Red Hat AMQ Broker 7.11

Deploying AMQ Broker on OpenShift

For Use with AMQ Broker 7.11

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Legal Notice

Abstract

Learn how to install and deploy AMQ Broker on OpenShift Container Platform.

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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 .

CHAPTER 1. INTRODUCTION TO AMQ BROKER ON OPENSHIFT CONTAINER PLATFORM

Red Hat AMQ Broker 7.11 is available as a containerized image for use with OpenShift Container Platform (OCP) 4.12, 4.13, 4.14 or 4.15.

AMQ Broker is based on Apache ActiveMQ Artemis. It provides a message broker that is JMS-compliant. After you have set up the initial broker pod, you can quickly deploy duplicates by using OpenShift Container Platform features.

1.1. VERSION COMPATIBILITY AND SUPPORT

For details about OpenShift Container Platform image version compatibility, see:

- OpenShift Container Platform 4.x Tested Integrations

NOTE

All deployments of AMQ Broker on OpenShift Container Platform now use RHEL 8 based images.

1.2. UNSUPPORTED FEATURES

- Master-slave-based high availability
  High availability (HA) achieved by configuring master and slave pairs is not supported. Instead, AMQ Broker uses the HA capabilities provided in OpenShift Container Platform.

- External clients cannot use the topology information provided by AMQ Broker
  When an AMQ Core Protocol JMS Client or an AMQ JMS Client connects to a broker in an OpenShift Container Platform cluster, the broker can send the client the IP address and port information for each of the other brokers in the cluster, which serves as a failover list for clients if the connection to the current broker is lost.

  The IP address provided for each broker is an internal IP address, which is not accessible to clients that are external to the OpenShift Container Platform cluster. To prevent external clients from trying to connect to a broker using an internal IP address, set the following configuration in the URI used by the client to initially connect to a broker.

Client	Configuration
AMQ Core Protocol JMS Client	**useTopologyForLoadBalancing=false**
AMQ JMS Client	**failover.amqpOpenServerListAction=IGNORE**

1.3. DOCUMENT CONVENTIONS

This document uses the following conventions for the **sudo** command, file paths, and replaceable values.

The sudo command

In this document, **sudo** is used for any command that requires root privileges. You should always exercise caution when using **sudo**, as any changes can affect the entire system. For more information about using **sudo**, see Managing sudo access.

About the use of file paths in this document

In this document, all file paths are valid for Linux, UNIX, and similar operating systems (for example, **/home/...**). If you are using Microsoft Windows, you should use the equivalent Microsoft Windows paths (for example, **C:\Users\...**).

Replaceable values

This document sometimes uses replaceable values that you must replace with values specific to your environment. Replaceable values are lowercase, enclosed by angle brackets (**< >**), and are styled using italics and **monospace** font. Multiple words are separated by underscores (_) .

For example, in the following command, replace ***<project_name>*** with your own project name.

```
$ oc new-project <project_name>
```

CHAPTER 2. PLANNING A DEPLOYMENT OF AMQ BROKER ON OPENSHIFT CONTAINER PLATFORM

This section describes how to plan an Operator-based deployment.

Operators are programs that enable you to package, deploy, and manage OpenShift applications. Often, Operators automate common or complex tasks. Commonly, Operators are intended to provide:

- Consistent, repeatable installations
- Health checks of system components
- Over-the-air (OTA) updates
- Managed upgrades

Operators enable you to make changes while your broker instances are running, because they are always listening for changes to the Custom Resource (CR) instances that you used to configure your deployment. When you make changes to a CR, the Operator reconciles the changes with the existing broker deployment and updates the deployment to reflect the changes. In addition, the Operator provides a message migration capability, which ensures the integrity of messaging data. When a broker in a clustered deployment shuts down due to an intentional scaledown of the deployment, this capability migrates messages to a broker Pod that is still running in the same broker cluster.

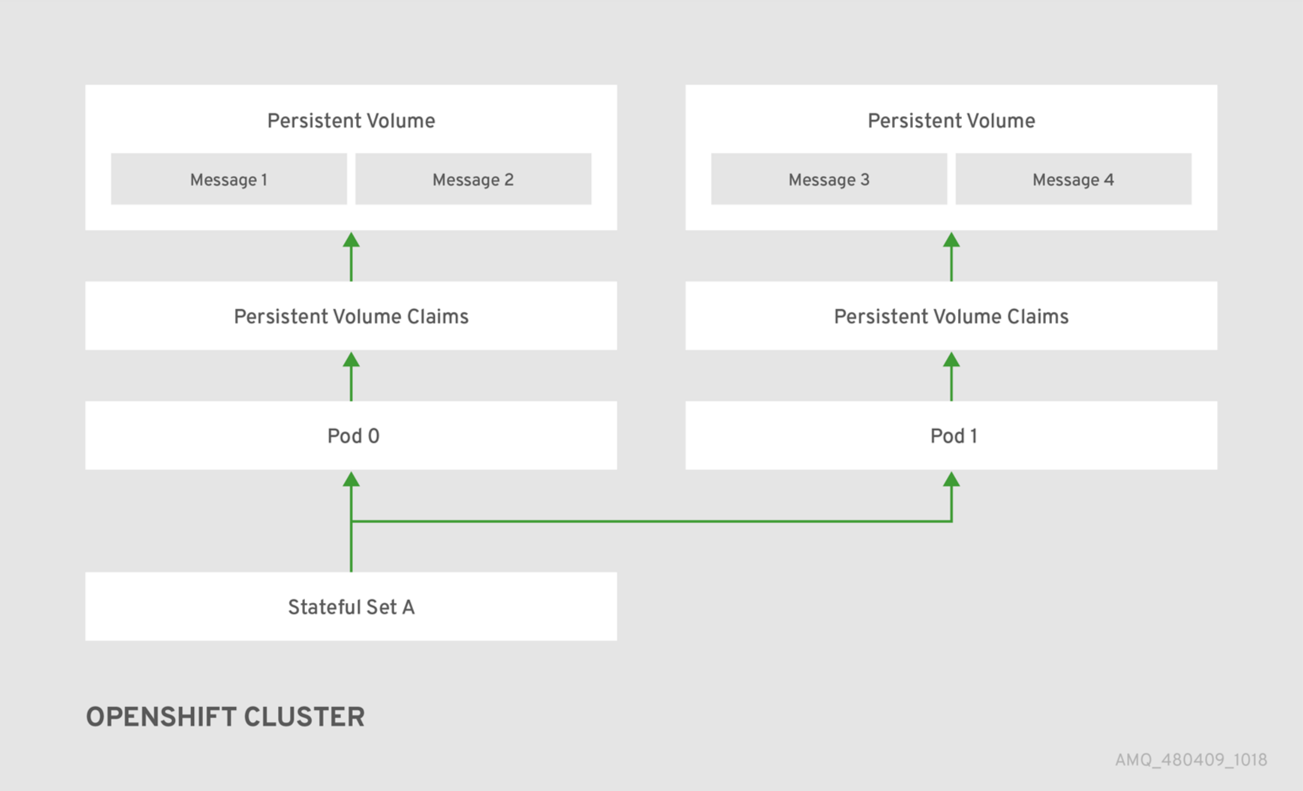
2.1. OVERVIEW OF HIGH AVAILABILITY (HA)

The term *high availability* refers to a system that can remain operational even when part of that system fails or is shut down. For AMQ Broker on OpenShift Container Platform, this means ensuring the integrity and availability of messaging data if a broker Pod fails.

AMQ Broker uses the HA capabilities provided in OpenShift Container Platform to mitigate Pod failures:

- If persistent storage is enabled on AMQ Broker, each broker Pod writes its data to a Persistent Volume (PV) that was claimed by using a Persistent Volume Claim (PVC). A PV remains available even after a Pod is deleted. If a broker Pod fails, OpenShift Container Platform restarts the Pod with the same name and uses the existing PV that contains the messaging data.
- You can run multiple broker Pods in a cluster and distribute Pods on separate nodes to protect against a node failure. In a cluster, each broker Pod writes its message data to its own PV which is then available to that broker Pod if it is restarted on a different node.

The following figure shows a clustered broker deployment. In this case, the two broker Pods in the broker cluster are still running.



Additional resources

For information on how to use persistent storage, see Section 2.7, “Operator deployment notes” .

For information on how to distribute broker Pods on separate nodes, see Section 4.14.2, “Controlling pod placement using tolerations”.

2.2. OVERVIEW OF THE AMQ BROKER OPERATOR CUSTOM RESOURCE DEFINITIONS

In general, a Custom Resource Definition (CRD) is a schema of configuration items that you can modify for a custom OpenShift object deployed with an Operator. By creating a corresponding Custom Resource (CR) instance, you can specify values for configuration items in the CRD. If you are an Operator developer, what you expose through a CRD essentially becomes the API for how a deployed object is configured and used. You can directly access the CRD through regular HTTP **curl** commands, because the CRD gets exposed automatically through Kubernetes.

You can install the AMQ Broker Operator using either the OpenShift command-line interface (CLI), or the Operator Lifecycle Manager, through the OperatorHub graphical interface. In either case, the AMQ Broker Operator includes the CRDs described below.

Main broker CRD

You deploy a CR instance based on this CRD to create and configure a broker deployment. Based on how you install the Operator, this CRD is:

- The **broker_activemqartemis_crd** file in the **crds** directory of the Operator installation archive (OpenShift CLI installation method)
- The **ActiveMQArtemis** CRD in the **Custom Resource Definitions** section of the OpenShift Container Platform web console (OperatorHub installation method)

Address CRD

You deploy a CR instance based on this CRD to create addresses and queues for a broker deployment.
Based on how you install the Operator, this CRD is:

- The **broker_activemqartemisaddress_crd** file in the **crds** directory of the Operator installation archive (OpenShift CLI installation method)
- The **ActiveMQArtemisAddresss** CRD in the **Custom Resource Definitions** section of the OpenShift Container Platform web console (OperatorHub installation method)

Security CRD

You deploy a CR instance based on this CRD to create users and associate those users with security contexts.
Based on how you install the Operator, this CRD is:

- The **broker_activemqartemissecurity_crd** file in the **crds** directory of the Operator installation archive (OpenShift CLI installation method)
- The **ActiveMQArtemisSecurity** CRD in the **Custom Resource Definitions** section of the OpenShift Container Platform web console (OperatorHub installation method).

Scaledown CRD

The **Operator** automatically creates a CR instance based on this CRD when instantiating a scaledown controller for message migration.
Based on how you install the Operator, this CRD is:

- The **broker_activemqartemisscaledown_crd** file in the **crds** directory of the Operator installation archive (OpenShift CLI installation method)
- The **ActiveMQArtemisScaledown** CRD in the **Custom Resource Definitions** section of the OpenShift Container Platform web console (OperatorHub installation method).

Additional resources

- To learn how to install the AMQ Broker Operator (and all included CRDs) using:
  - The OpenShift CLI, see Section 3.2, “Installing the Operator using the CLI”
  - The Operator Lifecycle Manager and OperatorHub graphical interface, see Section 3.3, “Installing the Operator using OperatorHub”.
- For complete configuration references to use when creating CR instances based on the main broker and address CRDs, see:
  - Section 8.1.1, “Broker Custom Resource configuration reference”
  - Section 8.1.2, “Address Custom Resource configuration reference”

2.3. OVERVIEW OF THE AMQ BROKER OPERATOR SAMPLE CUSTOM RESOURCES

The AMQ Broker Operator archive that you download and extract during installation includes sample Custom Resource (CR) files in the **deploy/crs** directory. These sample CR files enable you to:

- Deploy a minimal broker without SSL or clustering.
- Define addresses.

The broker Operator archive that you download and extract also includes CRs for example deployments in the **deploy/examples/address** and **deploy/examples/artemis** directories, as listed below.

address_queue.yaml

Deploys an address and queue with different names. Deletes the queue when the CR is undeployed.

address_topic.yaml

Deploys an address with a multicast routing type. Deletes the address when the CR is undeployed.

artemis_address_settings.yaml

Deploys a broker with specific address settings.

artemis_cluster_persistence.yaml

Deploys clustered brokers with persistent storage.

artemis_enable_metrics_plugin.yaml

Enables the Prometheus metrics plugin to collect metrics.

artemis_resources.yaml

Sets CPU and memory resource limits for the broker.

artemis_single.yaml

Deploys a single broker.

2.4. WATCH OPTIONS FOR A CLUSTER OPERATOR DEPLOYMENT

When the Cluster Operator is running, it starts to *watch* for updates of AMQ Broker custom resources (CRs).

You can choose to deploy the Cluster Operator to watch CRs from:

- A single namespace (the same namespace containing the Operator)
- All namespaces

NOTE

If you have already installed a previous version of the AMQ Broker Operator in a namespace on your cluster, Red Hat recommends that you do not install the AMQ Broker Operator 7.11 version to watch that namespace to avoid potential conflicts.

2.5. HOW THE OPERATOR DETERMINES THE CONFIGURATION TO USE TO DEPLOY IMAGES

In the **ActiveMQArtemis** CR, you can use any of the following configurations to deploy container images:

- Specify a version number in the **spec.version** attribute and allow the Operator to choose the broker and init container images to deploy for that version number.

- Specify the registry URLs of the specific broker and init container images that you want the Operator to deploy in the **spec.deploymentPlan.image** and **spec.deploymentPlan.initImage** attributes.

- Set the value of the **spec.deploymentPlan.image** attribute to **placeholder**, which means that the Operator chooses the latest broker and init container images that are known to the Operator version.

NOTE

If you do not use any of these configurations to deploy container images, the Operator chooses the latest broker and init container images that are known to the Operator version.

After you save a CR, the Operator performs the following validation to determine the configuration to use.

- The Operator checks if the CR contains a **spec.version** attribute.
    - If the CR does not contain a **spec.version** attribute, the Operator checks if the CR contains a **spec.deploymentPlan.image** and a **spec.deployment.Plan.initImage** attribute.
        - If the CR contains a **spec.deploymentPlan.image** and a **spec.deployment.Plan.initImage** attribute, the Operator deploys the container images that are identified by their registry URLs.
        - If the CR does not contain a **spec.deploymentPlan.image** and a **spec.deployment.Plan.initImage** attribute, the Operator chooses the container images to deploy. For more information, see Section 2.6, “How the Operator chooses container images”.
    - If the CR contains a **spec.version** attribute, the Operator verifies that the version number specified is within the valid range of versions that the Operator supports.
        - If the value of the **spec.version** attribute is not valid, the Operator stops the deployment.
        - If the value of the **spec.version** attribute is valid, the Operator checks if the CR contains a **spec.deploymentPlan.image** and a **spec.deployment.Plan.initImage** attribute.
            - If the CR contains a **spec.deploymentPlan.image** and a **spec.deployment.Plan.initImage** attribute, the Operator deploys the container images that are identified by their registry URLs.
            - If the CR does not contain a **spec.deploymentPlan.image** and a **spec.deployment.Plan.initImage** attribute, the Operator chooses the container images to deploy. For more information, see Section 2.6, “How the Operator chooses container images”.

NOTE

If the CR contains only one of the **spec.deploymentPlan.image** and the **spec.deployment.Plan.initImage** attributes, the Operator uses the **spec.version** number attribute to choose an image for the attribute that is not in the CR, or chooses the latest known image for that attribute if the **spec.version** attribute is not in the CR.

Red Hat recommends that you do not specify the **spec.deploymentPlan.image** attribute without the **spec.deployment.Plan.initImage** attribute, or vice versa, to prevent mismatched versions of broker and init container images from being deployed.

2.6. HOW THE OPERATOR CHOOSES CONTAINER IMAGES

If a CR does not contain a **spec.deploymentPlan.image** and a **spec.deployment.Plan.initImage** attribute, which specify the registry URLs of specific container images the Operator must deploy, the Operator automatically chooses the appropriate container images to deploy.

NOTE

If you install the Operator using the OpenShift command-line interface, the Operator installation archive includes a sample CR file called **broker_activemqartemis_cr.yaml**. In the sample CR, the **spec.deploymentPlan.image** property is included and set to its default value of **placeholder**. This value indicates that the Operator does not choose a broker container image until you deploy the CR.

The **spec.deploymentPlan.initImage** property, which specifies the Init Container image, is **not** included in the **broker_activemqartemis_cr.yaml** sample CR file. If you do not explicitly include the **spec.deploymentPlan.initImage** property in your CR and specify a value, the Operator chooses a built-in Init Container image that matches the version of the Operator container image chosen.

To choose broker and Init Container images, the Operator first determines an AMQ Broker version of the images that is required. The Operator gets the version from the value of the **spec.version** property. If the **spec.version** property is not set, the Operator uses the latest version of the images for AMQ Broker.

The Operator then detects your container platform. The AMQ Broker Operator can run on the following container platforms:

- OpenShift Container Platform (x86_64)
- OpenShift Container Platform on IBM Z (s390x)
- OpenShift Container Platform on IBM Power Systems (ppc64le)

Based on the version of AMQ Broker and your container platform, the Operator then references two sets of environment variables in the **operator.yaml** configuration file. These sets of environment variables specify broker and Init Container images for various versions of AMQ Broker, as described in the following section.

2.6.1. Environment variables for broker and init container images

The environment variables included in the **operator.yaml** have the following naming convention.

Container platform	Naming convention
OpenShift Container Platform	**RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_<*AMQ_Broker_version*>**
OpenShift Container Platform on IBM Z	**RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_<*AMQ_Broker_version*>_s390x**
OpenShift Container Platform on IBM Power Systems	**RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_<*AMQ_Broker_version*>_ppc64le**

The following are examples of environment variable names for broker and init container images for each supported container platform.

