endpoint** dialog, enter a URL that defines the new endpoint, for example, <file://target/messages/validOrders>.
4. Click **OK**.
5. Right-click the routing context node, and select **Refresh**.  
The new destination appears in the **JMX Navigator** view under the **Endpoints** node, in a folder that corresponds to the type of endpoint it is, for example, **file**.

#### Related topics

- [Section 24.2, “Deleting a routing endpoint”](#)

### 24.2. DELETING A ROUTING ENDPOINT

#### Overview

When testing failover scenarios or other scenarios that involve handling failures, it is helpful to be able to remove an endpoint from a routing context.

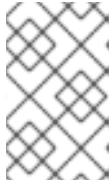
#### Procedure

To delete a routing endpoint:

1. In the **JMX Navigator** view, select the endpoint you want delete.
2. Right-click the selected endpoint to open the context menu, and then select **Delete Endpoint**.  
The tooling deletes the endpoint.

3. To remove the deleted endpoint from the view, right-click the **Endpoints** node, and select **Refresh**.

The endpoint disappears from the **JMX Navigator** view.



#### NOTE

To remove the endpoint's node from the **Project Explorer** view without rerunning the project, you need to explicitly delete it by right-clicking the node and selecting **Delete**. To remove it from view, refresh the project display.

#### Related topics

- [Section 24.1, "Adding a routing endpoint"](#)

## CHAPTER 25. EDITING RUNNING ROUTES

### OVERVIEW

You can experiment with changes to a running route without changing your project's routing context.

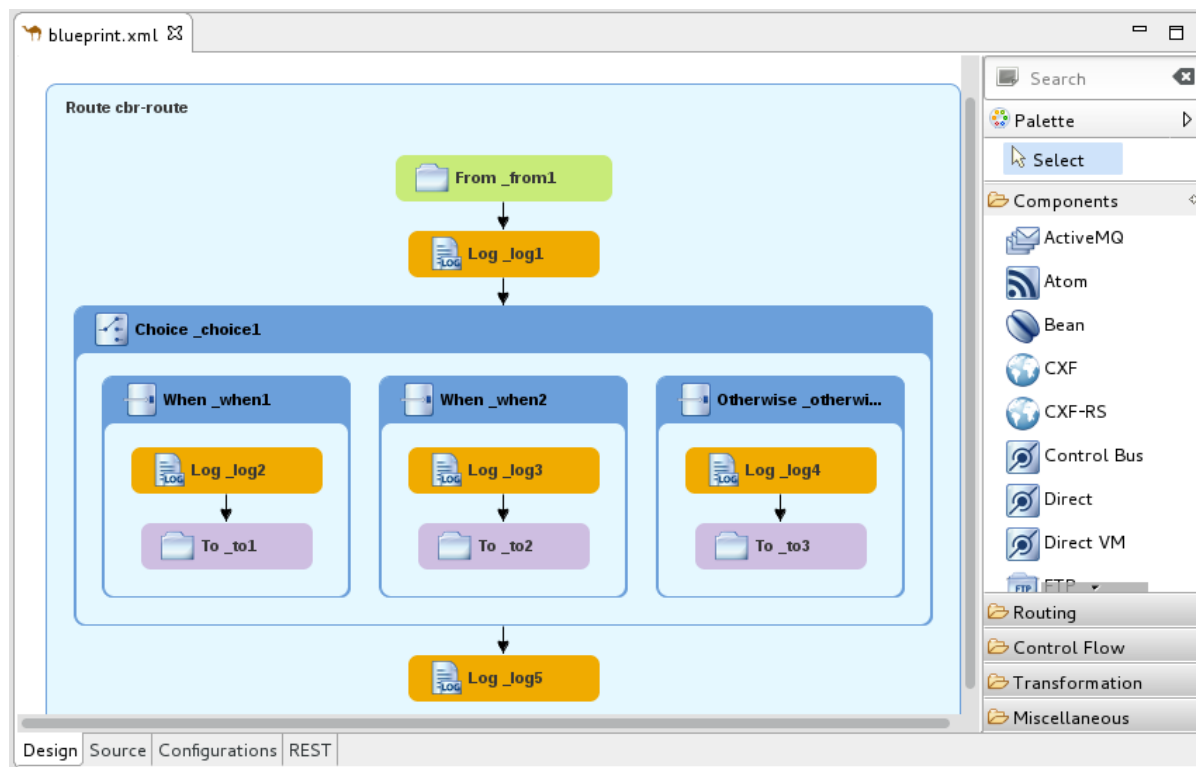
To do so:

- In the **JMX Navigator** view, enable the **Edit Routes** option on the running routing context. This opens an in-memory model of it – **Remote CamelContext:<camelContextId>** – in the route editor.
- In the route editor, make your changes to the in-memory model of the routing context. At the same time, you can set breakpoints on relevant nodes to use the Camel debugger and all of its features.  
You can edit the in-memory model to add, remove, or rearrange nodes; to add or remove properties of existing nodes; and to modify property values set on existing nodes. You must save changes made to the in-memory model to update the running context and to see results in the **Debug** perspective if you set breakpoints.
- In the **JMX Navigator** view, drop messages on the running routing context, or wait for messages to arrive from a timer, ActiveMQ, file, or other continuous input node.
- In the **Debug** perspective, evaluate results and use the Camel debugger to gain deeper insight into your routing context.

### MODIFYING A RUNNING ROUTE AND EVALUATING RESULTS

1. In the **JMX Navigator** view, select the routing context that contains the routes you want to edit.
2. Right-click the selected routing context to open the context menu, and select **Edit Routes**. The route editor opens an in-memory model of the routing context, **Remote CamelContext:<contextId>**, and displays all routes in the context, for example:





## NOTE

`<contextId>` is the ID of the **camelContext** element in the project's routing context **.xml** file. In this example, which is based on the **Fuse → Content Based Router** built-in template, the ID is **cbr-example-context**.

3. Edit the route as described in [Chapter 2, Editing a routing context in the route editor](#), then select **File → Save** to save the changes you made to the in-memory model and to update the running routing context.
4. Set breakpoints on the relevant nodes as described in [Chapter 13, Setting Breakpoints](#).
5. In the **JMX Navigator** view, drop a message on the running routing context's input node. If your project does not include test messages, you can create them as described in [Section 22.1, "Creating test messages for route tracing"](#).
6. Click **Yes** to confirm the switch to the **Debug** perspective.
7. In the Camel debugger, step the message through the breakpoints as you normally would (see [Chapter 14, Running the Camel Debugger](#)) to see the results your changes generated. The Camel debugger behaves the same in **Edit Routes** mode as in normal debug mode, so you can use any of the Camel debugger's features while a message is transiting the routing context.



## NOTE





When a message reaches the end of the routing context, the debugger is suspended. To continue debugging, switch back to the **Fuse Integration** perspective and drop another message on the input node in the **JMX Navigator** view. Each time you do so, the tooling asks you to confirm the switch to the **Debug** perspective.



## NOTE

During a route editing session, it is possible to lose the connection to the running routing context. If this happens, then in the **JMX Navigator** view, you would see something like this: **Local Processes** → **maven[xxxx][Disconnected]**. To continue the session, you must reconnect to the running routing context, select it in the **JMX Navigator** view, and then re-select **Edit Routes**.

## TERMINATING THE ROUTE EDITING SESSION

1. In the **Debug** perspective's **Debug** view, select the **Remote Camel Debug - camelContext--<contextId>--xxxxxxxxxxxxxxxxxxxx.xml [Remote Camel Context]** thread, and then click  on the menu bar to terminate the debugging session.
2. On **Console** view's menu bar, click  to terminate the routing context.
3. If you want to clear console output, click  on the **Console** view's menu bar.
4. Switch to the **Fuse Integration** perspective, and in the route editor, click  on the **Remote CamelContext:<contextId>** tab to close the in-memory model of the routing context file.

## RELATED TOPICS

- [Chapter 2, Editing a routing context in the route editor](#)
- [Part II, "Debugging Routing Contexts"](#)

## CHAPTER 26. MANAGING ROUTING CONTEXTS

The **JMX Navigator** view lets you suspend and resume running routing contexts.

### 26.1. SUSPENDING OPERATION OF A ROUTING CONTEXT

#### Overview

The tooling enables you to suspend the operation of a routing context in the **JMX Navigator** view. Suspending context operation gracefully shuts down all routes in the context, but keeps them loaded in memory, so that they can resume operation.

#### Procedure

To suspend operation of a routing context:

1. In the **JMX Navigator** view, expand the project's **Camel Contexts** node, and select the routing context whose operation you want to suspend.
2. Right-click the selected routing context to open the context menu, and then select **Suspend Camel Context**.



#### NOTE

If **Resume Camel Context** appears on the context menu, operation of the context is already suspended.

#### Related topics

- [Section 26.2, "Resuming operation of a routing context"](#)

### 26.2. RESUMING OPERATION OF A ROUTING CONTEXT

#### Overview

The tooling lets you resume operation of a suspended routing context in the **JMX Navigator** view. Resuming operation of a context restarts all of the routes in it so that they can process messages.

#### Procedure

To resume operation of a routing context:

1. In the **JMX Navigator** view, expand the project's **Camel Contexts** node, and select the routing context whose operation you want to resume.
2. Right-click the selected context to open the context menu, and then select **Resume Camel Context**.



#### NOTE

If **Suspend Camel Context** appears in the context menu, the context and its routes are running.

## Related topics

- [Section 26.1, "Suspending operation of a routing context"](#)

## PART IV. PUBLISHING APPLICATIONS TO A CONTAINER

To publish Fuse Integration projects to a server container, you must first add the server and its runtime definition to the tooling's **Servers** list. Then you can assign projects to the server runtime and set the publishing options for it.

## CHAPTER 27. MANAGING SERVERS



### NOTE

For step by step instructions on how to publish a Camel project to Red Hat Fuse, see [Chapter 28, Publishing Fuse Integration Projects to a Server](#).

### 27.1. ADDING A SERVER

#### Overview

For the tooling to manage a server, you need to add the server to the **Servers** list. Once added, the server appears in the **Servers** view, where you can connect to it and publish your Fuse Integration projects.



### NOTE

If adding a Red Hat Fuse server, it is recommended that you edit its *installDir/etc/users.properties* file and add user information, in the form of **user=password,role**, to enable the tooling to establish an SSH connection to the server.