Container platform	Environment variable names
OpenShift Container Platform	**RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_7116** **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_7116**
OpenShift Container Platform on IBM Z	**RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_7116_s390x** **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_s390x_7116**
OpenShift Container Platform on IBM Power Systems	**RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_7116_ppc64le** **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_ppc64le_7116**

The value of each environment variable specifies the address of a container image that is available from Red Hat. The image name is represented by a *Secure Hash Algorithm* (SHA) value. For example:

```
- name: RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_7116
  value: registry.redhat.io/amq7/amq-broker-rhel8@sha256:e8fa2a00e576ecb95561ffbdbf87b1c82d479c8791ab2c6ce741dd0d0b496d15
```

Therefore, based on an AMQ Broker version and your container platform, the Operator determines the applicable environment variable names for the broker and init container. The Operator uses the corresponding image values when starting the broker container.

Additional resources

- To learn how to use the AMQ Broker Operator to create a broker deployment, see Chapter 3, *Deploying AMQ Broker on OpenShift Container Platform using the AMQ Broker Operator* .

- For more information about how the Operator uses an Init Container to generate the broker configuration, see Section 4.1, "How the Operator generates the broker configuration" .
- To learn how to build and specify a *custom* Init Container image, see Section 4.9, "Specifying a custom Init Container image".

2.7. OPERATOR DEPLOYMENT NOTES

This section describes some important considerations when planning an Operator-based deployment

- Deploying the Custom Resource Definitions (CRDs) that accompany the AMQ Broker Operator requires cluster administrator privileges for your OpenShift cluster. When the Operator is deployed, non-administrator users can create broker instances via corresponding Custom Resources (CRs). To enable regular users to deploy CRs, the cluster administrator must first assign roles and permissions to the CRDs. For more information, see Creating cluster roles for Custom Resource Definitions in the OpenShift Container Platform documentation.
- When you update your cluster with the CRDs for the latest Operator version, this update affects **all** projects in the cluster. Any broker Pods deployed from previous versions of the Operator might become unable to update their status. When you click the Logs tab of a running broker Pod in the OpenShift Container Platform web console, you see messages indicating that 'UpdatePodStatus' has failed. However, the broker Pods and Operator in that project continue to work as expected. To fix this issue for an affected project, you must also upgrade that project to use the latest version of the Operator.
- While you can create more than one broker deployment in a given OpenShift project by deploying multiple Custom Resource (CR) instances, typically, you create a single broker deployment in a project, and then deploy multiple CR instances for addresses.
  Red Hat recommends you create broker deployments in separate projects.
- If you intend to deploy brokers with persistent storage and do not have container-native storage in your OpenShift cluster, you need to manually provision Persistent Volumes (PVs) and ensure that these are available to be claimed by the Operator. For example, if you want to create a cluster of two brokers with persistent storage (that is, by setting **persistenceEnabled=true** in your CR), you need to have two persistent volumes available. By default, each broker instance requires storage of 2 GiB.
  If you specify **persistenceEnabled=false** in your CR, the deployed brokers uses *ephemeral* storage. Ephemeral storage means that that every time you restart the broker Pods, any existing data is lost.

  For more information about provisioning persistent storage in OpenShift Container Platform, see:

  - Understanding persistent storage
- You must add configuration for the items listed below to the main broker CR instance **before** deploying the CR for the first time. You **cannot** add configuration for these items to a broker deployment that is already running.
  - The size and storage class of the Persistent Volume Claim (PVC) required by each broker in a deployment for persistent storage
  - Limits and requests for memory and CPU for each broker in a deployment
- If you update a parameter in your CR that the Operator is unable to dynamically update in the StatefulSet, the Operator deletes the StatefulSet and recreates it with the updated parameter

value. Deleting the StatefulSet causes all pods to be deleted and recreated, which causes a temporary broker outage. An example of a CR update that the Operator cannot dynamically update in the StatefulSet is if you change **persistenceEnabled=false** to **persistenceEnabled=true**.

2.8. IDENTIFYING NAMESPACES WATCHED BY EXISTING OPERATORS

If the cluster already contains installed Operators for AMQ Broker, and you want a new Operator to watch all or multiple namespaces, you must ensure that the new Operator does not watch any of the same namespaces as existing Operators. Use the following procedure to identify the namespaces watched by existing Operators.

Procedure

1. In the left pane of the OpenShift Container Platform web console, click **Workloads → Deployments**.

2. In the **Project** drop-down list, select **All Projects**.

3. In the **Filter Name** box, specify a string, for example, **amq**, to display the Operators for AMQ Broker that are installed on the cluster.

   NOTE

   The **namespace** column displays the namespace where each operator is **deployed**.

4. Check the namespaces that each installed Operator for AMQ Broker is configured to **watch**.

   a. Click the Operator name to display the Operator details and click the **YAML** tab.

   b. Search for **WATCH_NAMESPACE** and note the namespaces that the Operator watches.

   - If the **WATCH_NAMESPACE** section has a **fieldPath** field that has a value of **metadata.namespace**, the Operator is watching the namespace where it is deployed.

   - If the **WATCH_NAMESPACE** section has a **value** field that has list of namespaces, the Operator is watching the specified namespaces. For example:

```
- name: WATCH_NAMESPACE
  value: "namespace1, namespace2"
```

   - If the **WATCH_NAMESPACE** section has a **value** field that is empty or has an asterisk, the Operator is watching all the namespaces on the cluster. For example:

```
- name: WATCH_NAMESPACE
  value: ""
```

   In this case, before you deploy the new Operator, you must either uninstall the existing Operator or reconfigure it to watch specific namespaces.

The procedures in the next section show you how to install the Operator and use Custom Resources (CRs) to create broker deployments on OpenShift Container Platform. After you complete the procedures, the Operator runs in an individual Pod and each broker instance that you create runs as an individual Pod in a StatefulSet in the same project as the Operator. Later, you will see how to use a dedicated addressing CR to define addresses in your broker deployment.

CHAPTER 3. DEPLOYING AMQ BROKER ON OPENSHIFT CONTAINER PLATFORM USING THE AMQ BROKER OPERATOR

3.1. PREREQUISITES

- Before you install the Operator and use it to create a broker deployment, you should consult the Operator deployment notes in Section 2.7, “Operator deployment notes” .

3.2. INSTALLING THE OPERATOR USING THE CLI

NOTE

Each Operator release requires that you download the latest **AMQ Broker 7.11.6 Operator Installation and Example Files** as described below.

The procedures in this section show how to use the OpenShift command-line interface (CLI) to install and deploy the latest version of the Operator for AMQ Broker 7.11 in a given OpenShift project. In subsequent procedures, you use this Operator to deploy some broker instances.

- For an alternative method of installing the AMQ Broker Operator that uses the OperatorHub graphical interface, see Section 3.3, “Installing the Operator using OperatorHub” .
- To learn about *upgrading* existing Operator-based broker deployments, see Chapter 6, *Upgrading an Operator-based broker deployment*.

3.2.1. Preparing to deploy the Operator

Before you deploy the Operator using the CLI, you must download the Operator installation files and prepare the deployment.

Procedure

1. In your web browser, navigate to the **Software Downloads** page for AMQ Broker 7.11.6 releases.
2. Ensure that the value of the **Version** drop-down list is set to **7.11.6** and the **Patches** tab is selected.
3. Next to the latest **AMQ Broker 7.11.6 Operator Installation and Example Files**, click **Download**.
   Download of the **amq-broker-operator-7.11.6-ocp-install-examples.zip** compressed archive automatically begins.
4. Move the archive to your chosen directory. The following example moves the archive to a directory called **~/broker/operator**.

```
$ mkdir ~/broker/operator
$ mv amq-broker-operator-7.11.6-ocp-install-examples.zip ~/broker/operator
```

5. In your chosen directory, extract the contents of the archive. For example:

```
$ cd ~/broker/operator
$ unzip amq-broker-operator-7.11.6-ocp-install-examples.zip
```

6. Switch to the directory that was created when you extracted the archive. For example:

   ```
   $ cd amq-broker-operator-7.11.6-ocp-install-examples
   ```

7. Log in to OpenShift Container Platform as a cluster administrator. For example:

   ```
   $ oc login -u system:admin
   ```

8. Specify the project in which you want to install the Operator. You can create a new project or switch to an existing one.

   a. Create a new project:

   ```
   $ oc new-project <project_name>
   ```

   b. Or, switch to an existing project:

   ```
   $ oc project <project_name>
   ```

9. Specify a service account to use with the Operator.

   a. In the **deploy** directory of the Operator archive that you extracted, open the **service_account.yaml** file.

   b. Ensure that the **kind** element is set to **ServiceAccount**.

   c. If you want to change the default service account name, in the **metadata** section, replace **amq-broker-controller-manager** with a custom name.

   d. Create the service account in your project.

   ```
   $ oc create -f deploy/service_account.yaml
   ```

10. Specify a role name for the Operator.

    a. Open the **role.yaml** file. This file specifies the resources that the Operator can use and modify.

    b. Ensure that the **kind** element is set to **Role**.

    c. If you want to change the default role name, in the **metadata** section, replace **amq-broker-operator-role** with a custom name.

    d. Create the role in your project.

    ```
    $ oc create -f deploy/role.yaml
    ```

11. Specify a role binding for the Operator. The role binding binds the previously-created service account to the Operator role, based on the names you specified.

    a. Open the **role_binding.yaml** file.

b. Ensure that the **name** values for **ServiceAccount** and **Role** match those specified in the **service_account.yaml** and **role.yaml** files. For example:

```
metadata:
  name: amq-broker-operator-rolebinding
subjects:
  kind: ServiceAccount
  name: amq-broker-controller-manager
roleRef:
  kind: Role
  name: amq-broker-operator-role
```

c. Create the role binding in your project.

```
$ oc create -f deploy/role_binding.yaml
```

12. Specify a leader election role binding for the Operator. The role binding binds the previously-created service account to the leader election role, based on the names you specified.

a. Create a leader election role for the Operator.

```
$ oc create -f deploy/election_role.yaml
```

b. Create the leader election role binding in your project.

```
$ oc create -f deploy/election_role_binding.yaml
```

13. (Optional) If you want the Operator to watch multiple namespaces, complete the following steps:

> **NOTE**
>
> If the OpenShift Container Platform cluster already contains installed Operators for AMQ Broker, you must ensure the new Operator does not watch any of the same namespaces as existing Operators. For information on how to identify the namespaces that are watched by existing Operators, see, Identifying namespaces watched by existing Operators.

a. In the deploy directory of the Operator archive that you downloaded and extracted, open the **operator_yaml** file.

b. If you want the Operator to watch all namespaces in the cluster, in the **WATCH_NAMESPACE** section, add a **value** attribute and set the value to an asterisk. Comment out the existing attributes in the **WATCH_NAMESPACE** section. For example:

```
- name: WATCH_NAMESPACE
  value: "*"
# valueFrom:
#   fieldRef:
#     fieldPath: metadata.namespace
```

NOTE

To avoid conflicts, ensure that multiple Operators do not watch the same namespace. For example, if you deploy an Operator to watch **all** namespaces on the cluster, you cannot deploy another Operator to watch individual namespaces. If Operators are already deployed on the cluster, you can specify a list of namespaces that the new Operator watches, as described in the following step.

c. If you want the Operator to watch multiple, but not all, namespaces on the cluster, in the **WATCH_NAMESPACE** section, specify a list of namespaces. Ensure that you exclude any namespaces that are watched by existing Operators. For example:

```
- name: WATCH_NAMESPACE
  value: "namespace1, namespace2"`.
```

d. In the deploy directory of the Operator archive that you downloaded and extracted, open the **cluster_role_binding.yaml** file.

e. In the Subjects section, specify a namespace that corresponds to the OpenShift Container Platform project to which you are **deploying** the Operator. For example:

```
Subjects:
- kind: ServiceAccount
  name: amq-broker-controller-manager
  namespace: operator-project
```

NOTE

If you previously deployed brokers using an earlier version of the Operator, and you want to deploy the Operator to watch multiple namespaces, see Before you upgrade.

f. Create a cluster role in your project.

```
$ oc create -f deploy/cluster_role.yaml
```

g. Create a cluster role binding in your project.

```
$ oc create -f deploy/cluster_role_binding.yaml
```

In the procedure that follows, you deploy the Operator in your project.

3.2.2. Deploying the Operator using the CLI

The procedure in this section shows how to use the OpenShift command-line interface (CLI) to deploy the latest version of the Operator for AMQ Broker 7.11 in your OpenShift project.

Prerequisites

- You must have already prepared your OpenShift project for the Operator deployment. See Section 3.2.1, “Preparing to deploy the Operator” .

- Starting in AMQ Broker 7.3, you use a new version of the Red Hat Ecosystem Catalog to access container images. This new version of the registry requires you to become an authenticated user before you can access images. Before you can follow the procedure in this section, you must first complete the steps described in Red Hat Container Registry Authentication .

- If you intend to deploy brokers with persistent storage and do not have container-native storage in your OpenShift cluster, you need to manually provision Persistent Volumes (PVs) and ensure that they are available to be claimed by the Operator. For example, if you want to create a cluster of two brokers with persistent storage (that is, by setting **persistenceEnabled=true** in your Custom Resource), you need to have two PVs available. By default, each broker instance requires storage of 2 GiB.
  If you specify **persistenceEnabled=false** in your Custom Resource, the deployed brokers uses *ephemeral* storage. Ephemeral storage means that that every time you restart the broker Pods, any existing data is lost.

  For more information about provisioning persistent storage, see:

  - Understanding persistent storage

Procedure

1. In the OpenShift command-line interface (CLI), log in to OpenShift as a cluster administrator. For example:

   ```
   $ oc login -u system:admin
   ```

2. Switch to the project that you previously prepared for the Operator deployment. For example:

   ```
   $ oc project <project_name>
   ```

3. Switch to the directory that was created when you previously extracted the Operator installation archive. For example:

   ```
   $ cd ~/broker/operator/amq-broker-operator-7.11.6-ocp-install-examples
   ```

4. Deploy the CRDs that are included with the Operator. You must install the CRDs in your OpenShift cluster before deploying and starting the Operator.

   a. Deploy the main broker CRD.

   ```
   $ oc create -f deploy/crds/broker_activemqartemis_crd.yaml
   ```

   b. Deploy the address CRD.

   ```
   $ oc create -f deploy/crds/broker_activemqartemisaddress_crd.yaml
   ```

   c. Deploy the scaledown controller CRD.

   ```
   $ oc create -f deploy/crds/broker_activemqartemisscaledown_crd.yaml
   ```

   d. Deploy the security CRD:

   ```
   $ oc create -f deploy/crds/broker_activemqartemissecurity_crd.yaml
   ```

5. Link the pull secret associated with the account used for authentication in the Red Hat Ecosystem Catalog with the **default**, **deployer**, and **builder** service accounts for your OpenShift project.

   ```
   $ oc secrets link --for=pull default <secret_name>
   $ oc secrets link --for=pull deployer <secret_name>
   $ oc secrets link --for=pull builder <secret_name>
   ```

6. In the **deploy** directory of the Operator archive that you downloaded and extracted, open the **operator.yaml** file. Ensure that the value of the **spec.containers.image** property corresponds to version 7.11.6-opr-2 of the Operator, as shown below.

   ```
   spec:
     template:
       spec:
         containers:
           #image: registry.redhat.io/amq7/amq-broker-rhel8-operator:7.10
           image: registry.redhat.io/amq7/amq-broker-rhel8-
   operator@sha256:6a87f1a46da682870c4495bece5d8ef5b2fb62b4ecda9e6826664031757bf9
   84
   ```

   > NOTE
   >
   > In the **operator.yaml** file, the Operator uses an image that is represented by a *Secure Hash Algorithm* (SHA) value. The comment line, which begins with a number sign (**#**) symbol, denotes that the SHA value corresponds to a specific container image tag.

7. Deploy the Operator.

   ```
   $ oc create -f deploy/operator.yaml
   ```

   In your OpenShift project, the Operator starts in a new Pod.

   In the OpenShift Container Platform web console, the information on the **Events** tab of the Operator Pod confirms that OpenShift has deployed the Operator image that you specified, has assigned a new container to a node in your OpenShift cluster, and has started the new container.

   In addition, if you click the **Logs** tab within the Pod, the output should include lines resembling the following:

   ```
   ...
   {"level":"info","ts":1553619035.8302743,"logger":"kubebuilder.controller","msg":"Starting
   Controller","controller":"activemqartemisaddress-controller"}
   {"level":"info","ts":1553619035.830541,"logger":"kubebuilder.controller","msg":"Starting
   Controller","controller":"activemqartemis-controller"}
   {"level":"info","ts":1553619035.9306898,"logger":"kubebuilder.controller","msg":"Starting
   workers","controller":"activemqartemisaddress-controller","worker count":1}
   {"level":"info","ts":1553619035.9311671,"logger":"kubebuilder.controller","msg":"Starting
   workers","controller":"activemqartemis-controller","worker count":1}
   ```

   The preceding output confirms that the newly-deployed Operator is communicating with Kubernetes, that the controllers for the broker and addressing are running, and that these controllers have started some workers.

NOTE

It is recommended that you deploy only a **single instance** of the AMQ Broker Operator in a given OpenShift project. Setting the **spec.replicas** property of your Operator deployment to a value greater than **1**, or deploying the Operator more than once in the same project is **not** recommended.

Additional resources

- For an alternative method of installing the AMQ Broker Operator that uses the OperatorHub graphical interface, see Section 3.3, "Installing the Operator using OperatorHub" .

3.3. INSTALLING THE OPERATOR USING OPERATORHUB

3.3.1. Overview of the Operator Lifecycle Manager

In OpenShift Container Platform 4.5 and later, the *Operator Lifecycle Manager* (OLM) helps users install, update, and generally manage the lifecycle of all Operators and their associated services running across their clusters. It is part of the Operator Framework, an open source toolkit designed to manage Kubernetes-native applications (Operators) in an effective, automated, and scalable way.

The OLM runs by default in OpenShift Container Platform 4.5 and later, which aids cluster administrators in installing, upgrading, and granting access to Operators running on their cluster. The OpenShift Container Platform web console provides management screens for cluster administrators to install Operators, as well as grant specific projects access to use the catalog of Operators available on the cluster.

OperatorHub is the graphical interface that OpenShift cluster administrators use to discover, install, and upgrade Operators using the OLM. With one click, these Operators can be pulled from OperatorHub, installed on the cluster, and managed by the OLM, ready for engineering teams to self-service manage the software in development, test, and production environments.

When you have deployed the Operator, you can use Custom Resource (CR) instances to create broker deployments such as standalone and clustered brokers.

3.3.2. Deploying the Operator from OperatorHub

This procedure shows how to use OperatorHub to deploy the latest version of the Operator for AMQ Broker to a specified OpenShift project.

NOTE

In OperatorHub, you can install only the latest Operator version that is provided in each channel. If you want to install an earlier version of an Operator, you must install the Operator by using the CLI. For more information, see Section 3.2, "Installing the Operator using the CLI".

Prerequisites

- The **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)** Operator must be available in OperatorHub.
- You have cluster administrator privileges.

Procedure

1. Log in to the OpenShift Container Platform web console as a cluster administrator.

2. In left navigation menu, click **Operators** → **OperatorHub**.

3. On the **Project** drop-down menu at the top of the **OperatorHub** page, select the project in which you want to deploy the Operator.

4. On the **OperatorHub** page, use the **Filter by keyword…** box to find the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)** Operator.

   NOTE

   In OperatorHub, you might find more than one Operator than includes **AMQ Broker** in its name. Ensure that you click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)** Operator. When you click this Operator, review the information pane that opens. For AMQ Broker 7.11, the latest minor version tag of this Operator is **7.11.6-opr-2**.

5. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)** Operator. On the dialog box that appears, click **Install**.

6. On the **Install Operator** page:

   a. Under **Update Channel**, select the **7.11.x** channel to receive updates for version 7.11 only. The **7.11.x** channel is a Long Term Support (LTS) channel.
      Depending on when your OpenShift Container Platform cluster was installed, you may also see channels for older versions of AMQ Broker. The only other supported channel is **7.10.x**, which is also an LTS channel.

   b. Under **Installation Mode**, choose which namespaces the Operator watches:

      - A specific namespace on the cluster - The Operator is installed in that namespace and only monitors that namespace for CR changes.

      - All namespaces - The Operator monitors all namespaces for CR changes.

      NOTE

      If you previously deployed brokers using an earlier version of the Operator, and you want deploy the Operator to watch many namespaces, see Before you upgrade.

7. From the **Installed Namespace** drop-down menu, select the project in which you want to install the Operator.

8. Under **Approval Strategy**, ensure that the radio button entitled **Automatic** is selected. This option specifies that updates to the Operator do not require manual approval for installation to take place.

9. Click **Install**.

When the Operator installation is complete, the **Installed Operators** page opens. You should see that the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)** Operator is installed in the project namespace that you specified.

Additional resources

- To learn how to create a broker deployment in a project that has the Operator for AMQ Broker installed, see Section 3.4.1, “Deploying a basic broker instance” .

3.4. CREATING OPERATOR-BASED BROKER DEPLOYMENTS

3.4.1. Deploying a basic broker instance

The following procedure shows how to use a Custom Resource (CR) instance to create a basic broker deployment.

> **NOTE**
>
> - While you can create more than one broker deployment in a given OpenShift project by deploying multiple Custom Resource (CR) instances, typically, you create a single broker deployment in a project, and then deploy multiple CR instances for addresses.
>   Red Hat recommends you create broker deployments in separate projects.
> - In AMQ Broker 7.11, if you want to configure the following items, you must add the appropriate configuration to the main broker CR instance **before** deploying the CR for the first time.
>   - The size and storage class of the Persistent Volume Claim (PVC) required by each broker in a deployment for persistent storage
>   - Limits and requests for memory and CPU for each broker in a deployment

Prerequisites

- You must have already installed the AMQ Broker Operator.
  - To use the OpenShift command-line interface (CLI) to install the AMQ Broker Operator, see Section 3.2, “Installing the Operator using the CLI” .
  - To use the OperatorHub graphical interface to install the AMQ Broker Operator, see Section 3.3, “Installing the Operator using OperatorHub” .
- You should understand how the Operator chooses a broker container image to use for your broker deployment. For more information, see Section 2.6, “How the Operator chooses container images”.
- Starting in AMQ Broker 7.3, you use a new version of the Red Hat Ecosystem Catalog to access container images. This new version of the registry requires you to become an authenticated user before you can access images. Before you can follow the procedure in this section, you must first complete the steps described in Red Hat Container Registry Authentication .

Procedure

When you have successfully installed the Operator, the Operator is running and listening for changes related to your CRs. This example procedure shows how to use a CR instance to deploy a basic broker in your project.

1. Start configuring a Custom Resource (CR) instance for the broker deployment.

a. Using the OpenShift command-line interface:

   i. Log in to OpenShift as a user that has privileges to deploy CRs in the project in which you are creating the deployment.

   ```
   oc login -u <user> -p <password> --server=<host:port>
   ```

   ii. Open the sample CR file called **broker_activemqartemis_cr.yaml** that was included in the **deploy/crs** directory of the Operator installation archive that you downloaded and extracted.

b. Using the OpenShift Container Platform web console:

   i. Log in to the console as a user that has privileges to deploy CRs in the project in which you are creating the deployment.

   ii. Start a new CR instance based on the main broker CRD. In the left pane, click **Administration → Custom Resource Definitions**

   iii. Click the **ActiveMQArtemis** CRD.

   iv. Click the **Instances** tab.

   v. Click **Create ActiveMQArtemis**.
   Within the console, a YAML editor opens, enabling you to configure a CR instance.

For a basic broker deployment, a configuration might resemble that shown below.

```
apiVersion: broker.amq.io/v1beta1
kind: ActiveMQArtemis
metadata:
  name: ex-aao
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
```

Observe that in the **broker_activemqartemis_cr.yaml** sample CR file, the **image** property is set to a default value of **placeholder**. This value indicates that, by default, the **image** property does not specify a broker container image to use for the deployment. To learn how the Operator determines the appropriate broker container image to use, see Section 2.6, “How the Operator chooses container images”.

> NOTE
>
> The **broker_activemqartemis_cr.yaml** sample CR uses a naming convention of **ex-aao**. This naming convention denotes that the CR is an **example** resource for the AMQ Broker **Operator**. AMQ Broker is based on the **ActiveMQ Artemis** project. When you deploy this sample CR, the resulting StatefulSet uses the name **ex-aao-ss**. Furthermore, broker Pods in the deployment are directly based on the StatefulSet name, for example, **ex-aao-ss-0**, **ex-aao-ss-1**, and so on. The application name in the CR appears in the deployment as a label on the StatefulSet. You might use this label in a Pod selector, for example.

2. The **size** property specifies the number of brokers to deploy. A value of **2** or greater specifies a clustered broker deployment. However, to deploy a single broker instance, ensure that the value is set to **1**.

3. Deploy the CR instance.

    a. Using the OpenShift command-line interface:

        i. Save the CR file.

        ii. Switch to the project in which you are creating the broker deployment.

        ```
        $ oc project <project_name>
        ```

        iii. Create the CR instance.

        ```
        $ oc create -f <path/to/custom_resource_instance>.yaml
        ```

    b. Using the OpenShift web console:

        i. When you have finished configuring the CR, click **Create**.

4. In the OpenShift Container Platform web console, click **Workloads → StatefulSets**. You see a new StatefulSet called **ex-aao-ss**.

    a. Click the **ex-aao-ss** StatefulSet. You see that there is one Pod, corresponding to the single broker that you defined in the CR.

    b. Within the StatefulSet, click the **Pods** tab. Click the **ex-aao-ss** Pod. On the **Events** tab of the running Pod, you see that the broker container has started. The **Logs** tab shows that the broker itself is running.

5. To test that the broker is running normally, access a shell on the broker Pod to send some test messages.

    a. Using the OpenShift Container Platform web console:

        i. Click **Workloads → Pods**.

        ii. Click the **ex-aao-ss** Pod.

        iii. Click the **Terminal** tab.

    b. Using the OpenShift command-line interface:

        i. Get the Pod names and internal IP addresses for your project.

```
$ oc get pods -o wide

NAME                          STATUS   IP
amq-broker-operator-54d996c   Running  10.129.2.14
ex-aao-ss-0                   Running  10.129.2.15
```

ii. Access the shell for the broker Pod.

```
$ oc rsh ex-aao-ss-0
```

6. From the shell, use the **artemis** command to send some test messages. Specify the internal IP address of the broker Pod in the URL. For example:

```
sh-4.2$ ./amq-broker/bin/artemis producer --url tcp://10.129.2.15:61616 --destination
queue://demoQueue
```

The preceding command automatically creates a queue called **demoQueue** on the broker and sends a default quantity of 1000 messages to the queue.

You should see output that resembles the following:

```
Connection brokerURL = tcp://10.129.2.15:61616
Producer ActiveMQQueue[demoQueue], thread=0 Started to calculate elapsed time ...

Producer ActiveMQQueue[demoQueue], thread=0 Produced: 1000 messages
Producer ActiveMQQueue[demoQueue], thread=0 Elapsed time in second : 3 s
Producer ActiveMQQueue[demoQueue], thread=0 Elapsed time in milli second : 3492 milli
seconds
```

Additional resources

- For a complete configuration reference for the main broker Custom Resource (CR), see Section 8.1, "Custom Resource configuration reference".
- To learn how to connect a running broker to AMQ Management Console, see Chapter 5, *Connecting to AMQ Management Console for an Operator-based broker deployment* .

3.4.2. Deploying clustered brokers

If there are two or more broker Pods running in your project, the Pods automatically form a broker cluster. A clustered configuration enables brokers to connect to each other and redistribute messages as needed, for load balancing.

The following procedure shows you how to deploy clustered brokers. By default, the brokers in this deployment use *on demand* load balancing, meaning that brokers will forward messages only to other brokers that have matching consumers.

Prerequisites

- A basic broker instance is already deployed. See Section 3.4.1, "Deploying a basic broker instance".

Procedure

1. Open the CR file that you used for your basic broker deployment.

2. For a clustered deployment, ensure that the value of **deploymentPlan.size** is **2** or greater. For example:

   ```
   apiVersion: broker.amq.io/v1beta1
   kind: ActiveMQArtemis
   metadata:
     name: ex-aao
   spec:
     deploymentPlan:
       size: 4
       image: placeholder
       ...
   ```

   NOTE

   In the **metadata** section, you need to include the **namespace** property and specify a value **only** if you are using the OpenShift Container Platform web console to create your CR instance. The value that you should specify is the name of the OpenShift project for your broker deployment.

3. Save the modified CR file.

4. Log in to OpenShift as a user that has privileges to deploy CRs in the project in which you previously created your basic broker deployment.

   ```
   $ oc login -u <user> -p <password> --server=<host:port>
   ```

5. Switch to the project in which you previously created your basic broker deployment.

   ```
   $ oc project <project_name>
   ```

6. At the command line, apply the change:

   ```
   $ oc apply -f <path/to/custom_resource_instance>.yaml
   ```

   In the OpenShift Container Platform web console, additional broker Pods starts in your project, according to the number specified in your CR. By default, the brokers running in the project are clustered.

7. Open the **Logs** tab of each Pod. The logs show that OpenShift has established a cluster connection bridge on each broker. Specifically, the log output includes a line like the following:

   ```
   targetConnector=ServerLocatorImpl (identity=(Cluster-connection-
   bridge::ClusterConnectionBridge@6f13fb88
   ```

3.4.3. Applying Custom Resource changes to running broker deployments

The following are some important things to note about applying Custom Resource (CR) changes to running broker deployments:

- You cannot dynamically update the **persistenceEnabled** attribute in your CR. To change this attribute, scale your cluster down to zero brokers. Delete the existing CR. Then, recreate and redeploy the CR with your changes, also specifying a deployment size.

- As described in Section 3.2.2, "Deploying the Operator using the CLI" , if you create a broker deployment with persistent storage (that is, by setting **persistenceEnabled=true** in your CR), you might need to provision Persistent Volumes (PVs) for the AMQ Broker Operator to claim for your broker Pods. If you scale down the size of your broker deployment, the Operator releases any PVs that it previously claimed for the broker Pods that are now shut down. However, if you *remove* your broker deployment by deleting your CR, AMQ Broker Operator **does not** release Persistent Volume Claims (PVCs) for any broker Pods that are still in the deployment when you remove it. In addition, these unreleased PVs are unavailable to any new deployment. In this case, you need to manually release the volumes. For more information, see Release a persistent volume in the OpenShift documentation.

- In AMQ Broker 7.11, if you want to configure the following items, you must add the appropriate configuration to the main CR instance **before** deploying the CR for the first time.

  - The size and storage class of the Persistent Volume Claim (PVC) required by each broker in a deployment for persistent storage.

  - Limits and requests for memory and CPU for each broker in a deployment .

- During an active scaling event, any further changes that you apply are queued by the Operator and executed only when scaling is complete. For example, suppose that you scale the size of your deployment down from four brokers to one. Then, while scaledown is taking place, you also change the values of the broker administrator user name and password. In this case, the Operator queues the user name and password changes until the deployment is running with one active broker.

- All CR changes – apart from changing the size of your deployment, or changing the value of the **expose** attribute for acceptors, connectors, or the console – cause existing brokers to be restarted. If you have multiple brokers in your deployment, only one broker restarts at a time.

3.5. CHANGING THE LOGGING LEVEL FOR THE OPERATOR

The default logging level for AMQ Broker Operator is **info**, which logs information and error messages. You can change the default logging level to increase or decrease the detail that is written to the Operator logs.

If you use the OpenShift Container Platform command-line interface to install the Operator, you can set the new logging level in the Operator configuration file, **operator.yaml**, either before or after you install the Operator. If you use Operator Hub, you can use the OpenShift Container Platform web console to set the logging level in the Operator subscription after you install the Operator.

The other available logging levels for the Operator are:

error

Writes error messages only to the log.

debug

Write all messages to the log including debugging messages.

Procedure

1. Using the OpenShift Container Platform command-line interface:

a. Log in as a cluster administrator. For example:

```
$ oc login -u system:admin
```

b. If the Operator is not installed, complete the following steps to change the logging level.

   i. In the **deploy** directory of the Operator archive that you downloaded and extracted, open the **operator.yaml** file.

   ii. Change the value of the **zap-log-level** attribute to **debug** or **error**. For example:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    control-plane: controller-manager
  name: amq-broker-controller-manager
  spec:
    containers:
    - args:
      - --zap-log-level=error
  ...
```

   iii. Save the **operator.yaml** file.

   iv. Install the Operator.

c. If the Operator is already installed, use the **sed** command to change the logging level in the **deploy/operator.yaml** file and redeploy the Operator. For example, the following command changes the logging level from **info** to **error** and redeploys the Operator:

```
$ sed 's/--zap-log-level=info/--zap-log-level=error/' deploy/operator.yaml | oc apply -f -
```

2. Using the OpenShift Container Platform web console:

a. Log in to the OpenShift Container Platform as a cluster administrator.

b. In the left pane, click **Operators → Installed Operators**.

c. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**Operator.

d. Click the **Subscriptions** tab.

e. Click **Actions**.

f. Click **Edit Subscription**.

g. Click the **YAML** tab.
Within the console, a YAML editor opens, enabling you to edit the subscription.

h. In the **config** element, add an environment variable called **ARGS** and specify a logging level of **info**, **debug** or **error**. In the following example, an **ARGS** environment variable that specifies a logging level of **debug** is passed to the Operator container.