#### Procedure

There are three ways to add a new server to the **Servers** view:

- In the **Servers** view, click **No servers are available. Click this link to create a new server...**



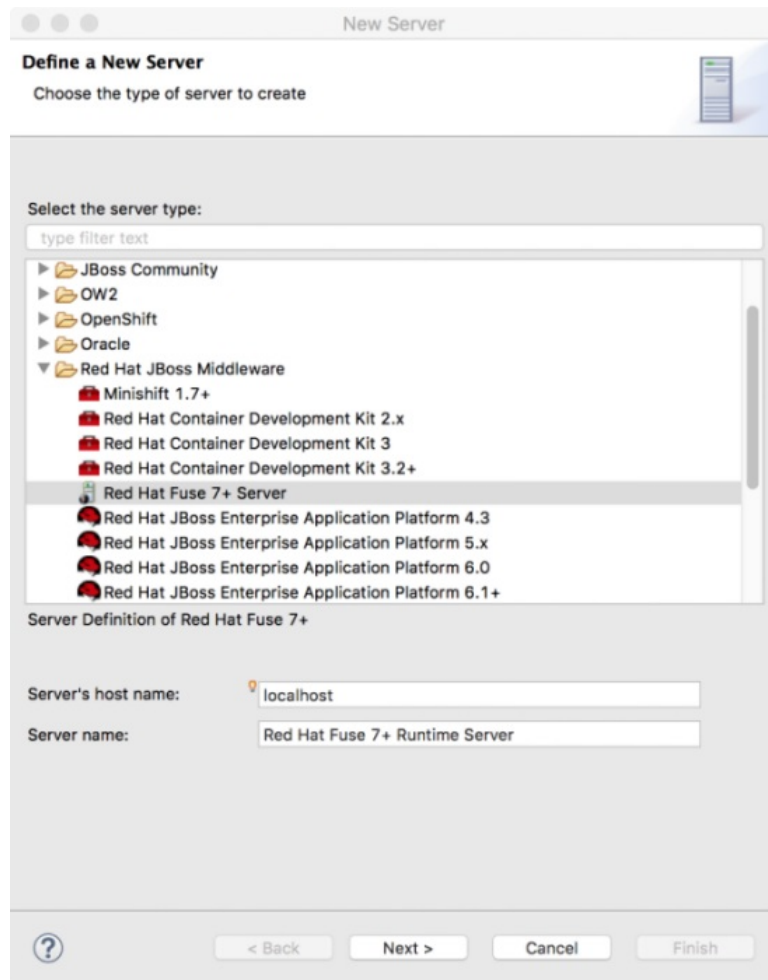
### NOTE

This link appears in the **Servers** view only when no server has been defined. If you defined and added a server when you first created your project, the **Servers** view displays that server.

- In the **Servers** view, right-click to open the context menu and select **New → Server**.
- On the menu bar, select **File → New → Other → Server → Server**.

In the **Define a New Server** dialog, to add a new server:

1. Expand the **Red Hat JBoss Middleware** node to expose the list of available server options:



2. Click the server that you want to add.
3. In the **Server's host name** field, accept the default (**localhost**).



#### NOTE

The address of **localhost** is **0.0.0.0**.

4. In the **Server name** field, accept the default, or enter a different name for the runtime server.
5. For **Server runtime environment**, accept the default or click **Add** to open the server's runtime definition page:

**Red Hat Fuse Runtime**  
Runtime definition for Red Hat Fuse 7+

Please point to a Red Hat Fuse installation.

Name  
Red Hat Fuse 7+ Runtime

Home Directory [Download and install runtime...](#)  
Browse...

Runtime JRE

Execution Environment: JavaSE-1.8 Environments...

Alternate JRE: Java SE 8 [1.8.0\_171] Installed JREs...

< Back Next > Cancel Finish



## NOTE

If the server is not already installed on your machine, you can install it now by clicking **Download and install runtime...** and following the site's download instructions. Depending on the site, you might be required to provide valid credentials before you can continue the download process.

6. Accept the default for the installation **Name**.
7. In the **Home Directory** field, enter the path where the server runtime is installed, or click **Browse** to find and select it.
8. Next to **Execution Environment**, select the runtime JRE from the drop-down menu. If the version you want does not appear in the list, click **Environments** and select the version from the list that appears. The JRE version you select must be installed on your machine.



## NOTE

See [Red Hat Fuse Supported Configurations](#) for the required Java version.

9. Leave the **Alternate JRE** option as is.
10. Click **Next** to save the server's runtime definition and open its **Configuration details** page:



11. Accept the default for **SSH Port (8101)**.  
The runtime uses the SSH port to connect to the server's Karaf shell. If this default is incorrect for your setup, you can discover the correct port number by looking in the server's `installDir/etc/org.apache.karaf.shell.cfg` file.
12. In the **User Name** field, enter the name used to log into the server.  
For Red Hat Fuse, this is a user name stored in the Red Hat Fuse `installDir/etc/users.properties` file.



#### NOTE

If the default user has been activated (uncommented) in the `/etc/users.properties` file, the tooling autofills the **User Name** and **Password** fields with the default user's name and password, as shown in [\[servCnfigDetails\]](#).

If a user has not been set up, you can either add one to that file by using the format **user=password,role** (for example, **joe=secret,Administrator**), or you can set one using the karaf **jaas** command set:

- **jaas:realms** – to list the realms
- **jaas:manage --index 1** – to edit the first (server) realm
- **jaas:useradd <username> <password>** – to add a user and associated password
- **jaas:roleadd <username> Administrator** – to specify the new user's role
- **jaas:update** – to update the realm with the new user information

If a **jaas** realm has already been selected for the server, you can discover the user name by issuing the command **JBossFuse:karaf@root>jaas:users**.

13. In the **Password** field, enter the password required for **User Name** to log into the server.
14. Click **Finish** to save the server's configuration details.  
The server runtime appears in the **Servers** view.

Expanding the server node exposes the server's JMX node:




## 27.2. STARTING A SERVER

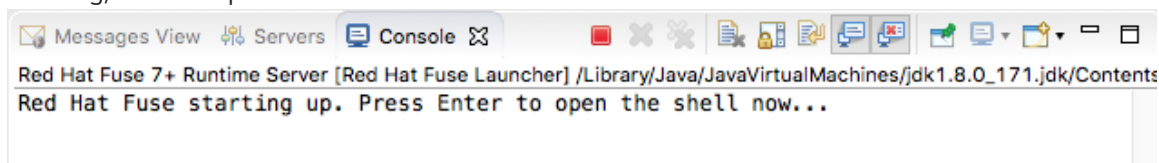
### Overview

When you start a configured server, the tooling opens the server's remote management console in the **Terminal** view. This allows you to easily manage the container while testing your application.

### Procedure

To start a server:

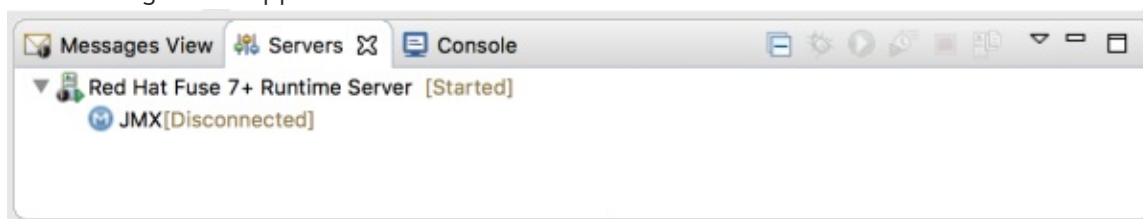
1. In the **Servers** view, select the server you want to start.
  2. Click  .
- The **Console** view opens and displays a message asking you to wait while the container is starting, for example:



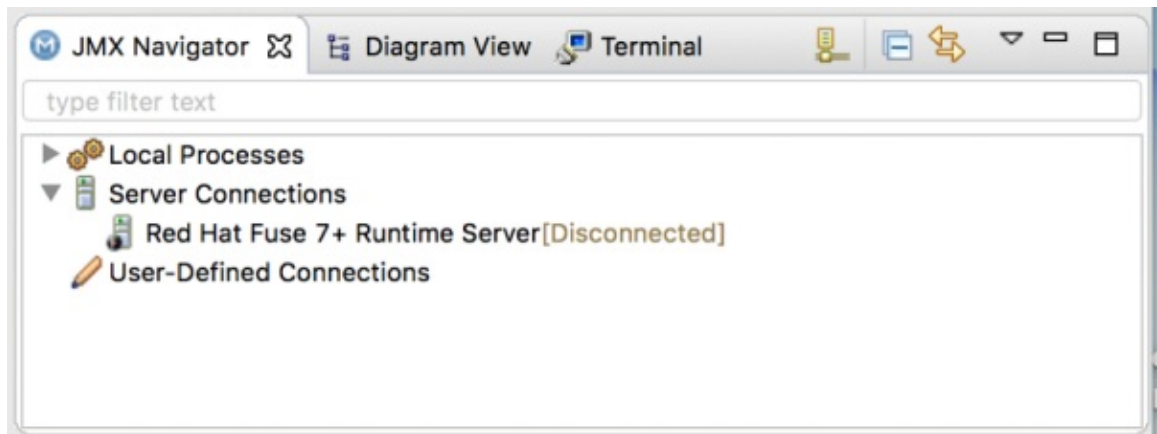
### NOTE

If you did not properly configure the user name and password for opening the remote console, a dialog opens asking you to enter the proper credentials. See [Section 27.1, "Adding a Server"](#) .

- After the container has started up, the **Terminal** view opens to display the container's management console.
- The running server appears in the **Servers** view:



- The running server also appears in the **JMX Navigator** view under **Server Connections**:

**NOTE**

If the server is running on the same machine as the tooling, the server also has an entry under **Local Processes**.

## 27.3. CONNECTING TO A RUNNING SERVER

### Overview

After you start a configured server, it appears in the **Servers** view and in the **JMX Navigator** view under the **Server Connections** node. You may need to expand the **Server Connections** node to see the server.

To publish and test your Fuse project application on the running server, you must first connect to it. You can connect to a running server either in the **Servers** view or in the **JMX Navigator** view.

**NOTE**

The **Servers** view and the **JMX Navigator** view are synchronized with regards to server connections. That is, connecting to a server in the **Servers** view also connects it in the **JMX Navigator** view, and vice versa.