```
apiVersion: operators.coreos.com/v1alpha1
kind: Subscription
```

```
spec:
  ...
  config:
    env:
    - name: ARGS
      value: "--zap-log-level=debug"
  ...
```

i. Click Save.

3.6. VIEWING STATUS INFORMATION FOR YOUR BROKER DEPLOYMENT

You can view the status of a series of standard conditions reported by OpenShift Container Platform for your broker deployment. You can also view additional status information provided in the Custom Resource (CR) for your broker deployment.

Procedure

1. Open the CR instance for the broker deployment.

    a. Using the OpenShift command-line interface:

        i. Log in to OpenShift Container Platform as a user that has privileges to view CRs in the project for the broker deployment.

        ii. View the CR for your deployment.

        ```
        oc get ActiveMQArtemis <CR instance name> -n <namespace> -o yaml
        ```

    b. Using the OpenShift Container Platform web console:

        i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

        ii. In the left pane, click **Operators → Installed Operator**.

        iii. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**operator.

        iv. Click the **ActiveMQ Artemis** tab.

        v. Click the name of the ActiveMQ Artemis instance.

2. View the status of the OpenShift Container Platform conditions for your broker deployment.

    a. Using the OpenShift command-line interface:

        i. Go to the **status** section of the CR and view the **conditions** details.

    b. Using the OpenShift Container Platform web console:

        i. In the **Details** tab, scroll down to the **Conditions** section.
        A condition has a status and a type. It might also have a reason, a message and other details. A condition has a status value of **True** if the condition is met, **False** if the condition is not met, or **Unknown** if the status of the condition cannot be determined.

NOTE

The **Valid** condition also has a status of **Unknown** if the CR does not comply with the recommended use of the **spec.deploymentPlan.image**, **spec.deploymentPlan.initImage** and the **spec.version** attribute in a CR. For more information, see Section 6.4.3, "Validation of restrictions applied to automatic upgrades".

Status information is provided for the following conditions:

Condition name	Displays the status of...
Valid	The validation of the CR. If the status of the **Valid** condition is **False**, the Operator does not complete the reconciliation and update the StatefulSet until you first resolve the issue that caused the false status.
Deployed	The availability of the StatefulSet, Pods and other resources.
Ready	A top-level condition which summarizes the other more detailed conditions. The **Ready** condition has a status of**True** only if none of the other conditions have a status of **False**.
BrokerPropertiesApplied	The properties configured in the CR that use the **brokerProperties** attribute. For more information about the **BrokerPropertiesApplied** condition, see Section 4.17, "Configuring items not exposed in the Custom Resource Definition".
JaasPropertiesApplied	The Java Authentication and Authorization Service (JAAS) login modules configured in the CR. For more information about the **JaasPropertiesApplied** condition, see Section 4.3.1, "Configuring JAAS login modules in a secret".

3. View additional status information for your broker deployment in the **status** section of the CR. The following additional status information is displayed:

deploymentPlanSize

The number of broker Pods in the deployment.

podstatus

The status and name of each broker Pod in the deployment.

version

The version of the broker and the registry URLs of the broker and init container images that are deployed.

upgrade

The ability of the Operator to apply major, minor, patch and security updates to the deployment, which is determined by the values of the **spec.deploymentPlan.image** and **spec.version** attributes in the CR.

- If the **spec.deploymentPlan.image** attribute specifies the registry URL of a broker container image, the status of all upgrade types is **False**, which means that the Operator container image, the status of all upgrade types is **False**, which means that the Operator cannot upgrade the existing container images.

- If the **spec.deploymentPlan.image** attribute is not in the CR or has a value of **placeholder**, the configuration of the **spec.version** attribute affects the **upgrade** status as follows:
  - The status of **securityUpdates** is **True**, irrespective of whether the **spec.version** attribute is configured or its value.
  - The status of **patchUpdates** is **True** if the value of the **spec.version** attribute has only a major and a minor version, for example, '7.10', so the Operator can upgrade to the latest patch version of the container images.
  - The status of **minorUpdates** is **True** if the value of the **spec.version attribute** has only a major version, for example, '7', so the Operator can upgrade to the latest minor and patch versions of the container images.
  - The status of **majorUpdates** is **True** if the **spec.version** attribute is not in the CR, so any available upgrades can be deployed, including an upgrade from 7.x.x to 8.x.x, if this version is available.

CHAPTER 4. CONFIGURING OPERATOR-BASED BROKER DEPLOYMENTS

4.1. HOW THE OPERATOR GENERATES THE BROKER CONFIGURATION

Before you use Custom Resource (CR) instances to configure your broker deployment, you should understand how the Operator generates the broker configuration.

When you create an Operator-based broker deployment, a Pod for each broker runs in a StatefulSet in your OpenShift project. An application container for the broker runs within each Pod.

The Operator runs a type of container called an *Init Container* when initializing each Pod. In OpenShift Container Platform, Init Containers are specialized containers that run before application containers. Init Containers can include utilities or setup scripts that are not present in the application image.

By default, the AMQ Broker Operator uses a built-in Init Container. The Init Container uses the main CR instance for your deployment to generate the configuration used by each broker application container.

If you have specified address settings in the CR, the Operator generates a default configuration and then merges or replaces that configuration with the configuration specified in the CR. This process is described in the section that follows.

4.1.1. How the Operator generates the address settings configuration

If you have included an address settings configuration in the main Custom Resource (CR) instance for your deployment, the Operator generates the address settings configuration for each broker as described below.

1. The Operator runs the Init Container before the broker application container. The Init Container generates a **default** address settings configuration. The default address settings configuration is shown below.

```
<address-settings>
  <!--
  if you define auto-create on certain queues, management has to be auto-create
  -->
  <address-setting match="activemq.management#">
    <dead-letter-address>DLQ</dead-letter-address>
    <expiry-address>ExpiryQueue</expiry-address>
    <redelivery-delay>0</redelivery-delay>
    <!--
    with -1 only the global-max-size is in use for limiting
    -->
    <max-size-bytes>-1</max-size-bytes>
    <message-counter-history-day-limit>10</message-counter-history-day-limit>
    <address-full-policy>PAGE</address-full-policy>
    <auto-create-queues>true</auto-create-queues>
    <auto-create-addresses>true</auto-create-addresses>
    <auto-create-jms-queues>true</auto-create-jms-queues>
    <auto-create-jms-topics>true</auto-create-jms-topics>
  </address-setting>

  <!-- default for catch all -->
  <address-setting match="#">
    <dead-letter-address>DLQ</dead-letter-address>
    <expiry-address>ExpiryQueue</expiry-address>
    <redelivery-delay>0</redelivery-delay>
    <!--
    with -1 only the global-max-size is in use for limiting
    -->
    <max-size-bytes>-1</max-size-bytes>
    <message-counter-history-day-limit>10</message-counter-history-day-limit>
    <address-full-policy>PAGE</address-full-policy>
    <auto-create-queues>true</auto-create-queues>
    <auto-create-addresses>true</auto-create-addresses>
    <auto-create-jms-queues>true</auto-create-jms-queues>
    <auto-create-jms-topics>true</auto-create-jms-topics>
  </address-setting>
<address-settings>
```

2. If you have also specified an address settings configuration in your Custom Resource (CR) instance, the Init Container processes that configuration and converts it to XML.

3. Based on the value of the **applyRule** property in the CR, the Init Container *merges* or *replaces* the default address settings configuration shown above with the configuration that you have specified in the CR. The result of this merge or replacement is the final address settings configuration that the broker will use.

4. When the Init Container has finished generating the broker configuration (including address settings), the broker application container starts. When starting, the broker container copies its configuration from the installation directory previously used by the Init Container. You can inspect the address settings configuration in the **broker.xml** configuration file. For a running broker, this file is located in the **/home/jboss/amq-broker/etc** directory.

Additional resources

- For an example of using the **applyRule** property in a CR, see Section 4.2.4, "Matching address settings to configured addresses in an Operator-based broker deployment".

4.1.2. Directory structure of a broker Pod

When you create an Operator-based broker deployment, a Pod for each broker runs in a StatefulSet in your OpenShift project. An application container for the broker runs within each Pod.

The Operator runs a type of container called an *Init Container* when initializing each Pod. In OpenShift Container Platform, Init Containers are specialized containers that run before application containers. Init Containers can include utilities or setup scripts that are not present in the application image.

When generating the configuration for a broker instance, the Init Container uses files contained in a default installation directory. This installation directory is on a volume that the Operator mounts to the broker Pod and which the Init Container and broker container share. The path that the Init Container uses to mount the shared volume is defined in an environment variable called **CONFIG_INSTANCE_DIR**. The default value of **CONFIG_INSTANCE_DIR** is **/amq/init/config**. In the documentation, this directory is referred to as ***<install_dir>***.

NOTE

You cannot change the value of the **CONFIG_INSTANCE_DIR** environment variable.

By default, the installation directory has the following sub-directories:

Sub-directory	Contents
***<install_dir>*/bin**	Binaries and scripts needed to run the broker.
***<install_dir>*/etc**	Configuration files.
***<install_dir>*/data**	The broker journal.
***<install_dir>*/lib**	JARs and libraries needed to run the broker.
***<install_dir>*/log**	Broker log files.
***<install_dir>*/tmp**	Temporary web application files.

When the Init Container has finished generating the broker configuration, the broker application container starts. When starting, the broker container copies its configuration from the installation directory previously used by the Init Container. When the broker Pod is initialized and running, the broker configuration is located in the **/home/jboss/amq-broker** directory (and subdirectories) of the broker.

Additional resources

- For more information about how the Operator chooses a container image for the built-in Init Container, see Section 2.6, “How the Operator chooses container images” .
- To learn how to build and specify a custom Init Container image, see Section 4.9, “Specifying a custom Init Container image”.

4.2. CONFIGURING ADDRESSES AND QUEUES FOR OPERATOR-BASED BROKER DEPLOYMENTS

For an Operator-based broker deployment, you use two separate Custom Resource (CR) instances to configure address and queues and their associated settings.

- To create address and queues on your brokers, you deploy a CR instance based on the address Custom Resource Definition (CRD).
  - If you used the OpenShift command-line interface (CLI) to install the Operator, the address CRD is the **broker_activemqartemisaddress_crd.yaml** file that was included in the **deploy/crds** of the Operator installation archive that you downloaded and extracted.
  - If you used OperatorHub to install the Operator, the address CRD is the **ActiveMQArtemisAddress** CRD listed under **Administration → Custom Resource Definitions** in the OpenShift Container Platform web console.
- To configure address and queue settings that you then match to specific addresses, you include configuration in the main Custom Resource (CR) instance used to create your broker deployment .

  - If you used the OpenShift CLI to install the Operator, the main broker CRD is the **broker_activemqartemis_crd.yaml** file that was included in the **deploy/crds** of the Operator installation archive that you downloaded and extracted.

  - If you used OperatorHub to install the Operator, the main broker CRD is the **ActiveMQArtemis** CRD listed under **Administration → Custom Resource Definitions**in the OpenShift Container Platform web console.

In general, the address and queue settings that you can configure for a broker deployment on OpenShift Container Platform are **fully equivalent** to those of standalone broker deployments on Linux or Windows. However, you should be aware of some differences in *how* those settings are configured. Those differences are described in the following sub-section.

4.2.1. Differences in configuration of address and queue settings between OpenShift and standalone broker deployments

- To configure address and queue settings for broker deployments on OpenShift Container Platform, you add configuration to an **addressSettings** section of the main Custom Resource (CR) instance for the broker deployment. This contrasts with standalone deployments on Linux or Windows, for which you add configuration to an **address-settings** element in the **broker.xml** configuration file.

- The format used for the names of configuration items differs between OpenShift Container Platform and standalone broker deployments. For OpenShift Container Platform deployments, configuration item names are in *camel case*, for example, **defaultQueueRoutingType**. By contrast, configuration item names for standalone deployments are in lower case and use a dash (**-**) separator, for example, **default-queue-routing-type**.
  The following table shows some further examples of this naming difference.

Configuration item for standalone broker deployment	Configuration item for OpenShift broker deployment
address-full-policy	addressFullPolicy
auto-create-queues	autoCreateQueues
default-queue-routing-type	defaultQueueRoutingType
last-value-queue	lastValueQueue

Additional resources

- For examples of creating addresses and queues and matching settings for OpenShift Container Platform broker deployments, see:

  - Creating addresses and queues for a broker deployment on OpenShift Container Platform

  - Matching address settings to configured addresses for a broker deployment on OpenShift Container Platform

- To learn about all of the configuration options for addresses, queues, and address settings for OpenShift Container Platform broker deployments, see Section 8.1, “Custom Resource configuration reference”.

- For comprehensive information about configuring addresses, queues, and associated address settings for **standalone** broker deployments, see Configuring addresses and queues in *Configuring AMQ Broker*. You can use this information to create equivalent configurations for broker deployments on OpenShift Container Platform.

4.2.2. Creating addresses and queues for an Operator-based broker deployment

The following procedure shows how to use a Custom Resource (CR) instance to add an address and associated queue to an Operator-based broker deployment.

> NOTE
>
> To create multiple addresses and/or queues in your broker deployment, you need to create separate CR files and deploy them individually, specifying new address and/or queue names in each case. In addition, the **name** attribute of each CR instance must be unique.

Prerequisites

- You must have already installed the AMQ Broker Operator, including the dedicated Custom Resource Definition (CRD) required to create addresses and queues on your brokers. For information on two alternative ways to install the Operator, see:
  - Section 3.2, “Installing the Operator using the CLI” .
  - Section 3.3, “Installing the Operator using OperatorHub” .
- You should be familiar with how to use a CR instance to create a basic broker deployment. For more information, see Section 3.4.1, “Deploying a basic broker instance” .

Procedure

1. Start configuring a Custom Resource (CR) instance to define addresses and queues for the broker deployment.
   a. Using the OpenShift command-line interface:
      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

```
oc login -u <user> -p <password> --server=<host:port>
```

      ii. Open the sample CR file called **broker_activemqartemisaddress_cr.yaml** that was included in the **deploy/crs** directory of the Operator installation archive that you downloaded and extracted.
   b. Using the OpenShift Container Platform web console:
      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.
      ii. Start a new CR instance based on the address CRD. In the left pane, click **Administration → Custom Resource Definitions**
      iii. Click the **ActiveMQArtemisAddresss** CRD.

iv. Click the **Instances** tab.

v. Click **Create ActiveMQArtemisAddress**.
Within the console, a YAML editor opens, enabling you to configure a CR instance.

2. In the **spec** section of the CR, add lines to define an address, queue, and routing type. For example:

```
apiVersion: broker.amq.io/v1beta1
kind: ActiveMQArtemisAddress
metadata:
   name: myAddressDeployment0
   namespace: myProject
spec:
   ...
   addressName: myAddress0
   queueName: myQueue0
   routingType: anycast
   ...
```

The preceding configuration defines an address named **myAddress0** with a queue named **myQueue0** and an **anycast** routing type.

NOTE

In the **metadata** section, you need to include the **namespace** property and specify a value **only** if you are using the OpenShift Container Platform web console to create your CR instance. The value that you should specify is the name of the OpenShift project for your broker deployment.

3. Deploy the CR instance.

   a. Using the OpenShift command-line interface:

      i. Save the CR file.

      ii. Switch to the project for the broker deployment.

      ```
      $ oc project <project_name>
      ```

      iii. Create the CR instance.

      ```
      $ oc create -f <path/to/address_custom_resource_instance>.yaml
      ```

   b. Using the OpenShift web console:

      i. When you have finished configuring the CR, click **Create**.

4.2.3. Deleting addresses and queues for an Operator-based broker deployment

The following procedure shows how to use a Custom Resource (CR) instance to delete an address and associated queue from an Operator-based broker deployment.

Procedure

1. Ensure that you have an address CR file with the details, for example, the **name**, **addressName** and **queueName**, of the address and queue you want to delete. For example:

```
apiVersion: broker.amq.io/v1beta1
kind: ActiveMQArtemisAddress
metadata:
   name: myAddressDeployment0
   namespace: myProject
spec:
   ...
   addressName: myAddress0
   queueName: myQueue0
   routingType: anycast
   ...
```

2. In the **spec** section of the address CR, add the **removeFromBrokerOnDelete** attribute and set to a value of **true**.

```
..
spec:
  addressName: myAddress1
  queueName: myQueue1
  routingType: anycast
  removeFromBrokerOnDelete: true
```

   Setting the **removeFromBrokerOnDelete** attribute to **true** causes the Operator to remove the address and any associated message for all brokers in the deployment when you delete the address CR.

3. Apply the updated address CR to set the **removeFromBrokerOnDelete** attribute for the address you want to delete.

```
$ oc apply -f <path/to/address_custom_resource_instance>.yaml
```

4. Delete the address CR to delete the address from the brokers in the deployment.

```
$ oc delete -f <path/to/address_custom_resource_instance>.yaml
```

4.2.4. Matching address settings to configured addresses in an Operator-based broker deployment

If delivery of a message to a client is unsuccessful, you might not want the broker to make ongoing attempts to deliver the message. To prevent infinite delivery attempts, you can define a *dead letter address* and an associated *dead letter queue*. After a specified number of delivery attempts, the broker removes an undelivered message from its original queue and sends the message to the configured dead letter address. A system administrator can later consume undelivered messages from a dead letter queue to inspect the messages.

The following example shows how to configure a dead letter address and queue for an Operator-based broker deployment. The example demonstrates how to:

- Use the **addressSetting** section of the main broker Custom Resource (CR) instance to configure address settings.

- Match those address settings to addresses in your broker deployment.

Prerequisites

- You created an **ActiveMQArtemis** CR instance to deploy a broker. For more information, see Section 3.4.1, "Deploying a basic broker instance" .
- You are familiar with the **default** address settings configuration that the Operator merges or replaces with the configuration specified in your CR instance. For more information, see Section 4.1.1, "How the Operator generates the address settings configuration" .

Procedure

1. Start configuring an address CR instance to add a dead letter address and queue to receive undelivered messages for each broker in the deployment.
   a. Using the OpenShift command-line interface:
      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

         ```
         oc login -u <user> -p <password> --server=<host:port>
         ```

      ii. Open the sample CR file called **broker_activemqartemisaddress_cr.yaml** that was included in the **deploy/crs** directory of the Operator installation archive that you downloaded and extracted.
   b. Using the OpenShift Container Platform web console:
      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.
      ii. Start a new CR instance based on the address CRD. In the left pane, click **Administration → Custom Resource Definitions**
      iii. Click the **ActiveMQArtemisAddresss** CRD.
      iv. Click the **Instances** tab.
      v. Click **Create ActiveMQArtemisAddress**.
         Within the console, a YAML editor opens, enabling you to configure a CR instance.
2. In the **spec** section of the CR, add lines to specify a dead letter address and queue to receive undelivered messages. For example:

   ```
   apiVersion: broker.amq.io/v1beta1
   kind: ActiveMQArtemisAddress
   metadata:
     name: ex-aaoaddress
   spec:
     ...
     addressName: myDeadLetterAddress
     queueName: myDeadLetterQueue
     routingType: anycast
     ...
   ```

The preceding configuration defines a dead letter address named **myDeadLetterAddress** with a dead letter queue named **myDeadLetterQueue** and an **anycast** routing type.

> **NOTE**
>
> In the **metadata** section, you need to include the **namespace** property and specify a value **only** if you are using the OpenShift Container Platform web console to create your CR instance. The value that you should specify is the name of the OpenShift project for your broker deployment.

3. Deploy the address CR instance.

   a. Using the OpenShift command-line interface:

      i. Save the CR file.

      ii. Switch to the project for the broker deployment.

      ```
      $ oc project <project_name>
      ```

      iii. Create the address CR.

      ```
      $ oc create -f <path/to/address_custom_resource_instance>.yaml
      ```

   b. Using the OpenShift web console:

      i. When you have finished configuring the CR, click **Create**.

4. Edit the main broker CR instance for the broker deployment.

   a. Using the OpenShift command-line interface:

      i. Log in to OpenShift as a user that has privileges to edit and deploy CRs in the project for the broker deployment.

      ```
      $ oc login -u <user> -p <password> --server=<host:port>
      ```

      ii. Edit the CR.

      ```
       oc edit ActiveMQArtemis <CR instance name> -n <namespace>
      ```

   b. Using the OpenShift Container Platform web console:

      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. In the left pane, click **Operators → Installed Operator**.

      iii. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**operator.

      iv. Click the **AMQ Broker** tab.

      v. Click the name of the ActiveMQArtemis instance name.

      vi. Click the **YAML** tab.

Within the console, a YAML editor opens, enabling you to edit the CR instance.

NOTE

In the **metadata** section, you need to include the **namespace** property and specify a value **only** if you are using the OpenShift Container Platform web console to create your CR instance. The value that you should specify is the name of the OpenShift project for your broker deployment.

5. In the **spec** section of the CR, add a new **addressSettings** section that contains a single **addressSetting** section, as shown below.

```
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
  addressSettings:
    addressSetting:
```

6. Add a single instance of the **match** property to the **addressSetting** block. Specify an address-matching expression. For example:

```
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
  addressSettings:
    addressSetting:
    - match: myAddress
```

match

Specifies the address, or *set* of address to which the broker applies the configuration that follows. In this example, the value of the **match** property corresponds to a single address called **myAddress**.

7. Add properties related to undelivered messages and specify values. For example:

```
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
  addressSettings:
    addressSetting:
    - match: myAddress
      deadLetterAddress: myDeadLetterAddress
      maxDeliveryAttempts: 5
```

deadLetterAddress

Address to which the broker sends undelivered messages.

maxDeliveryAttempts

Maximum number of delivery attempts that a broker makes before moving a message to the configured dead letter address.
In the preceding example, if the broker makes five unsuccessful attempts to deliver a message to an address that begins with **myAddress**, the broker moves the message to the specified dead letter address, **myDeadLetterAddress**.

8. (Optional) Apply similar configuration to another address or set of addresses. For example:

```
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
  addressSettings:
    addressSetting:
    - match: myAddress
      deadLetterAddress: myDeadLetterAddress
      maxDeliveryAttempts: 5
    - match: 'myOtherAddresses#'
      deadLetterAddress: myDeadLetterAddress
      maxDeliveryAttempts: 3
```

In this example, the value of the second **match** property includes a hash wildcard character. The wildcard character means that the preceding configuration is applied to **any** address that begins with the string **myOtherAddresses**.

NOTE

If you use a wildcard expression as a value for the **match** property, you must enclose the value in single quotation marks, for example, **'myOtherAddresses#'**.

9. At the beginning of the **addressSettings** section, add the **applyRule** property and specify a value. For example:

```
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
  addressSettings:
    applyRule: merge_all
    addressSetting:
    - match: myAddress
      deadLetterAddress: myDeadLetterAddress
      maxDeliveryAttempts: 5
    - match: 'myOtherAddresses#'
      deadLetterAddress: myDeadLetterAddress
      maxDeliveryAttempts: 3
```

The **applyRule** property specifies how the Operator applies the configuration that you add to the CR for each matching address or set of addresses. The values that you can specify are:

merge_all

- For address settings specified in both the CR **and** the default configuration that match the same address or set of addresses:
  - Replace any property values specified in the default configuration with those specified in the CR.
  - Keep any property values that are specified uniquely in the CR **or** the default configuration. Include each of these in the final, merged configuration.
- For address settings specified in either the CR **or** the default configuration that uniquely match a particular address or set of addresses, include these in the final, merged configuration.

merge_replace

- For address settings specified in both the CR **and** the default configuration that match the same address or set of addresses, include the settings specified in the **CR** in the final, merged configuration. **Do not** include any properties specified in the default configuration, even if these are not specified in the CR.
- For address settings specified in either the CR **or** the default configuration that uniquely match a particular address or set of addresses, include these in the final, merged configuration.

replace_all

Replace **all** address settings specified in the default configuration with those specified in the CR. The final, merged configuration corresponds exactly to that specified in the CR.

NOTE

If you do not explicitly include the **applyRule** property in your CR, the Operator uses a default value of **merge_all**.

10. Save the CR instance.

Additional resources

- To learn about all of the configuration options for addresses, queues, and address settings for OpenShift Container Platform broker deployments, see Section 8.1, "Custom Resource configuration reference".
- If you installed the AMQ Broker Operator using the OpenShift command-line interface (CLI), the installation archive that you downloaded and extracted contains some additional examples of configuring address settings. In the **deploy/examples** folder of the installation archive, see:
  - **artemis-basic-address-settings-deployment.yaml**
  - **artemis-merge-replace-address-settings-deployment.yaml**
  - **artemis-replace-address-settings-deployment.yaml**
- For comprehensive information about configuring addresses, queues, and associated address settings for **standalone** broker deployments, see Configuring addresses and queues in *Configuring AMQ Broker*. You can use this information to create equivalent configurations for broker deployments on OpenShift Container Platform.
- For more information about Init Containers in OpenShift Container Platform, see Using Init Containers to perform tasks before a pod is deployed in the OpenShift Container Platform documentation.

4.3. CONFIGURING AUTHENTICATION AND AUTHORIZATION

By default, AMQ Broker uses a Java Authentication and Authorization Service (JAAS) properties login module to authenticate and authorize users. The configuration for the default JAAS login module is stored in a **/home/jboss/amq-broker/etc/login.config** file on each broker Pod and reads user and role information from the **artemis-users.properties** and **artemis-roles.properties files** in the same directory. You add the user and role information to the properties files in the default login module by updating the **ActiveMQArtemisSecurity** Custom Resource (CR).

An alternative to updating the **ActiveMQArtemisSecurity** CR to add user and role information to the default properties files is to configure one or more JAAS login modules in a secret. This secret is mounted as a file on each broker Pod. Configuring JAAS login modules in a secret offers the following advantages over using the **ActiveMQArtemisSecurity** CR to add user and role information.

- If you configure a properties login module in a secret, the brokers do not need to restart each time you update the property files. For example, when you add a new user to a properties file and update the secret, the changes take effect without requiring a restart of the broker.
- You can configure JAAS login modules that are not defined in the **ActiveMQArtemisSecurity** CRD to authenticate users. For example, you can configure an LDAP login module or any other JAAS login module.

Both methods of configuring authentication and authorization for AMQ Broker are described in the following sections.

4.3.1. Configuring JAAS login modules in a secret

You can configure JAAS login modules in a secret to authenticate users with AMQ Broker. After you create the secret, you must add a reference to the secret in the main broker Custom Resource (CR) and also configure permissions in the CR to grant users access to AMQ Broker.

Procedure

1. Create a text file with your new JAAS login modules configuration and save the file as **login.config**. By saving the file as **login.config**, the correct key is inserted in the secret that you create from the text file. The following is an example login module configuration:

```
activemq {
  org.apache.activemq.artemis.spi.core.security.jaas.PropertiesLoginModule sufficient
    reload=true
    org.apache.activemq.jaas.properties.user="new-users.properties"
    org.apache.activemq.jaas.properties.role="new-roles.properties";

  org.apache.activemq.artemis.spi.core.security.jaas.PropertiesLoginModule sufficient
    reload=false
    org.apache.activemq.jaas.properties.user="artemis-users.properties"
    org.apache.activemq.jaas.properties.role="artemis-roles.properties"
    baseDir="/home/jboss/amq-broker/etc";
};
```

After you configure JAAS login modules in a secret and add a reference to the secret in the CR, the default login module is no longer used by AMQ Broker. However, a user in the **artemis-users.properties** file, which is referenced in the default login module, is required by the Operator to authenticate with the broker. To ensure that the Operator can authenticate with the broker after you configure a new JAAS login module, you must either:

- Include the default properties login module in the new login module configuration, as shown in the example above. In the example, the default properties login module uses the **artemis-users.properties** and **artemis-roles.properties** files. If you include the default login module in the new login module configuration, you must set the **baseDir** to the **/home/jboss/amq-broker/etc** directory, which contains the default properties files on each broker Pod.

- Add the user and role information required by the Operator to authenticate with the broker to a properties file referenced in the new login module configuration. You can copy this information from the default **artemis-users.properties** and **artemis-roles.properties** files, which are in the **/home/jboss/amq-broker/etc directory** on a broker Pod.

NOTE

The properties files referenced in a login module are loaded only when the broker calls the login module for the first time. A broker calls the login modules in the order that they are listed in the **login.config** file until it finds the login module to authenticate a user. By placing the login module that contains the credentials used by the Operator at the end of the **login.config** file, all preceding login modules are called when the broker authenticates the Operator. As a result, any status message which states that property files are not visible on the broker is cleared.

2. If the **login.config** file you created includes a properties login module, ensure that the users and roles files specified in the module contain user and role information. For example:

new-users.properties

```
ruben=ruben01!
anne=anne01!
rick=rick01!
bob=bob01!
```

new-roles.properties

```
admin=ruben, rick
group1=bob
group2=anne
```

3. Use the **oc create secret** command to create a secret from the text file that you created with the new login module configuration. If the login module configuration includes a properties login module, also include the associated users and roles files in the secret. For example:

```
oc create secret generic custom-jaas-config --from-file=login.config --from-file=new-users.properties --from-file=new-roles.properties
```

NOTE

The secret name must have a suffix of **-jaas-config** so the Operator can recognize that the secret contains login module configuration and propagate any updates to each broker Pod.

For more information about how to create secrets, see Secrets in the Kubernetes documentation.

4. Add the secret you created to the Custom Resource (CR) instance for your broker deployment.

   a. Using the OpenShift command-line interface:

      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. Edit the CR for your deployment.

```
oc edit ActiveMQArtemis <CR instance name> -n <namespace>
```

   b. Using the OpenShift Container Platform web console:

      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. In the left pane, click **Operators → Installed Operator**.

      iii. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**operator.

      iv. Click the **AMQ Broker** tab.

      v. Click the name of the ActiveMQArtemis instance name.

      vi. Click the **YAML** tab.
      Within the console, a YAML editor opens, enabling you to configure a CR instance.

5. Create an **extraMounts** element and a **secrets** element and add the name of the secret. The following example adds a secret named **custom-jaas-config** to the CR.

```
deploymentPlan:
  ...
```

```
extraMounts:
  secrets:
  - "custom-jaas-config"
...
```

6. In the CR, grant permissions to the roles that are configured on the broker.

   a. In the **spec** section of the CR, add a **brokerProperties** element and add the permissions. You can grant a role permissions to a single address. Or, you can specify a wildcard match using the **#** sign to grant a role permissions to all addresses. For example:

   ```
   spec:
     ...
     brokerProperties:
     - securityRoles.#.group2.send=true
     - securityRoles.#.group1.consume=true
     - securityRoles.#.group1.createAddress=true
     - securityRoles.#.group1.createNonDurableQueue=true
     - securityRoles.#.group1.browse=true
     ...
   ```

   In the example, the group2 role is assigned **send** permissions to all addresses and the group1 role is assigned **consume**, **createAddress**, **createNonDurableQueue** and **browse** permissions to all addresses.

7. Save the CR.
   The Operator mounts the **login.config** file in the secret in a **/amq/extra/secrets/*secret name*** directory on each Pod and configures the broker JVM to read the mounted **login.config** file instead of the default **login.config** file. If the **login.config** file contains a properties login module, the referenced users and roles properties file are also mounted on each Pod.

8. View the status information in the CR to verify that the brokers in your deployment are using the JAAS login modules in the secret for authentication.

   a. Using the OpenShift command-line interface:

      i. Get the status conditions in the CR for your brokers.

      ```
      $ oc get activemqartemis -o yaml
      ```

   b. Using the OpenShift web console:

      i. In the CR, navigate to the **status** section.

   c. In the status information, verify that a **JaasPropertiesApplied** type is present, which indicates that the broker is using the JAAS login modules configured in the secret. For example:

   ```
   - lastTransitionTime: "2023-02-06T20:50:01Z"
     message: ""
     reason: Applied
     status: "True"
     type: JaasPropertiesApplied
   ```

   When you update any of the files in the secret, the value of the **reason** field shows **OutofSync** until OpenShift Container Platform propagates the latest files in the secret to each broker Pod. For example, if you add a new user to the **new-users-properties** file and update the secret, you see the following status information until the updated file is propagated to each Pod:

```
- lastTransitionTime: "2023-02-06T20:55:20Z"
  message: 'new-users.properties status out of sync, expected: 287641156, current:
2177044732'
  reason: OutOfSync
  status: "False"
  type: JaasPropertiesApplied
```

9. When you update user or role information in a properties file that is referenced in the secret, use the **oc set data** command to update the secret. You must readd all the files to the secret again, including the **login.config** file. For example, if you add a new user to the **new-users.properties** file that you created earlier in this procedure, use the following command to update the **custom-jaas-config** secret:

```
oc set data secret/custom-jaas-config --from-file=login.config=login.config --from-file=new-users.properties=new-users.properties --from-file=new-roles.properties=new-roles.properties
```

NOTE

The broker JVM reads the configuration in the **login.config** file only when it starts. If you change the configuration in the **login.config** file, for example, to add a new login module, and update the secret, the broker does not use the new configuration until the broker is restarted.

Additional Resources

Section 8.2, "Example JAAS login module configurations"

Section 8.3, "Example: configuring AMQ Broker to use Red Hat Single Sign-On"

For information about the JAAS login module format, see JAAS Login Configuration File .

4.3.2. Configuring the default JAAS login module using the Security Custom Resource (CR)

You can use the **ActiveMQArtemisSecurity** Custom Resource (CR) to configure user and role information in the default JAAS properties login module to authenticate users with AMQ Broker. For an alternative method of configuring authentication and authorization on AMQ Broker by using secrets, see Section 4.3.1, "Configuring JAAS login modules in a secret" .

4.3.2.1. Configuring the default JAAS login module using the Security Custom Resource (CR)

The following procedure shows how to configure the default JAAS login module using the Security Custom Resource (CR).

Prerequisites

- You must have already installed the AMQ Broker Operator. For information on two alternative ways to install the Operator, see:

  - Section 3.2, “Installing the Operator using the CLI” .
  - Section 3.3, “Installing the Operator using OperatorHub” .
- You should be familiar with broker security as described in Securing brokers

PROCEDURE

You can deploy the security CR before or after you create a broker deployment. However, if you deploy the security CR after creating the broker deployment, the broker pod is restarted to accept the new configuration.

1. Start configuring a Custom Resource (CR) instance to define users and associated security configuration for the broker deployment.

   a. Using the OpenShift command-line interface:

      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

```
oc login -u <user> -p <password> --server=<host:port>
```

      ii. Edit the CR for your deployment.