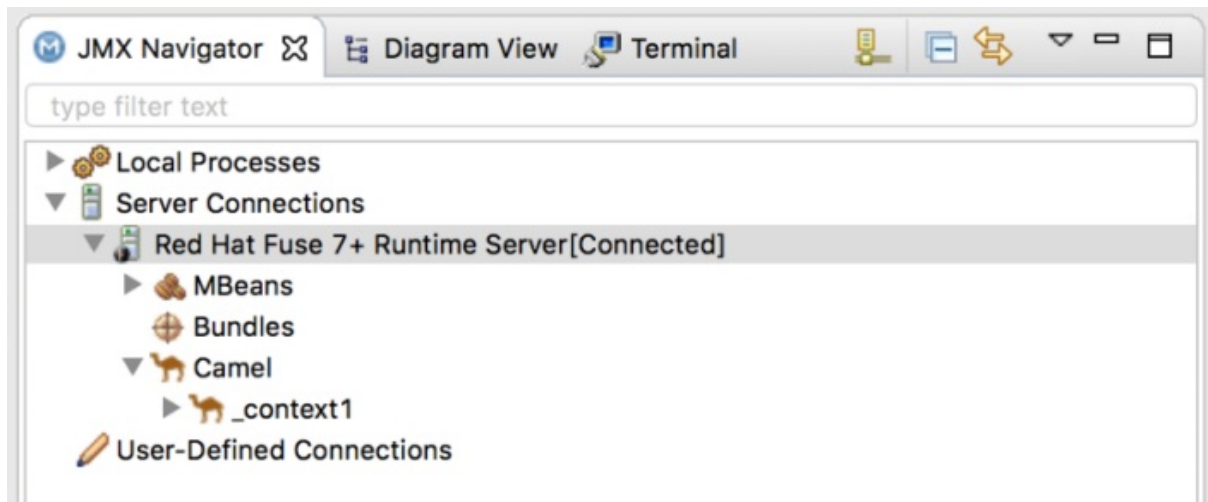
### Connecting to a running server in the Servers view

1. In the **Servers** view, expand the server runtime to expose its **JMX[Disconnected]** node.
2. Double-click the **JMX[Disconnected]** node:



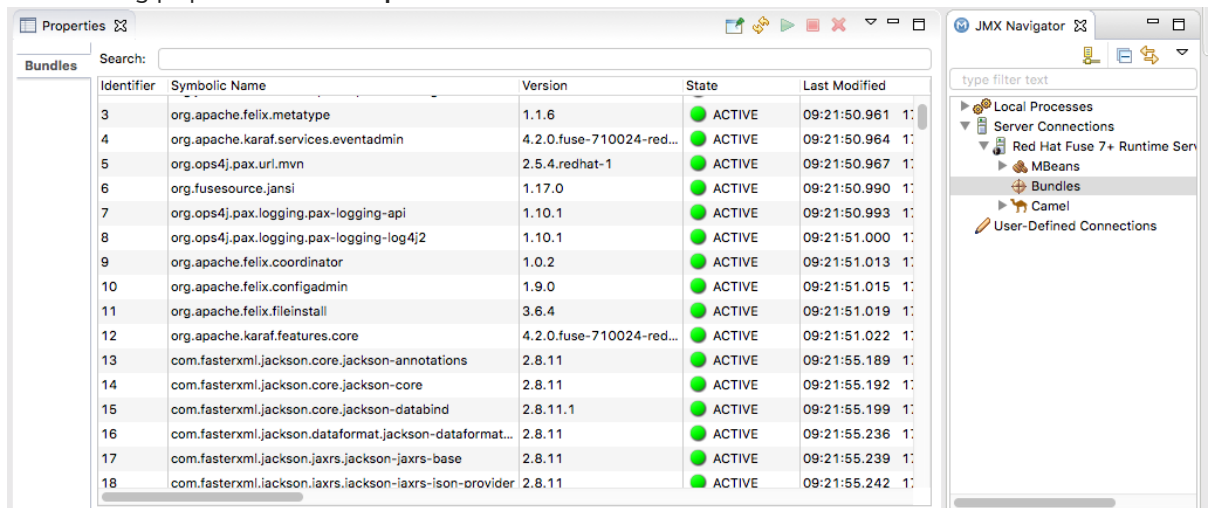
### Connecting to a running server in the JMX Navigator view

1. In the **JMX Navigator** view, under the **Server Connections** node, select the server to which you want to connect.
2. Double-click the selected server:



## Viewing bundles installed on the connected server

1. In either the **Servers** view or the **JMX Navigator** view, expand the server runtime tree to expose the **Bundles** node, and select it.
2. The tooling populates the **Properties** view with a list of bundles that are installed on the server:



Using the **Properties** view's **Search** tool, you can search for bundles by their **Symbolic Name** or by their **Identifier**, if you know it. As you type the symbolic name or the identifier, the list updates, showing only the bundles that match the current search string.



### NOTE

Alternatively, you can issue the **osgi:list** command in the **Terminal** view to see a generated list of bundles installed on the Red Hat Fuse server runtime. The tooling uses a different naming scheme for OSGi bundles displayed by the **osgi:list** command.

In the **<build>** section of project's **pom.xml** file, you can find the bundle's symbolic name and its bundle name (OSGi) listed in the **maven-bundle-plugin** entry. For more details, see [the section called "Verifying the project was published to the server"](#).

## 27.4. DISCONNECTING FROM A SERVER

## Overview

When you are done testing your application, you can disconnect from the server without stopping it.

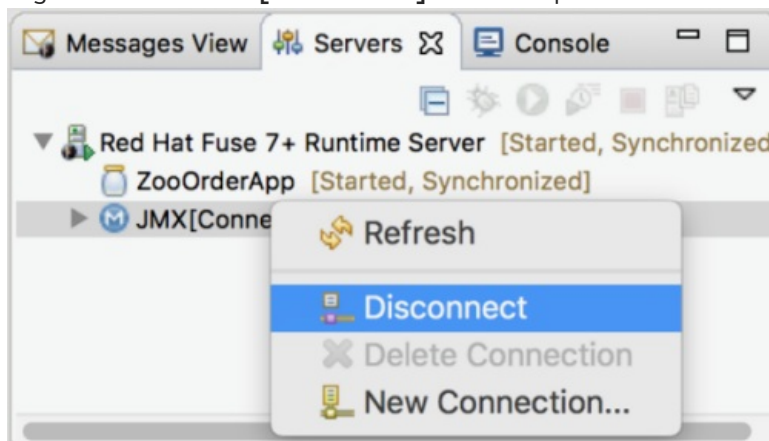


### NOTE

The **Servers** view and the **JMX Navigator** view are synchronized with regards to server connections. That is, disconnecting from a server in the **Servers** view also disconnects it in the **JMX Navigator** view, and vice versa.

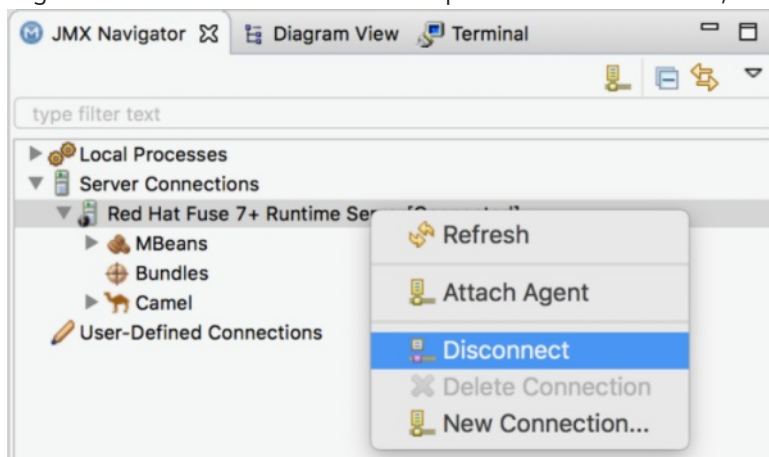
## Disconnecting from a server in the Servers view

1. In the **Servers** view, expand the server runtime to expose its **JMX[Connected]** node.
2. Right-click the **JMX[Connected]** node to open the context menu, and then select **Disconnect**.



## Disconnecting from a server in the JMX Navigator view

1. In the **JMX Navigator** view, under **Server Connections**, select the server from which you want to disconnect.
2. Right-click the selected server to open the context menu, and then select **Disconnect**.




## 27.5. STOPPING A SERVER

### Overview

You can shut down a server in the **Servers** view or in the server's remote console in the **Terminal** view.

## Using the Servers view

To stop a server:

1. In the **Servers** view, select the server you want to stop.
2. Click  .

## Using the remote console

To stop a server:

1. Open the **Terminal** view that is hosting the server's remote console.
2. Press: **CTRL+D**

## 27.6. DELETING A SERVER

### Overview

When you are finished with a configured server, or if you misconfigure a server, you can delete it and its configuration.

First, delete the server from the **Servers** view or from the **JMX Navigator** view. Next, delete the server's configuration.

### Deleting a server

1. In the **Servers** view, right-click the server you want to delete to open the context menu.
2. Select **Delete**.
3. Click **OK**.

### Deleting the server's configuration

On Linux and Windows machines, select **Window** → **Preferences**.

1. Expand the **Server** folder, and then select **Runtime Environments** to open the **Server Runtime Environments** page.
2. From the list, select the runtime environment of the server that you previously deleted from the **Servers** view, and then click **Remove**.
3. Click **OK**.