```
oc edit ActiveMQArtemis <CR instance name> -n <namespace>
```

   b. Using the OpenShift Container Platform web console:

      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. In the left pane, click **Operators → Installed Operator**.

      iii. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**operator.

      iv. Click the **AMQ Broker** tab.

      v. Click the name of the ActiveMQArtemis instance name

      vi. Click the **YAML** tab.
      Within the console, a YAML editor opens, enabling you to configure a CR instance.

2. In the **spec** section of the CR, add lines to define users and roles. For example:

```
apiVersion: broker.amq.io/v1beta1
kind: ActiveMQArtemisSecurity
metadata:
  name: ex-prop
spec:
  loginModules:
    propertiesLoginModules:
      - name: "prop-module"
        users:
          - name: "sam"
            password: "samspassword"
            roles:
              - "sender"
          - name: "rob"
            password: "robspassword"
            roles:
              - "receiver"
  securityDomains:
    brokerDomain:
      name: "activemq"
      loginModules:
        - name: "prop-module"
          flag: "sufficient"
  securitySettings:
    broker:
      - match: "#"
        permissions:
          - operationType: "send"
            roles:
              - "sender"
          - operationType: "createAddress"
            roles:
              - "sender"
          - operationType: "createDurableQueue"
            roles:
              - "sender"
          - operationType: "consume"
            roles:
              - "receiver"
              ...
```

NOTE

Always specify values for the elements in the preceding example. For example, if you do not specify values for **securityDomains.brokerDomain** or values for roles, the resulting configuration might cause unexpected results.

The preceding configuration defines two users:

- a **propertiesLoginModule** named **prop-module** that defines a user named **sam** with a role named **sender**.
- a **propertiesLoginModule** named **prop-module** that defines a user named **rob** with a role named **receiver**.

The properties of these roles are defined in the **brokerDomain** and **broker** sections of the **securityDomains** section. For example, the **send** role is defined to allow users with that role to create a durable queue on any address. By default, the configuration applies to all deployed brokers defined by CRs in the current namespace. To limit the configuration to particular broker deployments, use the **applyToCrNames** option described in Section 8.1.3, “Security Custom Resource configuration reference”.

> **NOTE**
>
> In the **metadata** section, you need to include the **namespace** property and specify a value **only** if you are using the OpenShift Container Platform web console to create your CR instance. The value that you should specify is the name of the OpenShift project for your broker deployment.

3. Deploy the CR instance.

   a. Using the OpenShift command-line interface:

      i. Save the CR file.

      ii. Switch to the project for the broker deployment.

      ```
      $ oc project <project_name>
      ```

      iii. Create the CR instance.

      ```
      $ oc create -f <path/to/security_custom_resource_instance>.yaml
      ```

   b. Using the OpenShift web console:

      i. When you have finished configuring the CR, click **Create**.

Additional resources

- Section 8.1.3, “Security Custom Resource configuration reference”
- Section 3.4.1, “Deploying a basic broker instance”

4.3.2.2. Storing user passwords in a secret

In the Section 4.3.2.1, “Configuring the default JAAS login module using the Security Custom Resource (CR)” procedure, user passwords are stored in clear text in the **ActiveMQArtemisSecurity** CR. If you do not want to store passwords in clear text in the CR, you can exclude the passwords from the CR and store them in a secret. When you apply the CR, the Operator retrieves each user’s password from the secret and inserts it in the **artemis-users.properties** file on the broker pod.

Procedure

1. Use the **oc create secret** command to create a secret and add each user’s name and password. The secret name must follow a naming convention of **security-properties-*module name***, where *module name* is the name of the login module configured in the CR. For example:

   ```
   oc create secret generic security-properties-prop-module \
     --from-literal=sam=samspassword \
     --from-literal=rob=robspassword
   ```

2. In the **spec** section of the CR, add the user names that you specified in the secret along with the role information, but do not include each user’s password. For example:

   ```
   apiVersion: broker.amq.io/v1beta1
   kind: ActiveMQArtemisSecurity
   ```

```
metadata:
  name: ex-prop
spec:
  loginModules:
    propertiesLoginModules:
      - name: "prop-module"
        users:
          - name: "sam"
            roles:
              - "sender"
          - name: "rob"
            roles:
              - "receiver"
  securityDomains:
    brokerDomain:
      name: "activemq"
      loginModules:
        - name: "prop-module"
          flag: "sufficient"
  securitySettings:
    broker:
      - match: "#"
        permissions:
          - operationType: "send"
            roles:
              - "sender"
          - operationType: "createAddress"
            roles:
              - "sender"
          - operationType: "createDurableQueue"
            roles:
              - "sender"
          - operationType: "consume"
            roles:
              - "receiver"
              ...
```

3. Deploy the CR instance.

    a. Using the OpenShift command-line interface:

        i. Save the CR file.

        ii. Switch to the project for the broker deployment.

        ```
        $ oc project <project_name>
        ```

        iii. Create the CR instance.

        ```
        $ oc create -f <path/to/address_custom_resource_instance>.yaml
        ```

    b. Using the OpenShift web console:

        i. When you finish configuring the CR, click **Create**.

Additional resources

For more information about secrets in OpenShift Container Platform, see Providing sensitive data to pods in the OpenShift Container Platform documentation.

4.4. CONFIGURING BROKER STORAGE REQUIREMENTS

To use persistent storage in an Operator-based broker deployment, you set **persistenceEnabled** to **true** in the Custom Resource (CR) instance used to create the deployment. If you do not have container-native storage in your OpenShift cluster, you need to manually provision Persistent Volumes (PVs) and ensure that these are available to be claimed by the Operator using a Persistent Volume Claim (PVC). If you want to create a cluster of two brokers with persistent storage, for example, then you need to have two PVs available.

IMPORTANT

When you manually provision PVs in OpenShift Container Platform, ensure that you set the reclaim policy for each PV to **Retain**. If the reclaim policy for a PV is not set to **Retain** and the PVC that the Operator used to claim the PV is deleted, the PV is also deleted. Deleting a PV results in the loss of any data on the volume. For more information, about setting the reclaim policy, see Understanding persistent storage in the OpenShift Container Platform documentation.

By default, a PVC obtains 2 GiB of storage for each broker from the default storage class configured for the cluster. You can override the default size and storage class requested in the PVC, but only by configuring new values in the CR **before** deploying the CR for the first time.

4.4.1. Configuring broker storage size and storage class

The following procedure shows how to configure the Custom Resource (CR) instance for your broker deployment to specify the size and storage class of the Persistent Volume Claim (PVC) required by each broker for persistent message storage.

NOTE

If you change the storage configuration in the CR after you deploy AMQ Broker, the updated configuration is not applied retrospectively to existing Pods. However, the updated configuration is applied to new Pods that are created if you scale up the deployment.

Prerequisites

- You should be familiar with how to use a CR instance to create a basic broker deployment. See Section 3.4.1, “Deploying a basic broker instance” .
- You must have already provisioned Persistent Volumes (PVs) and made these available to be claimed by the Operator. For example, if you want to create a cluster of two brokers with persistent storage, you need to have two PVs available.
  For more information about provisioning persistent storage, see Understanding persistent storage in the OpenShift Container Platform documentation.

Procedure

1. Start configuring a Custom Resource (CR) instance for the broker deployment.
   a. Using the OpenShift command-line interface:

i. Log in to OpenShift as a user that has privileges to deploy CRs in the project in which you are creating the deployment.

```
oc login -u <user> -p <password> --server=<host:port>
```

ii. Open the sample CR file called **broker_activemqartemis_cr.yaml** that was included in the **deploy/crs** directory of the Operator installation archive that you downloaded and extracted.

b. Using the OpenShift Container Platform web console:

i. Log in to the console as a user that has privileges to deploy CRs in the project in which you are creating the deployment.

ii. Start a new CR instance based on the main broker CRD. In the left pane, click **Administration → Custom Resource Definitions**.

iii. Click the **ActiveMQArtemis** CRD.

iv. Click the **Instances** tab.

v. Click **Create ActiveMQArtemis**.
Within the console, a YAML editor opens, enabling you to configure a CR instance.

For a basic broker deployment, a configuration might resemble that shown below.

```
apiVersion: broker.amq.io/v1beta1
kind: ActiveMQArtemis
metadata:
  name: ex-aao
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
```

Observe that in the **broker_activemqartemis_cr.yaml** sample CR file, the **image** property is set to a default value of **placeholder**. This value indicates that, by default, the **image** property does not specify a broker container image to use for the deployment. To learn how the Operator determines the appropriate broker container image to use, see Section 2.6, “How the Operator chooses container images”.

2. To specify the broker storage size, in the **deploymentPlan** section of the CR, add a **storage** section. Add a **size** property and specify a value. For example:

```
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
    storage:
      size: 4Gi
```

storage.size

Size, in bytes, of the Persistent Volume Claim (PVC) that each broker Pod requires for persistent storage. This property applies only when **persistenceEnabled** is set to **true**. The value that you specify **must** include a unit using byte notation (for example, K, M, G), or the binary equivalents (Ki, Mi, Gi).

3. To specify the storage class that each broker Pod requires for persistent storage, in the **storage** section, add a **storageClassName** property and specify a value. For example:

```
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
    storage:
      size: 4Gi
      storageClassName: gp3
```

storage.storageClassName

The name of the storage class to request in the Persistent Volume Claim (PVC). Storage classes provide a way for administrators to describe and classify the available storage. For example, different storage classes might map to specific quality-of-service levels, backup policies and so on.
If you do do not specify a storage class, a persistent volume with the default storage class configured for the cluster is claimed by the PVC.

NOTE

If you specify a storage class, a persistent volume is claimed by the PVC only if the volume's storage class matches the specified storage class.

4. Deploy the CR instance.

   a. Using the OpenShift command-line interface:

      i. Save the CR file.

      ii. Switch to the project in which you are creating the broker deployment.

      ```
      $ oc project <project_name>
      ```

      iii. Create the CR instance.

      ```
      $ oc create -f <path/to/custom_resource_instance>.yaml
      ```

   b. Using the OpenShift web console:

i. When you have finished configuring the CR, click **Create**.

4.5. CONFIGURING RESOURCE LIMITS AND REQUESTS FOR OPERATOR-BASED BROKER DEPLOYMENTS

When you create an Operator-based broker deployment, the broker Pods in the deployment run in a StatefulSet on a node in your OpenShift cluster. You can configure the Custom Resource (CR) instance for the deployment to specify the host-node compute resources used by the broker container that runs in each Pod. By specifying limit and request values for CPU and memory (RAM), you can ensure satisfactory performance of the broker Pods.

IMPORTANT

- You must add configuration for limits and requests to the CR instance for your broker deployment **before** deploying the CR for the first time. You **cannot** add the configuration to a broker deployment that is already running.

- It is not possible for Red Hat to recommend values for limits and requests because these are based on your specific messaging system use-cases and the resulting architecture that you have implemented. However, it *is* recommended that you test and tune these values in a development environment before configuring them for your production environment.

- The Operator runs a type of container called an *Init Container* when initializing each broker Pod. Any resource limits and requests that you configure for each broker container also apply to each Init Container. For more information about the use of Init Containers in broker deployments, see Section 4.1, "How the Operator generates the broker configuration".

You can specify the following limit and request values:

CPU limit

For each broker container running in a Pod, this value is the maximum amount of host-node CPU that the container can consume. If a broker container attempts to exceed the specified CPU limit, OpenShift throttles the container. This ensures that containers have consistent performance, regardless of the number of Pods running on a node.

Memory limit

For each broker container running in a Pod, this value is the maximum amount of host-node memory that the container can consume. If a broker container attempts to exceed the specified memory limit, OpenShift terminates the container. The broker Pod restarts.

CPU request

For each broker container running in a Pod, this value is the amount of host-node CPU that the container requests. The OpenShift scheduler considers the CPU request value during Pod placement, to bind the broker Pod to a node with sufficient compute resources.

The CPU request value is the *minimum* amount of CPU that the broker container requires to run. However, if there is no contention for CPU on the node, the container can use all available CPU. If you have specified a CPU limit, the container cannot exceed that amount of CPU usage. If there is CPU contention on the node, CPU request values provide a way for OpenShift to weigh CPU usage across all containers.

Memory request

For each broker container running in a Pod, this value is the amount of host-node memory that the container requests. The OpenShift scheduler considers the memory request value during Pod placement, to bind the broker Pod to a node with sufficient compute resources.
The memory request value is the *minimum* amount of memory that the broker container requires to run. However, the container can consume as much available memory as possible. If you have specified a memory limit, the broker container cannot exceed that amount of memory usage.

CPU is measured in units called millicores. Each node in an OpenShift cluster inspects the operating system to determine the number of CPU cores on the node. Then, the node multiplies that value by 1000 to express the total capacity. For example, if a node has two cores, the CPU capacity of the node is expressed as **2000m**. Therefore, if you want to use one-tenth of a single core, you specify a value of **100m**.

Memory is measured in bytes. You can specify the value using byte notation (E, P, T, G, M, K) or the binary equivalents (Ei, Pi, Ti, Gi, Mi, Ki). The value that you specify must include a unit.

4.5.1. Configuring broker resource limits and requests

The following example shows how to configure the main Custom Resource (CR) instance for your broker deployment to set limits and requests for CPU and memory for each broker container that runs in a Pod in the deployment.

IMPORTANT

- You must add configuration for limits and requests to the CR instance for your broker deployment **before** deploying the CR for the first time. You **cannot** add the configuration to a broker deployment that is already running.

- It is not possible for Red Hat to recommend values for limits and requests because these are based on your specific messaging system use-cases and the resulting architecture that you have implemented. However, it *is* recommended that you test and tune these values in a development environment before configuring them for your production environment.

Prerequisites

- You should be familiar with how to use a CR instance to create a basic broker deployment. See Section 3.4.1, “Deploying a basic broker instance” .

Procedure

1. Start configuring a Custom Resource (CR) instance for the broker deployment.

    a. Using the OpenShift command-line interface:

        i. Log in to OpenShift as a user that has privileges to deploy CRs in the project in which you are creating the deployment.

        ```
        oc login -u <user> -p <password> --server=<host:port>
        ```

        ii. Open the sample CR file called **broker_activemqartemis_cr.yaml** that was included in the **deploy/crs** directory of the Operator installation archive that you downloaded and extracted.

b. Using the OpenShift Container Platform web console:

   i. Log in to the console as a user that has privileges to deploy CRs in the project in which you are creating the deployment.

   ii. Start a new CR instance based on the main broker CRD. In the left pane, click **Administration → Custom Resource Definitions**.

   iii. Click the **ActiveMQArtemis** CRD.

   iv. Click the **Instances** tab.

   v. Click **Create ActiveMQArtemis**.
   Within the console, a YAML editor opens, enabling you to configure a CR instance.

For a basic broker deployment, a configuration might resemble that shown below.

```
apiVersion: broker.amq.io/v1beta1
kind: ActiveMQArtemis
metadata:
  name: ex-aao
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
```

Observe that in the **broker_activemqartemis_cr.yaml** sample CR file, the **image** property is set to a default value of **placeholder**. This value indicates that, by default, the **image** property does not specify a broker container image to use for the deployment. To learn how the Operator determines the appropriate broker container image to use, see Section 2.6, “How the Operator chooses container images”.

2. In the **deploymentPlan** section of the CR, add a **resources** section. Add **limits** and **requests** sub-sections. In each sub-section, add a **cpu** and **memory** property and specify values. For example:

```
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
    resources:
      limits:
        cpu: "500m"
        memory: "1024M"
      requests:
        cpu: "250m"
        memory: "512M"
```

limits.cpu

Each broker container running in a Pod in the deployment cannot exceed this amount of host-node CPU usage.

limits.memory

Each broker container running in a Pod in the deployment cannot exceed this amount of host-node memory usage.

requests.cpu

Each broker container running in a Pod in the deployment requests this amount of host-node CPU. This value is the *minimum* amount of CPU required for the broker container to run.

requests.memory

Each broker container running in a Pod in the deployment requests this amount of host-node memory. This value is the *minimum* amount of memory required for the broker container to run.

3. Deploy the CR instance.

   a. Using the OpenShift command-line interface:

      i. Save the CR file.

      ii. Switch to the project in which you are creating the broker deployment.

```
$ oc project <project_name>
```

      iii. Create the CR instance.

```
$ oc create -f <path/to/custom_resource_instance>.yaml
```

   b. Using the OpenShift web console:

      i. When you have finished configuring the CR, click **Create**.

4.6. ENABLING ACCESS TO AMQ MANAGEMENT CONSOLE

Each broker Pod in an Operator-based deployment hosts its own instance of AMQ Management Console at port 8161. You can enable access to the console in the Custom Resource instance for your broker deployment. After you enable access to the console, you can use the console to view and manage the broker in your web browser.

Procedure

1. Edit the Custom Resource (CR) instance for your broker deployment .

   a. Using the OpenShift command-line interface:

      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

```
oc login -u <user> -p <password> --server=<host:port>
```

      ii. Edit the CR for your deployment.