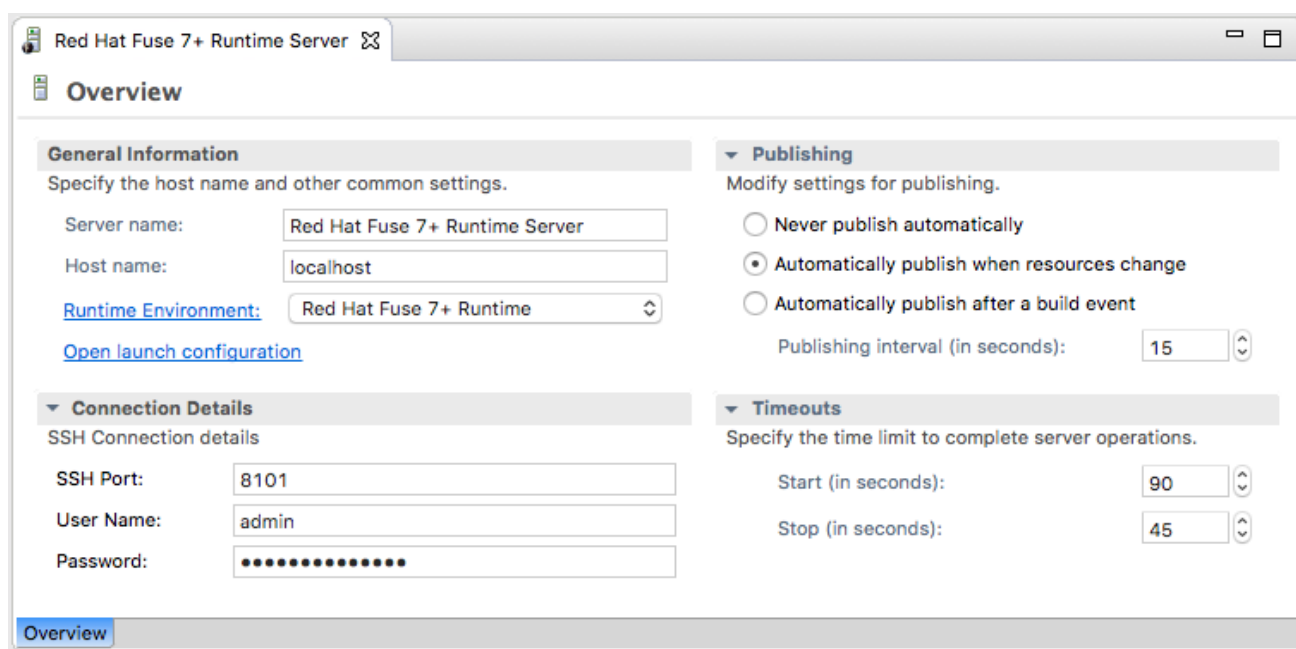
## CHAPTER 28. PUBLISHING FUSE INTEGRATION PROJECTS TO A SERVER

You deploy Fuse Integration projects into a server runtime using the Eclipse publishing mechanism. To do so, you must have defined and added the server to the **Servers** view in the **Fuse Integration** perspective. For a step-by-step demonstration, see .

### OVERVIEW

You can set up supported servers to publish assigned Fuse projects automatically or to publish them only when you manually invoke the publish command.

Each server runtime added to the **Servers** view has its own **Overview** page that contains its configuration, connection, and publishing details:



You might need to expand **Publishing** to expose the server runtime publishing options and default settings:

- **Never publish automatically** – You must select this option to manually publish projects.



#### IMPORTANT

You must also disable the **If server started, publish changes immediately** option on the server's **Add and Remove** page (for details see, [the section called "Publishing Fuse projects manually"](#)).

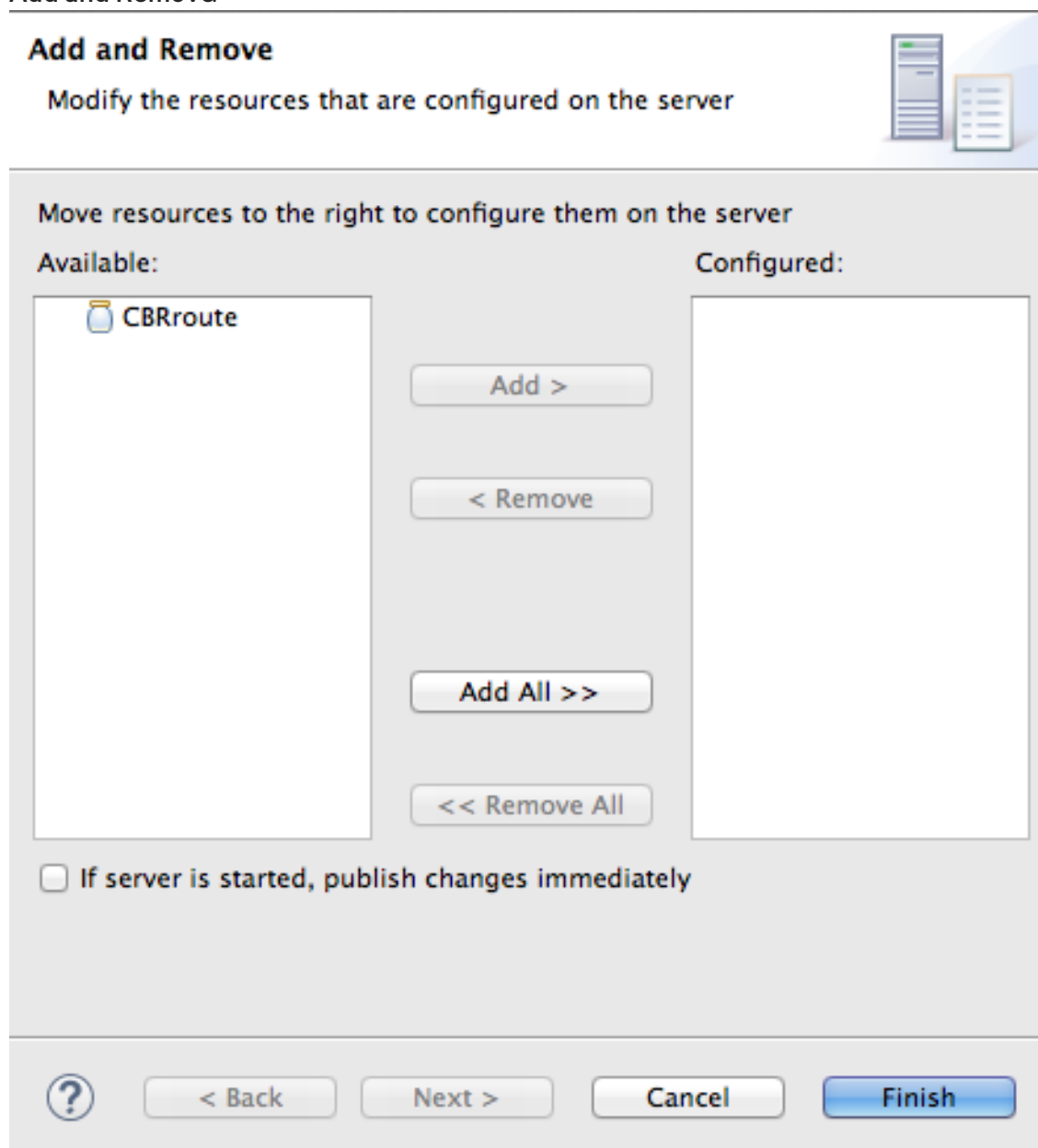
- **Automatically publish when resources change**– [default] Enable this option to automatically publish or republish a Fuse project when you save changes made to it. How quickly projects are published depends on the **Publishing interval** (default is 15 seconds).
- **Automatically publish after a build event**– For Fuse projects, works the same as **Automatically publish when resources change**



## PUBLISHING FUSE PROJECTS AUTOMATICALLY WHEN RESOURCES CHANGE

The default publishing option for server runtimes is **Automatically publish when resources change**

1. If necessary, start the server runtime to which you want to publish a Fuse project. For details, see [Section 27.2, "Starting a Server"](#).
2. In the **Servers** view, double-click the server runtime to open its **Overview** page.
3. Expand **Publishing**, and then select **Automatically publish when resources change**
4. To increase or decrease the interval between publishing cycles, click the radio button next to **Publishing interval (in seconds)** up or down, as appropriate.
5. In the **Servers** view, right-click the server runtime to open the context menu, and then select **Add and Remove**.

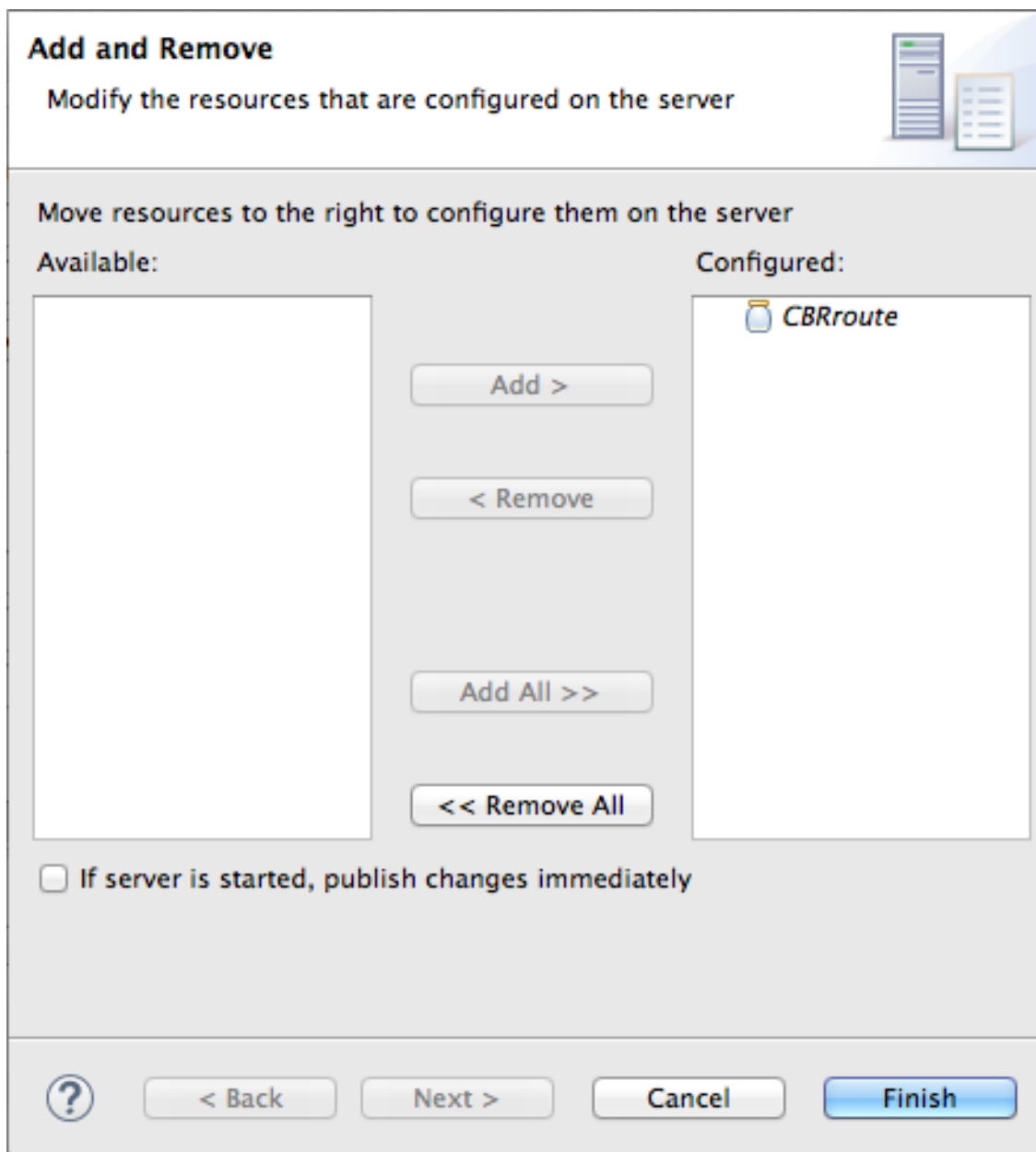


All resources available for publishing appear in the **Available** column.