```
oc edit ActiveMQArtemis <CR instance name> -n <namespace>
```

-

b. Using the OpenShift Container Platform web console:

  i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

  ii. In the left pane, click **Operators → Installed Operator**.

  iii. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**operator.

  iv. Click the **AMQ Broker** tab.

  v. Click the name of the ActiveMQArtemis instance name.

  vi. Click the **YAML** tab.
  Within the console, a YAML editor opens, which enables you to configure the CR instance.

2. In the **spec** section of the CR, add a **console** section. In the **console** section, add the **expose** attribute and set the value to. **true**. For example:

```
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
  console:
    expose: true
```

3. Save the CR.

Additional resources

For information about how to connect to AMQ Management Console, see Chapter 5, *Connecting to AMQ Management Console for an Operator-based broker deployment*

4.7. SETTING ENVIRONMENT VARIABLES FOR THE BROKER CONTAINERS

In the Custom Resource (CR) instance for your broker deployment, you can set environment variables that are passed to a AMQ Broker container.

For example, you can use standard environment variables such as **TZ** to set the timezone or **JDK_JAVA_OPTIONS** to prepend arguments to the command line arguments used by the Java launcher at startup. Or, you can use a custom variable for AMQ Broker, **JAVA_ARGS_APPEND**, to append custom arguments to the command line arguments used by the Java launcher.

Procedure

1. Edit the Custom Resource (CR) instance for your broker deployment.

  a. Using the OpenShift command-line interface:

   i. Enter the following command:

      ```
      oc edit ActiveMQArtemis <CR instance name> -n <namespace>
      ```

b. Using the OpenShift Container Platform web console:

   i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

   ii. In the left pane, click **Operators → Installed Operator**.

   iii. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**operator.

   iv. Click the **AMQ Broker** tab.

   v. Click the name of the ActiveMQArtemis instance name.

   vi. Click the **YAML** tab.
   Within the console, a YAML editor opens, which enables you to configure the CR instance.

2. In the **spec** section of the CR, add an **env** element and add the environment variables that you want to set for the AMQ Broker container. For example:

   ```
   apiVersion: broker.amq.io/v1beta1
   kind: ActiveMQArtemis
   metadata:
     name: ex-aao
   spec:
     ...
     env:
     - name: TZ
       value: Europe/Vienna
     - name: JAVA_ARGS_APPEND
       value: --Hawtio.realm=console
     - name: JDK_JAVA_OPTIONS
       value: -XshowSettings:system
     ...
   ```

   In the example, the CR configuration includes the following environment variables:

   - **TZ** to set the timezone of the AMQ Broker container.
   - **JAVA_ARGS_APPEND** to configure AMQ Management Console to use a realm named **console** for authentication.
   - **JDK_JAVA_OPTIONS** to set the Java **-XshowSettings:system** parameter, which displays system property settings for the Java Virtual Machine.

   NOTE

   Values configured using the **JDK_JAVA_OPTIONS** environment variable are prepended to the command line arguments used by the Java launcher. Values configured using the **JAVA_ARGS_APPEND** environment variable are appended to the arguments used by the launcher. If an argument is duplicated, the rightmost argument takes precedence.

3. Save the CR.

NOTE

Red Hat recommends that you do not change AMQ Broker environment variables that have an **AMQ_** prefix and that you exercise caution if you want to change the **POD_NAMESPACE** variable.

Additional resources

- For more information about defining environment variables, see Define Environment Variables for a Container.

4.8. OVERRIDING THE DEFAULT MEMORY LIMIT FOR A BROKER

You can override the default memory limit that is set for a broker. By default, a broker is assigned half of the maximum memory that is available to the broker's Java Virtual Machine. The following procedure shows how to configure the Custom Resource (CR) instance for your broker deployment to override the default memory limit.

Prerequisites

- You should be familiar with how to use a CR instance to create a basic broker deployment. See Section 3.4.1, "Deploying a basic broker instance" .

Procedure

1. Start configuring a Custom Resource (CR) instance to create a basic broker deployment.

   a. Using the OpenShift command-line interface:

      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

      ```
      oc login -u <user> -p <password> --server=<host:port>
      ```

      ii. Open the sample CR file called **broker_activemqartemis_cr.yaml** that was included in the **deploy/crs** directory of the Operator installation archive that you downloaded and extracted.

   b. Using the OpenShift Container Platform web console:

      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. Start a new CR instance based on the main broker CRD. In the left pane, click **Administration → Custom Resource Definitions**

      iii. Click the **ActiveMQArtemis** CRD.

      iv. Click the **Instances** tab.

      v. Click **Create ActiveMQArtemis**.
      Within the console, a YAML editor opens, enabling you to configure a CR instance.

For example, the CR for a basic broker deployment might resemble the following:

```
apiVersion: broker.amq.io/v1beta1
kind: ActiveMQArtemis
metadata:
  name: ex-aao
spec:
  deploymentPlan:
    size: 1
    image: placeholder
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
```

2. In the **spec** section of the CR, add a **brokerProperties** section. Within the **brokerProperties** section, add a **globalMaxSize** property and specify a memory limit. For example:

   ```
   spec:
       ...
       brokerProperties:
       - globalMaxSize=500m
       ...
   ```

   The default unit for the **globalMaxSize** property is bytes. To change the default unit, add a suffix of m (for MB) or g (for GB) to the value.

3. Apply the changes to the CR.

   a. Using the OpenShift command-line interface:

      i. Save the CR file.

      ii. Switch to the project for the broker deployment.

      ```
      $ oc project <project_name>
      ```

      iii. Apply the CR.

      ```
      $ oc apply -f <path/to/broker_custom_resource_instance>.yaml
      ```

   b. Using the OpenShift web console:

      i. When you finish editing the CR, click **Save**.

4. (Optional) Verify that the new value you set for the **globalMaxSize** property overrides the default memory limit assigned to the broker.

   a. Connect to the AMQ Management Console. For more information, see Chapter 5, *Connecting to AMQ Management Console for an Operator-based broker deployment* .

   b. From the menu, select **JMX**.

   c. Select **org.apache.activemq.artemis**.

   d. Search for **global**.

e. In the table that is displayed, confirm that the value in the **Global max** column is the same as the value that you configured for the **globalMaxSize** property.

4.9. SPECIFYING A CUSTOM INIT CONTAINER IMAGE

As described in Section 4.1, “How the Operator generates the broker configuration” , the AMQ Broker Operator uses a default, built-in Init Container to generate the broker configuration. To generate the configuration, the Init Container uses the main Custom Resource (CR) instance for your deployment. In certain situations, you might need to use a custom Init Container. For example, if you want to include extra runtime dependencies, **.jar** files, in the broker installation directory.

When you build a custom Init Container image, you must follow these important guidelines:

- In the build script (for example, a Docker Dockerfile or Podman Containerfile) that you create for the custom image, the **FROM** instruction must specify the latest version of the AMQ Broker Operator built-in Init Container as the base image. In your script, include the following line:

```
FROM registry.redhat.io/amq7/amq-broker-init-rhel8:7.11
```

- The custom image must include a script called **post-config.sh** that you include in a directory called **/amq/scripts**. The **post-config.sh** script is where you can modify or add to the initial configuration that the Operator generates. When you specify a custom Init Container, the Operator runs the **post-config.sh** script **after** it uses your CR instance to generate a configuration, but **before** it starts the broker application container.

- As described in Section 4.1.2, “Directory structure of a broker Pod” , the path to the installation directory used by the Init Container is defined in an environment variable called **CONFIG_INSTANCE_DIR**. The **post-config.sh** script should use this environment variable name when referencing the installation directory (for example, **${CONFIG_INSTANCE_DIR}/lib**) and **not** the actual value of this variable (for example, **/amq/init/config/lib**).

- If you want to include additional resources (for example, **.xml** or **.jar** files) in your custom broker configuration, you must ensure that these are included in the custom image and accessible to the **post-config.sh** script.

The following procedure describes how to specify a custom Init Container image.

Prerequisites

- You must have built a custom Init Container image that meets the guidelines described above. For a complete example of building and specifying a custom Init Container image for the ArtemisCloud Operator, see custom Init Container image for JDBC-based persistence .

- To provide a custom Init Container image for the AMQ Broker Operator, you need to be able to add the image to a repository in a container registry such as the Quay container registry.

- You should understand how the Operator uses an Init Container to generate the broker configuration. For more information, see Section 4.1, “How the Operator generates the broker configuration”.

- You should be familiar with how to use a CR to create a broker deployment. For more information, see Section 3.4, “Creating Operator-based broker deployments” .

Procedure

1. Edit the CR instance for the broker deployment.

   a. Using the OpenShift command-line interface:

      i. Log in to OpenShift Container Platform as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. Edit the CR for your deployment.

      ```
      oc edit ActiveMQArtemis <CR instance name> -n <namespace>
      ```

   b. Using the OpenShift Container Platform web console:

      i. Log in to OpenShift Container Platform as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. In the left pane, click **Administration → Custom Resource Definitions**

      iii. Click the **ActiveMQArtemis** CRD.

      iv. Click the **Instances** tab.

      v. Click the instance for your broker deployment.

      vi. Click the **YAML** tab.
      Within the console, a YAML editor opens, enabling you to edit the CR instance.

2. In the **deploymentPlan** section of the CR, add an **initImage** attribute and set the value to the URL of your custom Init Container image.

   ```
   apiVersion: broker.amq.io/v1beta1
   kind: ActiveMQArtemis
   metadata:
     name: ex-aao
   spec:
     deploymentPlan:
       size: 1
       image: placeholder
       initImage: <custom_init_container_image_url>
       requireLogin: false
       persistenceEnabled: true
       journalType: nio
       messageMigration: true
   ```

   initImage

   Specifies the full URL for your custom Init Container image, which must be available from a container registry.

IMPORTANT

If a CR has a custom init container image specified in the **spec.deploymentPlan.initImage** attribute, Red Hat recommends that you also specify the URL of the corresponding broker container image in the **spec.deploymentPlan.image** attribute to prevent automatic upgrades of the broker image. If you do not specify the URL of a specific broker container image in the **spec.deploymentPlan.image** attribute, the broker image can be automatically upgraded. After the broker image is upgraded, the versions of the broker and custom init container image are different, which might prevent the broker from running.

If you have a working deployment that has a custom init container, you can prevent any further upgrades of the broker container image to eliminate the risk of a newer broker image not working with your custom init container image. For more information about preventing upgrades to the broker image, see, Section 6.4.2, "Restricting automatic upgrades of images by using image URLs".

3. Save the CR.

Additional resources

- For a complete example of building and specifying a custom Init Container image for the ArtemisCloud Operator, see custom Init Container image for JDBC-based persistence .

4.10. CONFIGURING OPERATOR-BASED BROKER DEPLOYMENTS FOR CLIENT CONNECTIONS

4.10.1. Configuring acceptors

To enable client connections to broker Pods in your OpenShift deployment, you define *acceptors* for your deployment. Acceptors define how a broker Pod accepts connections. You define acceptors in the main Custom Resource (CR) used for your broker deployment. When you create an acceptor, you specify information such as the messaging protocols to enable on the acceptor, and the port on the broker Pod to use for these protocols.

The following procedure shows how to define a new acceptor in the CR for your broker deployment.

Procedure

1. In the **deploy/crs** directory of the Operator archive that you downloaded and extracted during your initial installation, open the **broker_activemqartemis_cr.yaml** Custom Resource (CR) file.

2. In the **acceptors** element, add a named acceptor. Add the **protocols** and **port** parameters. Set values to specify the messaging protocols to be used by the acceptor and the port on each broker Pod to expose for those protocols. For example:

```
spec:
...
  acceptors:
  - name: my-acceptor
```

```
    protocols: amqp
    port: 5672
...
```

The configured acceptor exposes port 5672 to AMQP clients. The full set of values that you can specify for the **protocols** parameter is shown in the table.

Protocol	Value
Core Protocol	**core**
AMQP	**amqp**
OpenWire	**openwire**
MQTT	**mqtt**
STOMP	**stomp**
All supported protocols	**all**

NOTE

- For each broker Pod in your deployment, the Operator also creates a default acceptor that uses port 61616. This default acceptor is required for broker clustering and has Core Protocol enabled.
- By default, the AMQ Broker management console uses port 8161 on the broker Pod. Each broker Pod in your deployment has a dedicated Service that provides access to the console. For more information, see Chapter 5, *Connecting to AMQ Management Console for an Operator-based broker deployment*.

3. To use another protocol on the same acceptor, modify the **protocols** parameter. Specify a comma-separated list of protocols. For example:

```
spec:
...
  acceptors:
  - name: my-acceptor
    protocols: amqp,openwire
    port: 5672
...
```

The configured acceptor now exposes port 5672 to AMQP and OpenWire clients.

4. To specify the number of concurrent client connections that the acceptor allows, add the **connectionsAllowed** parameter and set a value. For example:

```
spec:
...
```

```
  acceptors:
  - name: my-acceptor
    protocols: amqp,openwire
    port: 5672
    connectionsAllowed: 5
...
```

5. By default, an acceptor is exposed only to clients in the same OpenShift cluster as the broker deployment. To also expose the acceptor to clients outside OpenShift, add the **expose** parameter and set the value to **true**.

   ```
   spec:
   ...
     acceptors:
     - name: my-acceptor
       protocols: amqp,openwire
       port: 5672
       connectionsAllowed: 5
       expose: true
       ...
   ...
   ```

   When you expose an acceptor to clients outside OpenShift, the Operator automatically creates a dedicated Service and Route for each broker Pod in the deployment.

6. To enable secure connections to the acceptor from clients outside OpenShift, add the **sslEnabled** parameter and set the value to **true**.

   ```
   spec:
   ...
     acceptors:
     - name: my-acceptor
       protocols: amqp,openwire
       port: 5672
       connectionsAllowed: 5
       expose: true
       sslEnabled: true
       ...
   ...
   ```

   When you enable SSL (that is, Secure Sockets Layer) security on an acceptor (or connector), you can add related configuration, such as:

   - The secret name used to store authentication credentials in your OpenShift cluster. A secret is **required** when you enable SSL on the acceptor. For more information on generating this secret, see Section 4.10.2, “Securing broker-client connections” .
   - The Transport Layer Security (TLS) protocols to use for secure network communication. TLS is an updated, more secure version of SSL. You specify the TLS protocols in the **enabledProtocols** parameter.
   - Whether the acceptor uses two-way TLS, also known as *mutual authentication*, between the broker and the client. You specify this by setting the value of the **needClientAuth** parameter to **true**.

Additional resources

- To learn how to configure TLS to secure broker-client connections, including generating a secret to store authentication credentials, see Section 4.10.2, “Securing broker-client connections”.
- For a complete Custom Resource configuration reference, including configuration of acceptors and connectors, see Section 8.1, “Custom Resource configuration reference” .

4.10.2. Securing broker-client connections

If you have enabled security on your acceptor or connector (that is, by setting **sslEnabled** to **true**), you must configure Transport Layer Security (TLS) to allow certificate-based authentication between the broker and clients. TLS is an updated, more secure version of SSL. There are two primary TLS configurations:

One-way TLS

Only the broker presents a certificate. The certificate is used by the client to authenticate the broker. This is the most common configuration.

Two-way TLS

Both the broker and the client present certificates. This is sometimes called *mutual authentication*.

NOTE

The following procedures describe how to use self-signed certificates to configure one-way and two-way TLS. If a self-signed certificate is listed as a trusted certificate in a Java Virtual Machine (JVM) truststore, the JVM does not validate the expiry date of the certificate. In a production environment, Red Hat recommends that you use a certificate that is signed by a Certificate Authority.

The sections that follow describe:

- Configuration requirements for the broker certificate used by one-way and two-way TLS
- How to configure one-way TLS
- How to configure two-way TLS

For both one-way and two-way TLS, you complete the configuration by generating a secret that stores the credentials required for a successful TLS handshake between the broker and the client. This is the secret name that you must specify in the **sslSecret** parameter of your secured acceptor or connector. The secret must contain a Base64-encoded broker key store (both one-way and two-way TLS), a Base64-encoded broker trust store (two-way TLS only), and the corresponding passwords for these files, also Base64-encoded. The one-way and two-way TLS configuration procedures show how to generate this secret.

NOTE

If you do not explicitly specify a secret name in the **sslSecret** parameter of a secured acceptor or connector, the acceptor or connector assumes a default secret name. The default secret name uses the format ***<custom_resource_name>-<acceptor_name>*-secret** or ***<custom_resource_name>-<connector_name>*-secret**. For example, **my-broker-deployment-my-acceptor-secret**.

Even if the acceptor or connector assumes a default secrete name, you must still generate this secret yourself. It is not automatically created.

4.10.2.1. Configuring a broker certificate for host name verification

NOTE

This section describes some requirements for the broker certificate that you must generate when configuring one-way or two-way TLS.

When a client tries to connect to a broker Pod in your deployment, the **verifyHost** option in the client connection URL determines whether the client compares the Common Name (CN) of the broker's certificate to its host name, to verify that they match. The client performs this verification if you specify **verifyHost=true** or similar in the client connection URL.

You might omit this verification in rare cases where you have no concerns about the security of the connection, for example, if the brokers are deployed on an OpenShift cluster in an isolated network. Otherwise, for a secure connection, it is advisable for a client to perform this verification. In this case, correct configuration of the broker key store certificate is essential to ensure successful client connections.

In general, when a client is using host verification, the CN that you specify when generating the broker certificate must match the full host name for the Route on the broker Pod that the client is connecting to. For example, if you have a deployment with a single broker Pod, the CN might look like the following:

```
CN=my-broker-deployment-0-svc-rte-my-openshift-project.my-openshift-domain
```

To ensure that the CN can resolve to **any** broker Pod in a deployment with multiple brokers, you can specify an asterisk (*****) wildcard character in place of the ordinal of the broker Pod. For example:

```
CN=my-broker-deployment-*-svc-rte-my-openshift-project.my-openshift-domain
```

The CN shown in the preceding example successfully resolves to any broker Pod in the **my-broker-deployment** deployment.

In addition, the Subject Alternative Name (SAN) that you specify when generating the broker certificate must **individually list** all broker Pods in the deployment, as a comma-separated list. For example:

```
"SAN=DNS:my-broker-deployment-0-svc-rte-my-openshift-project.my-openshift-domain,DNS:my-broker-deployment-1-svc-rte-my-openshift-project.my-openshift-domain,..."
```

4.10.2.2. Configuring one-way TLS

The procedure in this section shows how to configure one-way Transport Layer Security (TLS) to secure a broker-client connection.

In one-way TLS, only the broker presents a certificate. This certificate is used by the client to authenticate the broker.

Prerequisites

- You should understand the requirements for broker certificate generation when clients use host name verification. For more information, see Section 4.10.2.1, “Configuring a broker certificate for host name verification”.

Procedure

1. Generate a self-signed certificate for the broker key store.

   ```
   $ keytool -genkey -alias broker -keyalg RSA -keystore ~/broker.ks
   ```

2. Export the certificate from the broker key store, so that it can be shared with clients. Export the certificate in the Base64-encoded **.pem** format. For example:

   ```
   $ keytool -export -alias broker -keystore ~/broker.ks -file ~/broker_cert.pem
   ```

3. On the client, create a client trust store that imports the broker certificate.

   ```
   $ keytool -import -alias broker -keystore ~/client.ts -file ~/broker_cert.pem
   ```

4. Log in to OpenShift Container Platform as an administrator. For example:

   ```
   $ oc login -u system:admin
   ```

5. Switch to the project that contains your broker deployment. For example:

   ```
   $ oc project <my_openshift_project>
   ```

6. Create a secret to store the TLS credentials. For example:

   ```
   $ oc create secret generic my-tls-secret \
   --from-file=broker.ks=~/broker.ks \
   --from-file=client.ts=~/client.ks \
   --from-literal=keyStorePassword=<password> \
   --from-literal=trustStorePassword=<password>
   ```

   #### NOTE

   When generating a secret, OpenShift requires you to specify both a key store and a trust store. The trust store key is generically named **client.ts**. For one-way TLS between the broker and a client, a trust store is not actually required. However, to successfully generate the secret, you need to specify *some* valid store file as a value for **client.ts**. The preceding step provides a "dummy" value for **client.ts** by reusing the previously-generated broker key store file. This is sufficient to generate a secret with all of the credentials required for one-way TLS.

7. Link the secret to the service account that you created when installing the Operator. For example:

   ```
   $ oc secrets link sa/amq-broker-operator secret/my-tls-secret
   ```

8. Specify the secret name in the **sslSecret** parameter of your secured acceptor or connector. For example:

   ```
   spec:
   ...
     acceptors:
     - name: my-acceptor
       protocols: amqp,openwire
       port: 5672
       sslEnabled: true
       sslSecret: my-tls-secret
       expose: true
       connectionsAllowed: 5
   ...
   ```

4.10.2.3. Configuring two-way TLS

The procedure in this section shows how to configure two-way Transport Layer Security (TLS) to secure a broker-client connection.

In two-way TLS, both the broker and client presents certificates. The broker and client use these certificates to authenticate each other in a process sometimes called *mutual authentication*.

Prerequisites

- You should understand the requirements for broker certificate generation when clients use host name verification. For more information, see Section 4.10.2.1, “Configuring a broker certificate for host name verification”.

Procedure

1. Generate a self-signed certificate for the broker key store.

   ```
   $ keytool -genkey -alias broker -keyalg RSA -keystore ~/broker.ks
   ```

2. Export the certificate from the broker key store, so that it can be shared with clients. Export the certificate in the Base64-encoded **.pem** format. For example:

   ```
   $ keytool -export -alias broker -keystore ~/broker.ks -file ~/broker_cert.pem
   ```

3. On the client, create a client trust store that imports the broker certificate.

   ```
   $ keytool -import -alias broker -keystore ~/client.ts -file ~/broker_cert.pem
   ```

4. On the client, generate a self-signed certificate for the client key store.

   ```
   $ keytool -genkey -alias broker -keyalg RSA -keystore ~/client.ks
   ```

5. On the client, export the certificate from the client key store, so that it can be shared with the broker. Export the certificate in the Base64-encoded **.pem** format. For example:

```
$ keytool -export -alias broker -keystore ~/client.ks -file ~/client_cert.pem
```

6. Create a broker trust store that imports the client certificate.