6. To assign a resource (in this case, the **CBRroute** Fuse project) to the server runtime:

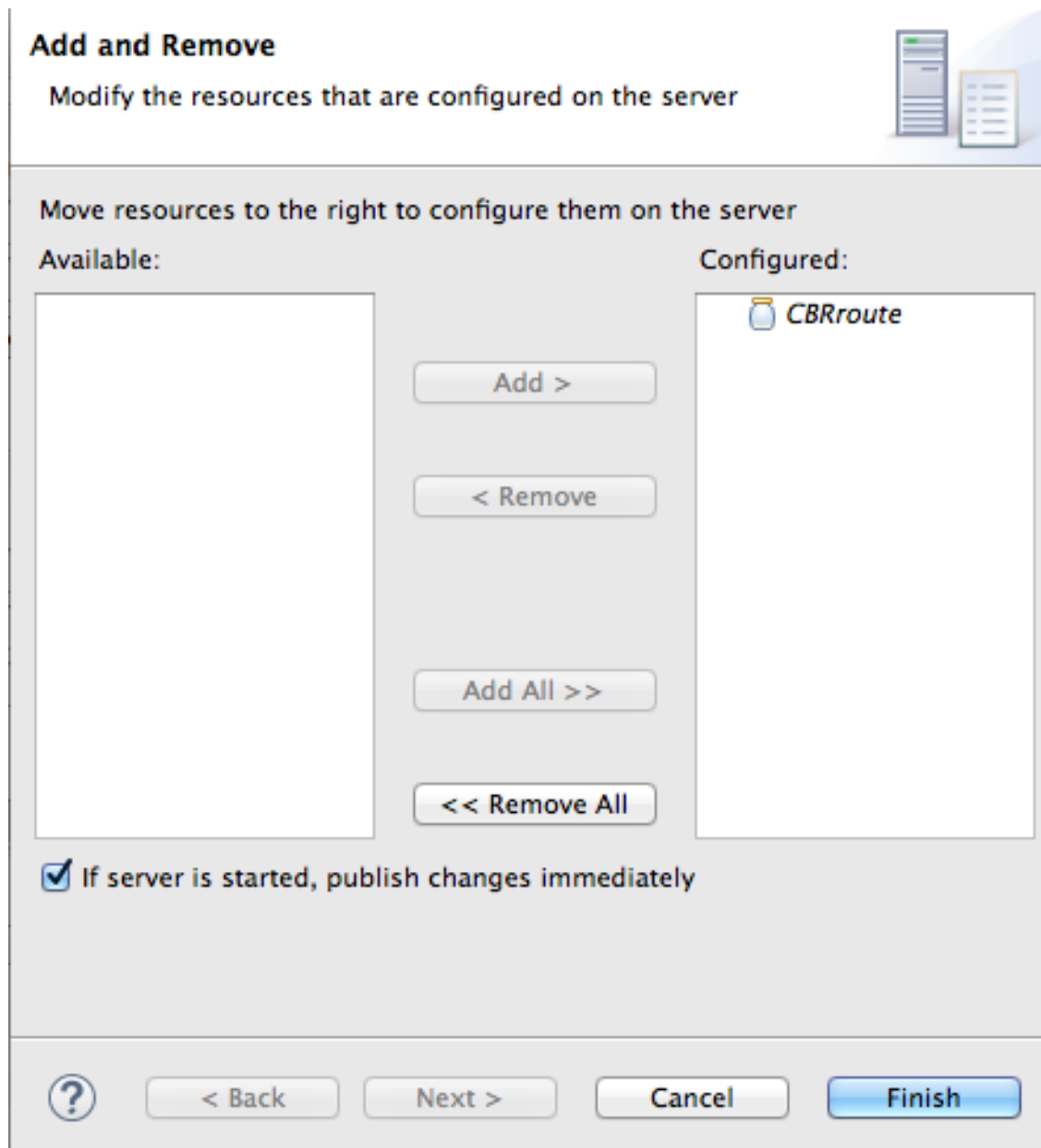


- Double-click it, or
- Select it, and click **Add**.  
The selected resource moves to the **Configured** column:



At this stage, the time at which the assigned resource would actually be published depends on whether the server runtime was running and on the **Publishing interval** setting. However, if the server was stopped, you would have to manually publish the project after you started the server (for details, see [the section called “Publishing Fuse projects manually”](#)).

7. Click the **If server started, publish changes immediately** option to enable it:

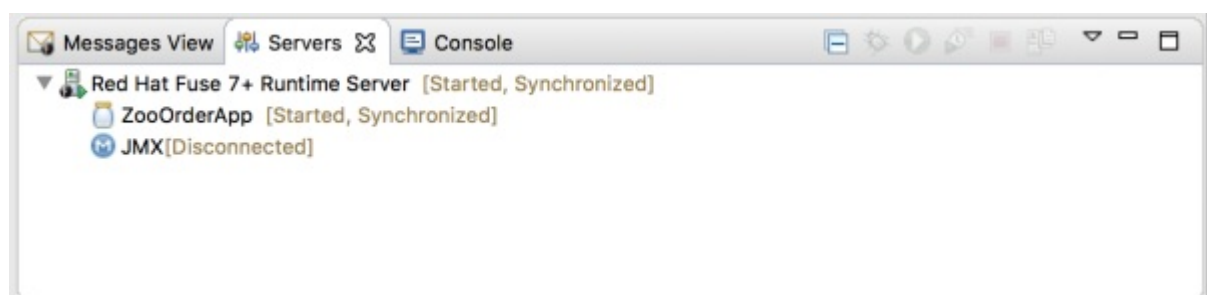


This option ensures that the configured project is published immediately once you click **Finish**. The **Automatically publish when resources change** option on the server runtime **Overview** page ensures that the configured project is republished whenever changes made to the local project are saved.

8. Click **Finish**.

The project appears in the **Servers** view under the server runtime node, and the server runtime status reports **[Started,Publishing...]**.

When publishing is done, the status of both the server runtime and the project report is **[Started,Synchronized]**:



**NOTE**

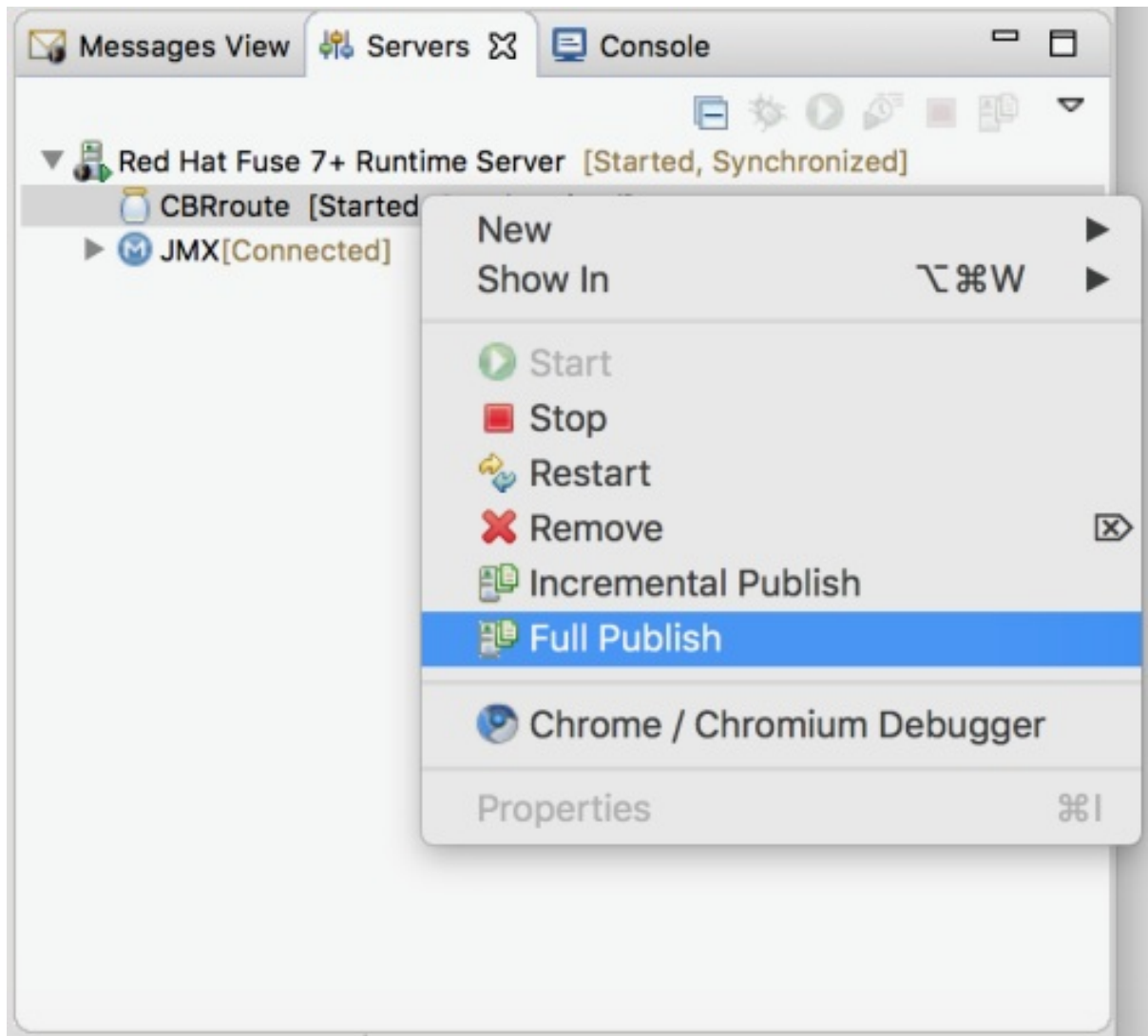
For a server runtime, **Synchronized** means that all published resources on the server are identical to their local counterparts. For a published resource, **Synchronized** means that it is identical to its local counterpart.

**PUBLISHING FUSE PROJECTS MANUALLY**

1. If necessary, start the server runtime to which you want to publish a Fuse project. For details, see [Section 27.2, “Starting a Server”](#).
2. In the **Servers** view, double-click the server runtime to open its **Overview** page.
3. Expand **Publishing**, and then select **Never publish automatically**.
4. Click **File** → **Save** to save the publishing option changes.
5. If the Fuse project has already been assigned to the server runtime, make sure this option is disabled: **If server started, publish changes immediately**
  - a. In the **Servers** view, right-click the server runtime to open the context menu.
  - b. Click **Add and Remove...** to open the server’s **Add and Remove** page.
  - c. If the following option is enabled, disable it: **If server started, publish changes immediately**.
  - d. Skip to [\[finish\]](#).
6. If the Fuse project has not been assigned to the server runtime, assign it now:
  - a. Follow [\[startAssignResource\]](#) through [\[stopAssignResource\]](#) in the section called [“Publishing Fuse projects automatically when resources change”](#).
  - b. Do not enable the **If server started, publish changes immediately** option.
7. Click **Finish**.  
The project appears in the **Servers** view under the server runtime node, and the server runtime status reports **[Started]**:



8. In the **Servers** view, right-click the project’s node. In this example, select the **CBRroute** Fuse project to open the context menu:



9. Select **Full Publish**.

During the publishing operation, the status of both the server runtime and the project report [**Started,Republish**].

When publishing is done, the status of both the server runtime and the project report [**Started,Synchronized**]:



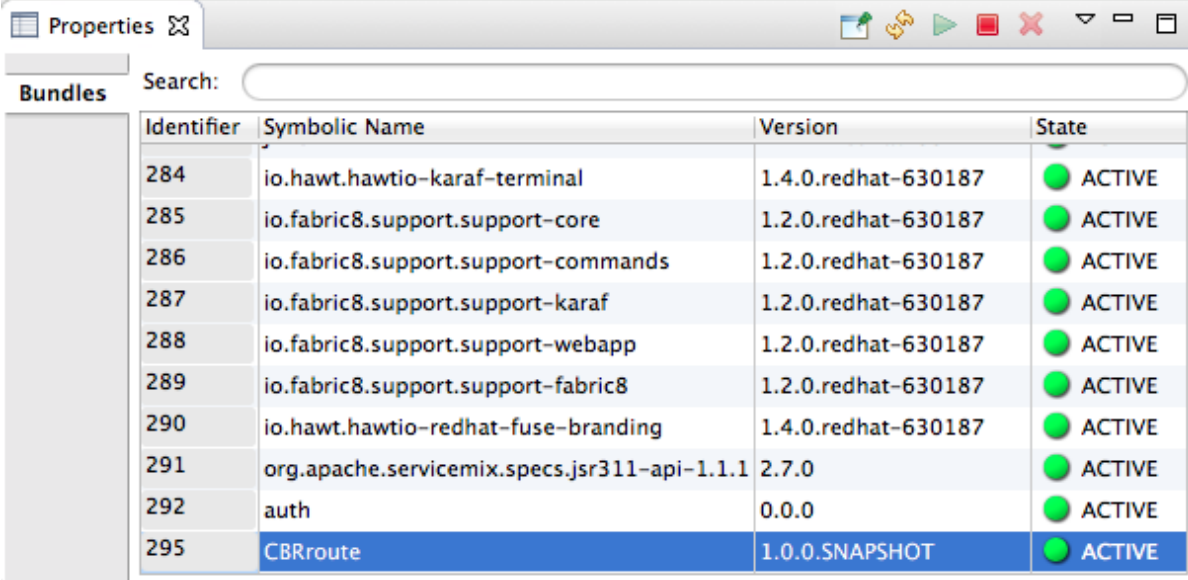
#### NOTE

The tooling does not support the **Incremental Publish** option. Clicking **Incremental Publish** results in a full publish.

## VERIFYING THE PROJECT WAS PUBLISHED TO THE SERVER

After you have published a Fuse project to a server runtime, you can connect to the server and check that the project's bundle was installed on it.

1. Connect to the server runtime. For details see [the section called "Connecting to a running server in the Servers view"](#).
2. In the **Servers** view, expand the server runtime tree to expose the **Bundles** node and select it. The tooling populates the **Properties** view with a list of bundles that are installed on the server:



Identifier	Symbolic Name	Version	State
284	io.hawt.hawtio-karaf-terminal	1.4.0.redhat-630187	ACTIVE
285	io.fabric8.support.support-core	1.2.0.redhat-630187	ACTIVE
286	io.fabric8.support.support-commands	1.2.0.redhat-630187	ACTIVE
287	io.fabric8.support.support-karaf	1.2.0.redhat-630187	ACTIVE
288	io.fabric8.support.support-webapp	1.2.0.redhat-630187	ACTIVE
289	io.fabric8.support.support-fabric8	1.2.0.redhat-630187	ACTIVE
290	io.hawt.hawtio-redhat-fuse-branding	1.4.0.redhat-630187	ACTIVE
291	org.apache.servicemix.specs.jsr311-api-1.1.1	2.7.0	ACTIVE
292	auth	0.0.0	ACTIVE
295	CBRroute	1.0.0.SNAPSHOT	ACTIVE

- To find your project's bundle, either scroll down to the bottom of the list, or start typing the bundle's **Symbolic Name** in the **Properties** view's **Search** box. The bundle's **Symbolic Name** is the name you gave your project when you created it.

## NOTE

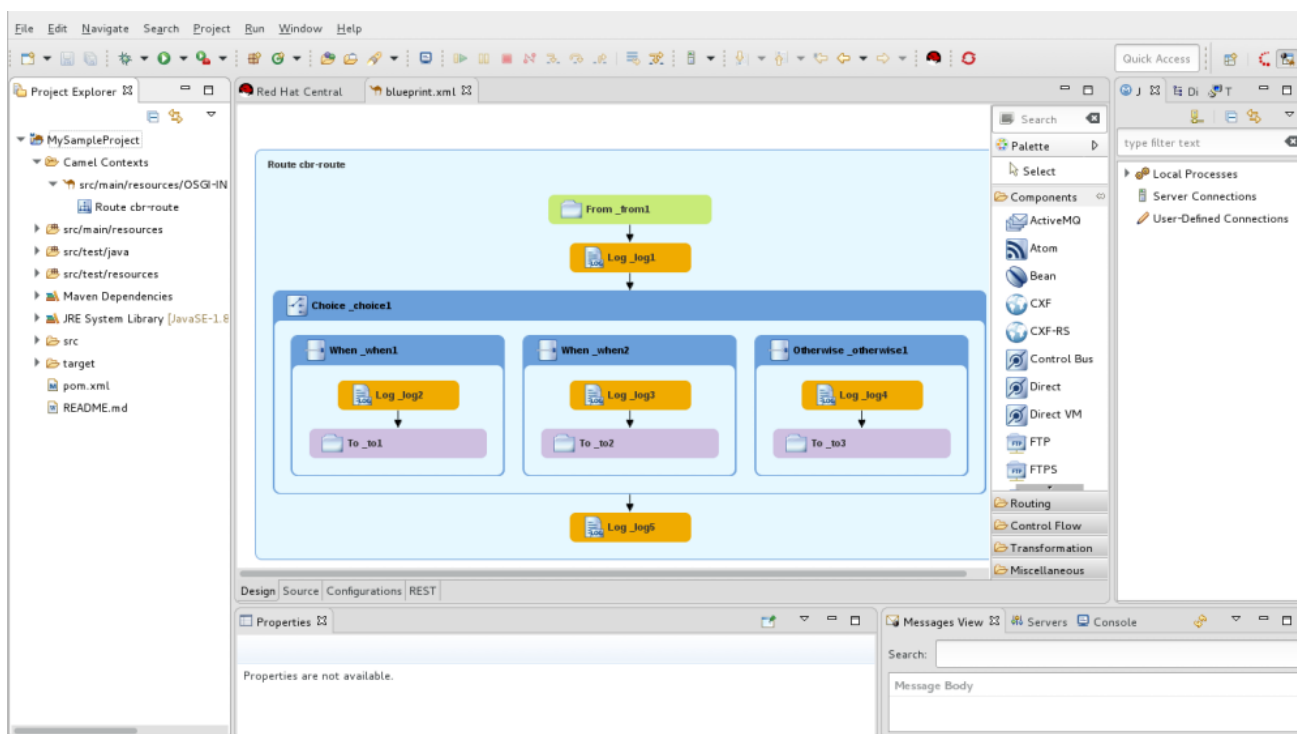
Alternatively, you can issue the **osgi:list** command in the **Terminal** view to see a generated list of bundles installed on the Fuse server runtime. The tooling uses a different naming scheme for OSGi bundles displayed by the **osgi:list** command.

In the **<build>** section of project's **pom.xml** file, you can find the bundle's symbolic name and its bundle name (OSGi) listed in the **maven-bundle-plugin** entry; for example:




```
<build>
  <defaultGoal>install</defaultGoal>
  <plugins>
    <plugin>
      <groupId>org.apache.felix</groupId>
      <artifactId>maven-bundle-plugin</artifactId>
      <version>${version.maven-bundle-plugin}</version>
      <extensions>>true</extensions>
      <configuration>
        <instructions>
          <Bundle-SymbolicName>CBRroute</Bundle-SymbolicName>
          <Bundle-Name>Empty Camel Blueprint Example [CBRroute]</Bundle-Name></instructions>
        </configuration>
      </plugin>
    </plugins>
  </build>
```

## APPENDIX A. FUSE INTEGRATION PERSPECTIVE

Use the **Fuse Integration** perspective to design, monitor, test, and publish your integration application.

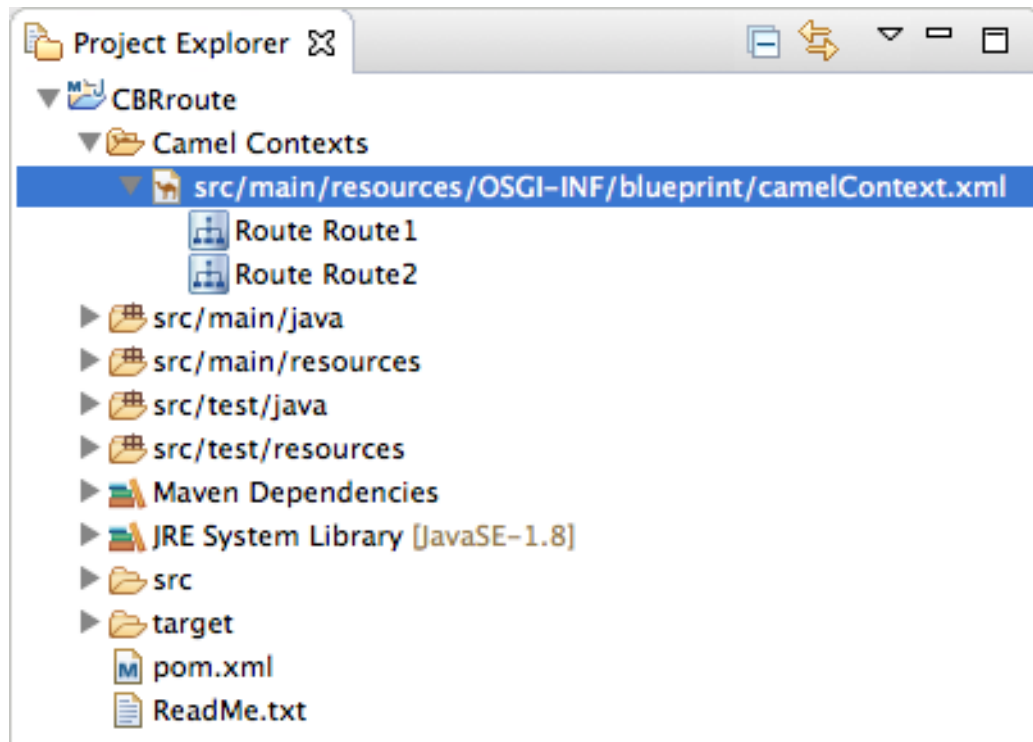


You can open the **Fuse Integration** perspective in the following ways:

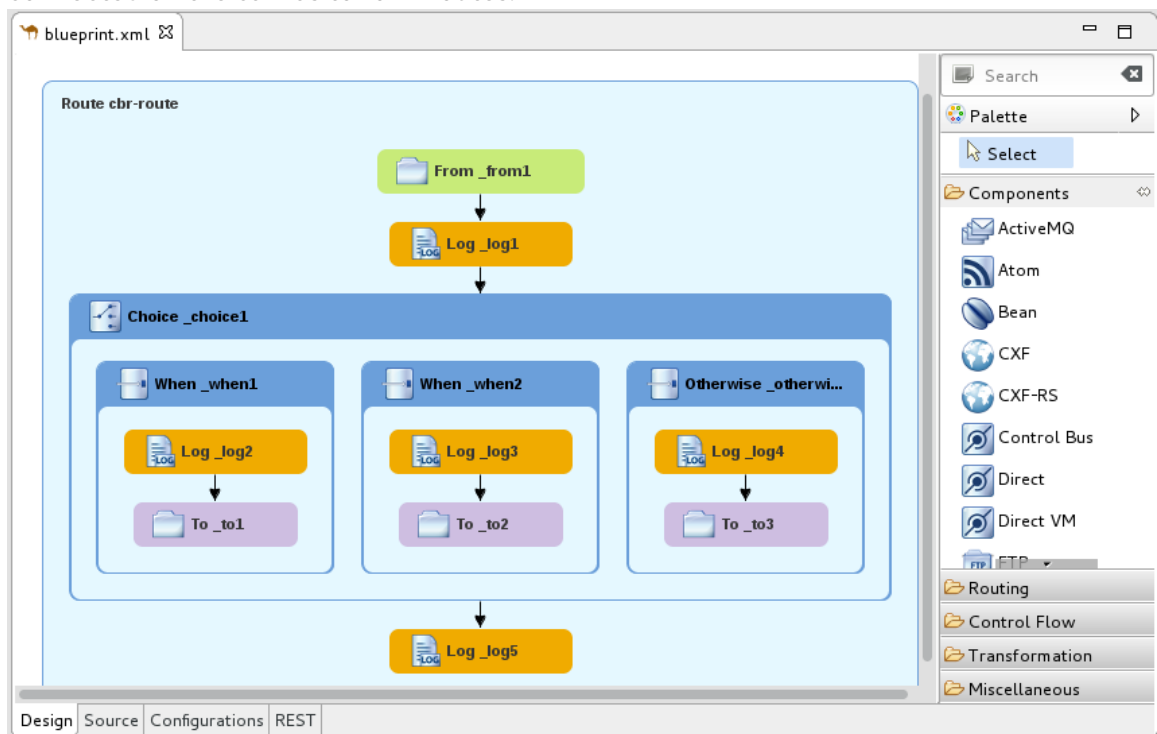
- When you create a new Fuse Integration project (see [Chapter 1, Creating a New Fuse Integration Project](#)), the tooling switches to the **Fuse Integration** perspective.
- Click  on the tool bar. If the  icon is not available on the tool bar, click  and then select **Fuse Integration** from the list of available perspectives.
- Select **Window** → **Perspective** → **Open Perspective** → **Fuse Integration**.

The **Fuse Integration** perspective consists of nine main areas:

- **Project Explorer** view  
Displays all projects known to the tooling. You can view all artifacts that make up each project. The **Project Explorer** view also displays all routing context **.xml** files for a project under its **Camel Contexts** node. This enables you to find and open a routing context file included in a project. Under each routing context **.xml** file, the **Project Explorer** view displays all routes defined within the context. For multiroute contexts, this lets you focus on a specific route on the canvas.



- The route editor
  - Provides the main design-time tooling and consists of three tabs:
    - **Design** – Displays a large grid area on which routes are constructed and a palette from which Enterprise Integration Patterns (EIPs) and Camel components are selected and then connected on the canvas to form routes.



The canvas is the route editor's workbench and where you do most of your work. It displays a graphical representation of one or more routes, which are made up of connected EIPs and Camel components (called nodes once they are placed on the canvas).

Selecting a node on the canvas populates the **Properties** view with the properties that apply to the selected node, so you can edit them.

The **Palette** contains all of the patterns and Camel components needed to construct a route and groups them according to function – **Components, Routing, Control Flow, Transformation, and Miscellaneous**.

- **Source**

Displays the contents of the .xml file for the routes constructed on the route editor's canvas.

You can edit the routing context in the **Source** tab as well as in the **Design** tab. The **Source** tab is useful for editing and adding any configuration, comments, or beans to the routing context file. The content assist feature helps you when working with configuration files. In the **Source** tab, press **Ctrl+Space** to see a list of possible values that can be inserted into your project.

```

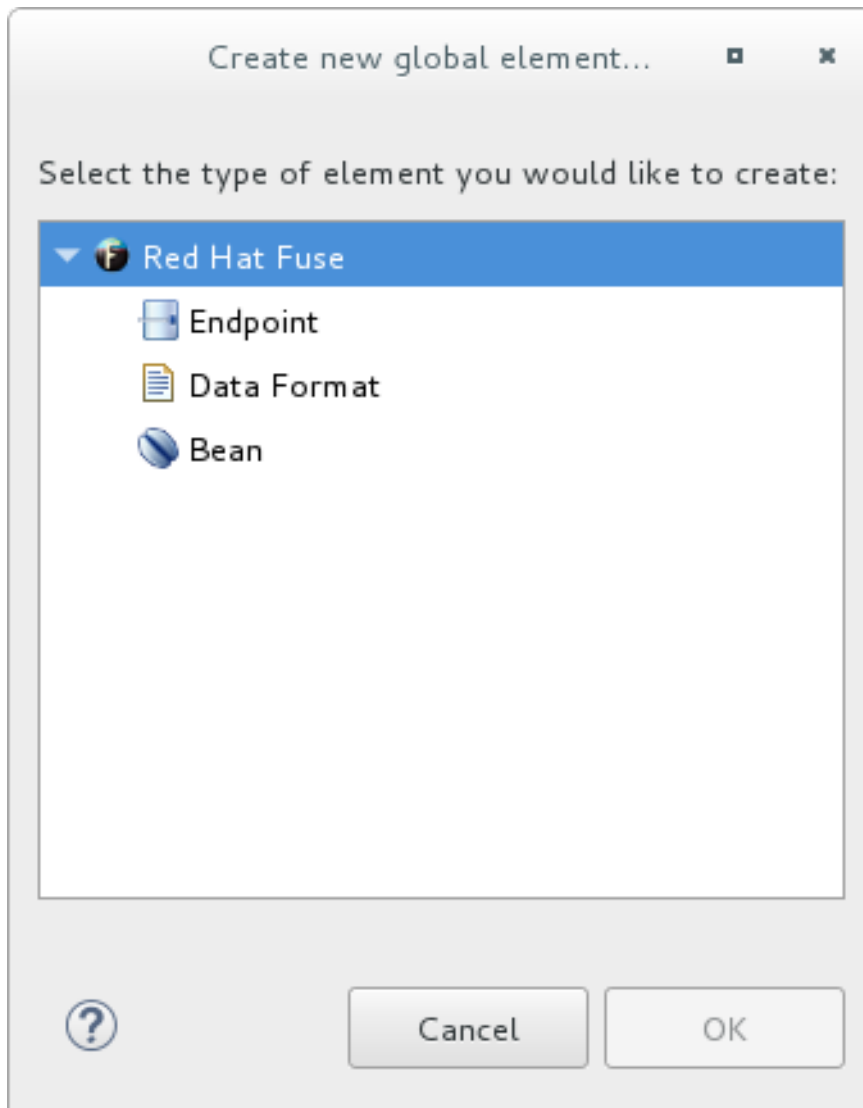
44 <route id="cbr-route">
45   <from id="from1" uri="file:work/cbr/input"/>
46   <log id="_log1" message="Receiving order ${file:name}"/>
47   <choice id="_choice1">
48     <when id="_when1">
49       <xpath id="_xpath1" >/order/customer/country = 'UK'</xpath>
50       <log id="_log2" message="Sending order ${file:name} to the UK"/>
51       <to id="_to1" uri="file:work/cbr/output/uk"/>
52     </when>
53     <when id="_when2">
54       <xpath id="_xpath2" >/order/customer/country = 'US'</xpath>
55       <log id="_log3" message="Sending order ${file:name} to the US"/>
56       <to id="_to2" uri="file:work/cbr/output/us"/>
57     </when>
58     <otherwise id="_otherwise1">
59       <log id="_log4" message="Sending order ${file:name} to another cou
60       <to id="_to3" uri="file:work/cbr/output/others"/>
61     </otherwise>
   </choice>
   <log id="_log5" message="Done processing ${file:name}"/>

```

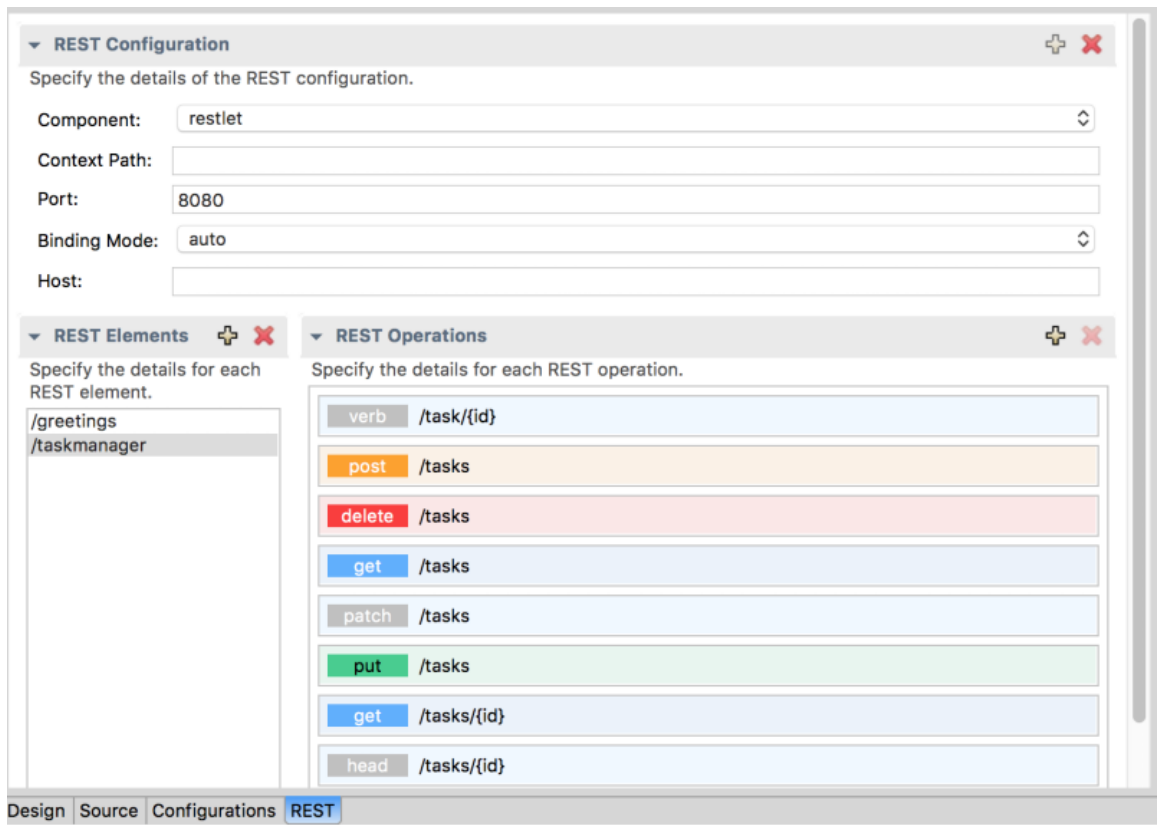
- **Configurations**

Provides an easy way to add shared configuration (global endpoints, data formats, beans) to a multi-route routing context. For details see [Section 2.6, "Adding global endpoints, data formats, or beans"](#).





- **REST**  
Provides a graphical representation of Rest DSL components.



- **Properties view**  
Displays the properties of the node selected on the canvas.
- **JMX Navigator view**  
Lists the JMX servers and the infrastructure they monitor. It enables you to browse JMX servers and the processes they are monitoring. It also identifies instances of Red Hat processes.

The **JMX Navigator** view drives all monitoring and testing activities in the **Fuse Integration** perspective. It determines which routes are displayed in the **Diagram View**, the **Properties view**, and the **Messages View**. It also provides menu commands for activating route tracing, adding and deleting JMS destinations, and starting and suspending routes. It is also the target for dragging and dropping messages onto a route.

By default, the **JMX Navigator** view shows all Java processes that are running on your local machine. You can add JMX servers as needed to view infrastructure on other machines.

- **Diagram View**  
Displays a graphical tree representing the node selected in the **JMX Navigator** view. When you select a process, server, endpoint, or other node, the **Diagram View** shows the selected node as the root with branches down to its children and grandchildren.

When you select a broker, the **Diagram View** displays up to three children: connections, topics, and queues. It also shows configured connections and destinations as grandchildren.

When you select a route, the **Diagram View** displays all nodes in the route and shows the different paths that messages can take through the route. It also displays timing metrics for each processing step in the route when route tracing is enabled.

- **Messages View**  
Lists the messages that have passed through the selected JMS destination or through Apache Camel endpoints when route tracing is enabled.

When a JMS destination is selected in the **JMX Navigator** view, the view lists all messages that are at the destination.

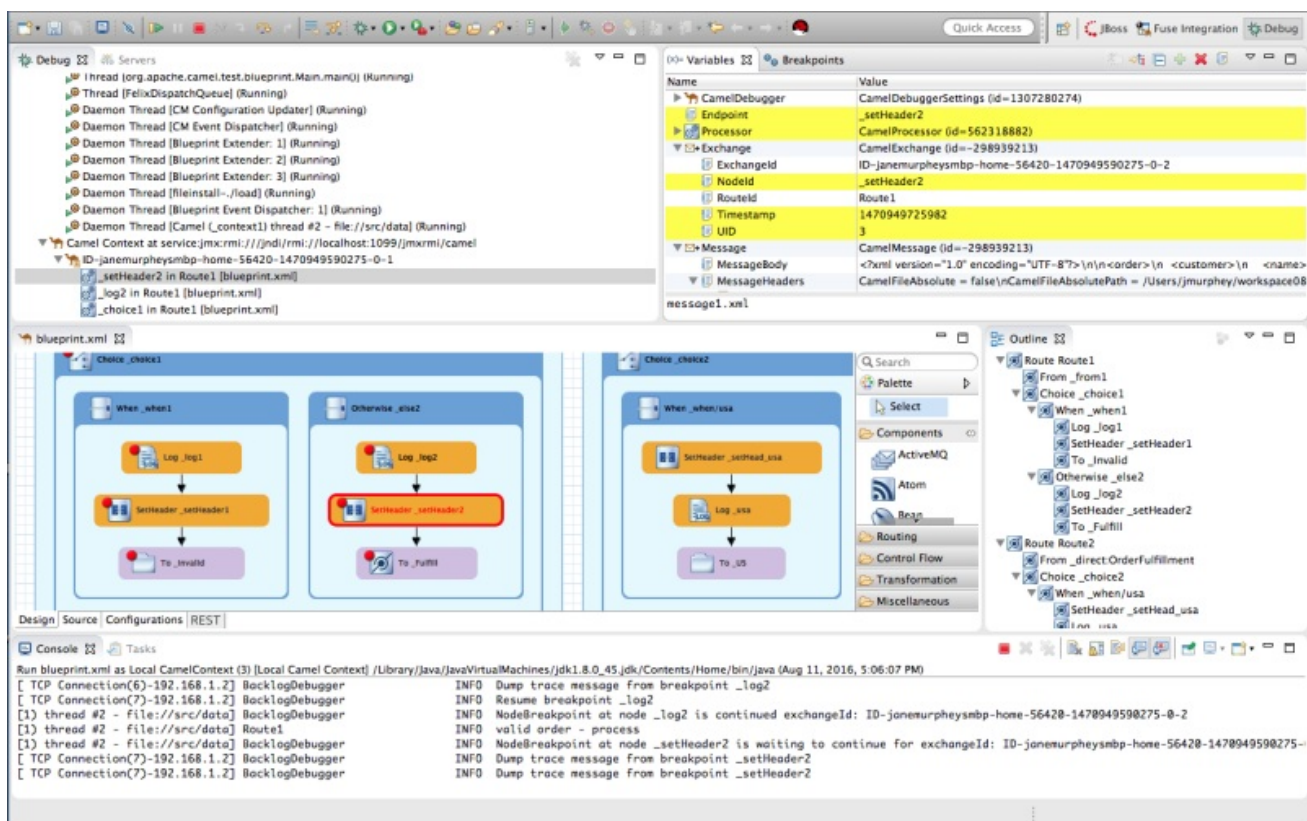
When route tracing is enabled, the **Messages View** lists all messages that passed through the nodes in the route since tracing started. You can configure the **Messages View** to display only the data in which you are interested and in your preferred sequence.

When a message trace in the **Messages View** is selected, its details (message body and all message headers) appear in the **Properties** view. In the **Diagram View**, the step in the route associated with the selected message trace is highlighted.

- **Servers** view  
Displays a list of servers managed by the tooling. It displays their runtime status and provides controls for adding, starting and stopping them and for publishing projects to them.
- **Terminal** view  
Displays the command console of the connected container. You can control the container by entering commands in the **Terminal** view.
- **Console** view  
Displays the console output for recently executed actions.

## APPENDIX B. DEBUG PERSPECTIVE

Use the **Debug** perspective to monitor and debug a running Camel context.



- **Debug view**

For the running Camel context, the **Debug** view displays the debug stack.

You can switch between breakpoints within the same message flow, listed under the **Camel Context at service:jmx:rmi://jndi/rmi://localhost:1099/jmxrmi/camel** entry, to review and compare variable values in the **Variables** view.

Messages flows are identified by their unique breadcrumb ID, and the breadcrumb ID of each subsequent message flow is incremented by 2. For example, if the breadcrumb ID for the first message flow is **ID-janemurpheysmbp-home-54620-1470949590275-0-1**, the breadcrumbID for the second message flow would be **ID-janemurpheysmbp-home-54620-1470949590275-0-3**.

- **Variables view**

For each node in the routing context that has a breakpoint set, the **Variables** view displays the value of the available variables when the breakpoint is hit. Each variable whose value changed since the preceding breakpoint is highlighted in yellow.



You can change the value of editable variables to check whether such changes produce the expected results and to test the robustness of your routing context.

You can also add variables to the watch list, so you can quickly and easily see whether their values change as expected at the expected point in the message flow.

- **Breakpoints view**

Displays a list of the breakpoints set in the routing context, and shows whether they are enabled or disabled. You can enable and disable individual breakpoints by checking (enabling) or unchecking (disabling) them. This enables you to temporarily focus on nodes in your routing

context that are behaving problematically.

The  button skips over disabled breakpoints to jump to the next active breakpoint in the routing context. In contrast, the  button jumps to the next node of execution in the routing context, regardless of breakpoints.

- **camel Context.xml** view

Displays the running routing context file in graphical mode. For nodes set with breakpoints, it shows the type of breakpoint set and whether the breakpoint is enabled or disabled. When a breakpoint is hit, its corresponding node on the canvas is outlined in red.

To check a node's configuration, open the **Properties** view and then select the node on the canvas in **camel Context.xml**.

- **Console** view

Displays the log output generated by the Camel debugger as it executes the routing context.

- **Properties** view

Displays the properties set for the node selected on the canvas in **CamelContext.xml**.