```
$ keytool -import -alias broker -keystore ~/broker.ts -file ~/client_cert.pem
```

7. Log in to OpenShift Container Platform as an administrator. For example:

```
$ oc login -u system:admin
```

8. Switch to the project that contains your broker deployment. For example:

```
$ oc project <my_openshift_project>
```

9. Create a secret to store the TLS credentials. For example:

```
$ oc create secret generic my-tls-secret \
--from-file=broker.ks=~/broker.ks \
--from-file=client.ts=~/broker.ts \
--from-literal=keyStorePassword=<password> \
--from-literal=trustStorePassword=<password>
```

NOTE

When generating a secret, OpenShift requires you to specify both a key store and a trust store. The trust store key is generically named **client.ts**. For two-way TLS between the broker and a client, you must generate a secret that includes the broker trust store, because this holds the client certificate. Therefore, in the preceding step, the value that you specify for the **client.ts** key is actually the **broker** trust store file.

10. Link the secret to the service account that you created when installing the Operator. For example:

```
$ oc secrets link sa/amq-broker-operator secret/my-tls-secret
```

11. Specify the secret name in the **sslSecret** parameter of your secured acceptor or connector. For example:

```
spec:
...
  acceptors:
  - name: my-acceptor
    protocols: amqp,openwire
    port: 5672
    sslEnabled: true
    sslSecret: my-tls-secret
    expose: true
    connectionsAllowed: 5
...
```

4.10.3. Networking services in your broker deployments

On the **Networking** pane of the OpenShift Container Platform web console for your broker deployment, there are two running services; a *headless* service and a *ping* service. The default name of the headless service uses the format ***<custom_resource_name>*-hdls-svc**, for example, **my-broker-deployment-hdls-svc**. The default name of the ping service uses a format of ***<custom_resource_name>*-ping-svc**, for example, **`my-broker-deployment-ping-svc**.

The headless service provides access to port 61616, which is used for internal broker clustering.

The ping service is used by the brokers for discovery, and enables brokers to form a cluster within the OpenShift environment. Internally, this service exposes port 8888.

4.10.4. Connecting to the broker from internal and external clients

The examples in this section show how to connect to the broker from internal clients (that is, clients in the same OpenShift cluster as the broker deployment) and external clients (that is, clients outside the OpenShift cluster).

4.10.4.1. Connecting to the broker from internal clients

To connect an internal client to a broker, in the client connection details, specify the DNS resolvable name of the broker pod. For example:

```
$ tcp://ex–aao-ss-0:<port>
```

If the internal client is using the Core protocol and the **useTopologyForLoadBalancing=false** key was not set in the connection URL, after the client connects to the broker for the first time, the broker can inform the client of the addresses of all the brokers in the cluster. The client can then load balance connections across all brokers.

If your brokers have durable subscription queues or request/reply queues, be aware of the caveats associated with using these queues when client connections are load balanced. For more information, see Section 4.10.4.4, “Caveats to load balancing client connections when you have durable subscription queues or reply/request queues”.

4.10.4.2. Connecting to the broker from external clients

When you expose an acceptor to external clients (that is, by setting the value of the **expose** parameter to **true**), the Operator automatically creates a dedicated service and route for each broker pod in the deployment.

An external client can connect to the broker by specifying the full host name of the route created for the broker pod. You can use a basic **curl** command to test external access to this full host name. For example:

```
$ curl https://my-broker-deployment-0-svc-rte-my-openshift-project.my-openshift-domain
```

The full host name of the route for the broker pod must resolve to the node that is hosting the OpenShift router. The OpenShift router uses the host name to determine where to send the traffic inside the OpenShift internal network. By default, the OpenShift router listens to port 80 for nonsecured (that is, non-SSL) traffic and port 443 for secured (that is, SSL-encrypted) traffic. For an HTTP connection, the router automatically directs traffic to port 443 if you specify a secure connection URL (that is, **https**), or to port 80 if you specify a non-secure connection URL (that is, **http**).

If you want external clients to load balance connections across the brokers in the cluster:

- Enable load balancing by configuring the **haproxy.router.openshift.io/balance** roundrobin option on the OpenShift route for each broker pod.
- If an external client uses the Core protocol, set the **useTopologyForLoadBalancing=false** key in the client's connection URL.
  Setting the **useTopologyForLoadBalancing=false** key prevents a client from using the AMQ Broker Pod DNS names that are in the cluster topology information provided by the broker. The Pod DNS names resolve to internal IP addresses, which an external client cannot access.

If your brokers have durable subscription queues or request/reply queues, be aware of the caveats associated with using these queues when load balancing client connections. For more information, see Section 4.10.4.4, "Caveats to load balancing client connections when you have durable subscription queues or reply/request queues".

If you don't want external clients to load balance connections across the brokers in the cluster:

- In each client's connection URL, specify the full host name of the route for each broker pod. The client attempts to connect to the first host name in the connection URL. However, if the first host name is unavailable, the client automatically connects to the next host name in the connection URL, and so on.
- If an external client uses the Core protocol, set the **useTopologyForLoadBalancing=false** key in the client's connection URL to prevent the client from using the cluster topology information provided by the broker.

For non-HTTP connections:

- Clients must explicitly specify the port number (for example, port 443) as part of the connection URL.
- For one-way TLS, the client must specify the path to its trust store and the corresponding password, as part of the connection URL.
- For two-way TLS, the client must **also** specify the path to its **key** store and the corresponding password, as part of the connection URL.

Some example client connection URLs, for supported messaging protocols, are shown below.

External Core client, using one-way TLS

```
tcp://my-broker-deployment-0-svc-rte-my-openshift-project.my-openshift-domain:443?
useTopologyForLoadBalancing=false&sslEnabled=true \
&trustStorePath=~/client.ts&trustStorePassword=<password>
```

NOTE

The **useTopologyForLoadBalancing** key is explicitly set to **false** in the connection URL because an external Core client cannot use topology information returned by the broker. If this key is set to **true** or you do not specify a value, it results in a DEBUG log message.

External Core client, using two-way TLS

```
tcp://my-broker-deployment-0-svc-rte-my-openshift-project.my-openshift-domain:443?
useTopologyForLoadBalancing=false&sslEnabled=true \
&keyStorePath=~/client.ks&keyStorePassword=<password> \
&trustStorePath=~/client.ts&trustStorePassword=<password>
```

External OpenWire client, using one-way TLS

```
ssl://my-broker-deployment-0-svc-rte-my-openshift-project.my-openshift-domain:443"

# Also, specify the following JVM flags
-Djavax.net.ssl.trustStore=~/client.ts -Djavax.net.ssl.trustStorePassword=<password>
```

External OpenWire client, using two-way TLS

```
ssl://my-broker-deployment-0-svc-rte-my-openshift-project.my-openshift-domain:443"

# Also, specify the following JVM flags
-Djavax.net.ssl.keyStore=~/client.ks -Djavax.net.ssl.keyStorePassword=<password> \
-Djavax.net.ssl.trustStore=~/client.ts -Djavax.net.ssl.trustStorePassword=<password>
```

External AMQP client, using one-way TLS

```
amqps://my-broker-deployment-0-svc-rte-my-openshift-project.my-openshift-domain:443?
transport.verifyHost=true \
&transport.trustStoreLocation=~/client.ts&transport.trustStorePassword=<password>
```

External AMQP client, using two-way TLS

```
amqps://my-broker-deployment-0-svc-rte-my-openshift-project.my-openshift-domain:443?
transport.verifyHost=true \
&transport.keyStoreLocation=~/client.ks&transport.keyStorePassword=<password> \
&transport.trustStoreLocation=~/client.ts&transport.trustStorePassword=<password>
```

4.10.4.3. Connecting to the Broker using a NodePort

As an alternative to using a route, an OpenShift administrator can configure a NodePort to connect to a broker pod from a client outside OpenShift. The NodePort should map to one of the protocol-specific ports specified by the acceptors configured for the broker.

By default, NodePorts are in the range 30000 to 32767, which means that a NodePort typically does not match the intended port on the broker Pod.

To connect from a client outside OpenShift to the broker via a NodePort, you specify a URL in the format ***<protocol>*://*<ocp_node_ip>*:*<node_port_number>***.

4.10.4.4. Caveats to load balancing client connections when you have durable subscription queues or reply/request queues

Durable subscriptions

A durable subscription is represented as a queue on a broker and is created when a durable subscriber first connects to the broker. This queue exists and receives messages until the client unsubscribes. If the client reconnects to a different broker, another durable subscription queue is created on that broker. This can cause the following issues.

Issue	Mitigation
Messages may get stranded in the original subscription queue.	Ensure that message redistribution is enabled. For more information, see Enabling message redistribution.
Messages may be received in the wrong order as there is a window during message redistribution when other messages are still routed.	None.
When a client unsubscribes, it deletes the queue only on the broker it last connected to. This means that the other queues can still exist and receive messages.	To delete other empty queues that may exist for a client that unsubscribed, configure both of the following properties: Set the **auto-delete-queues-message-count** property to **0** so that a queue can only be deleted if there are no messages in the queue. Set the **auto-delete-queues-delay** property to delete a queue that has no messages after it has not been used for a specified number of milliseconds. For more information, see Configuring automatic creation and deletion of addresses and queues.

Request/Reply queues

When a JMS Producer creates a temporary reply queue, the queue is created on the broker. If the client that is consuming from the work queue and replying to the temporary queue connects to a different broker, the following issues can occur.

Issue	Mitigation
Since the reply queue does not exist on the broker that the client is connected to, the client may generate an error.	Ensure that the **auto-create-queues** property is set to **true**. For more information, seeConfiguring automatic creation and deletion of addresses and queues.
Messages sent to the work queue may not be distributed.	Ensure that messages are load balanced on demand by setting the **message-load-balancing** property to **ON-DEMAND**. Also, ensure that message redistribution is enabled. For more information, see Enabling message redistribution.

Additional resources

- For more information about using methods such as Routes and NodePorts for communicating from outside an OpenShift cluster with services running in the cluster, see:

   - Configuring ingress cluster traffic overview in the OpenShift Container Platform documentation.

4.11. CONFIGURING LARGE MESSAGE HANDLING FOR AMQP MESSAGES

Clients might send large AMQP messages that can exceed the size of the broker's internal buffer, causing unexpected errors. To prevent this situation, you can configure the broker to store messages as files when the messages are larger than a specified minimum value. Handling large messages in this way means that the broker does not hold the messages in memory. Instead, the broker stores the messages in a dedicated directory used for storing large message files.

For a broker deployment on OpenShift Container Platform, the large messages directory is **/opt/*<custom_resource_name>*/data/large-messages** on the Persistent Volume (PV) used by the broker for message storage. When the broker stores a message as a large message, the queue retains a reference to the file in the large messages directory.

> NOTE
>
> You can configure the large message size limit in the broker configuration for the AMQP protocol only. For the AMQ Core and Openwire protocols, you can configure large message size limits in the client connection configuration. For more information, see the Red Hat AMQ Clients documentation .

4.11.1. Configuring AMQP acceptors for large message handling

The following procedure shows how to configure an acceptor to handle an AMQP message larger than a specified size as a large message.

Prerequisites

- You should be familiar with how to configure acceptors for Operator-based broker deployments. See Section 4.10.1, "Configuring acceptors".
- To store large AMQP messages in a dedicated large messages directory, your broker deployment must be using persistent storage (that is, **persistenceEnabled** is set to **true** in the Custom Resource (CR) instance used to create the deployment). For more information about configuring persistent storage, see:
   - Section 2.7, "Operator deployment notes"
   - Section 8.1, "Custom Resource configuration reference"

Procedure

1. Open the Custom Resource (CR) instance in which you previously defined an AMQP acceptor.
   a. Using the OpenShift command-line interface:

   ```
   $ oc edit -f <path/to/custom_resource_instance>.yaml
   ```

   b. Using the OpenShift Container Platform web console:
      i. In the left navigation menu, click **Administration → Custom Resource Definitions**

ii. Click the **ActiveMQArtemis** CRD.

iii. Click the **Instances** tab.

iv. Locate the CR instance that corresponds to your project namespace.

A previously-configured AMQP acceptor might resemble the following:

```
spec:
...
  acceptors:
  - name: my-acceptor
    protocols: amqp
    port: 5672
    connectionsAllowed: 5
    expose: true
    sslEnabled: true
...
```

2. Specify the minimum size, in bytes, of an AMQP message that the broker handles as a large message. For example:

```
spec:
...
  acceptors:
  - name: my-acceptor
    protocols: amqp
    port: 5672
    connectionsAllowed: 5
    expose: true
    sslEnabled: true
    amqpMinLargeMessageSize: 204800
    ...
...
```

In the preceding example, the broker is configured to accept AMQP messages on port 5672. Based on the value of **amqpMinLargeMessageSize**, if the acceptor receives an AMQP message with a body larger than or equal to 204800 bytes (that is, 200 kilobytes), the broker stores the message as a large message.

The broker stores the message in the large messages directory (**/opt/*<custom_resource_name>*/data/large-messages**, by default) on the persistent volume (PV) used by the broker for message storage.

If you do not explicitly specify a value for the **amqpMinLargeMessageSize** property, the broker uses a default value of 102400 (that is, 100 kilobytes).

If you set **amqpMinLargeMessageSize** to a value of **-1**, large message handling for AMQP messages is disabled.

4.12. CONFIGURING BROKER HEALTH CHECKS

You can configure health checks on AMQ Broker by using startup, liveness and readiness probes.

- A startup probe indicates whether the application within a container is started.

- A liveness probe determines if a container is still running.
- A readiness probe determines if a container is ready to accept service requests

If a startup probe or a liveness probe check of a Pod fails, the probe restarts the Pod.

AMQ Broker includes default readiness and liveness probes. The default liveness probe checks if the broker is running by pinging the broker's HTTP port. The default readiness probe checks if the broker can accept network traffic by opening a connection to each of the acceptor ports configured for the broker.

A limitation of using the default liveness and readiness probes is that they are unable to identify underlying issues, for example, issues with the broker's file system. You can create custom liveness and readiness probes that use the broker's command-line utility, **artemis**, to run more comprehensive health checks.

AMQ Broker does not include a default startup probe. You can configure a startup probe in the **ActiveMQArtemis** Custom Resource (CR).

4.12.1. Configuring a startup probe

You can configure a startup probe to check if the AMQ Broker application within the broker container has started.

Procedure

1. Edit the CR instance for the broker deployment.
    a. Using the OpenShift command-line interface:
        i. Log in to OpenShift Container Platform as a user that has privileges to deploy CRs in the project for the broker deployment.
        ii. Edit the CR for your deployment.

        ```
        oc edit ActiveMQArtemis <CR instance name> -n <namespace>
        ```

    b. Using the OpenShift Container Platform web console:
        i. Log in to OpenShift Container Platform as a user that has privileges to deploy CRs in the project for the broker deployment.
        ii. In the left pane, click **Administration → Custom Resource Definitions**
        iii. Click the **ActiveMQArtemis** CRD.
        iv. Click the **Instances** tab.
        v. Click the instance for your broker deployment.
        vi. Click the **YAML** tab.
        Within the console, a YAML editor opens, enabling you to edit the CR instance.
2. In the **deploymentPlan** section of the CR, add a **startupProbe** section. For example:

```
spec:
```

```
deploymentPlan:
  startupProbe:
    exec:
      command:
        - /bin/bash
        - '-c'
        - /opt/amq/bin/artemis
        - 'check'
        - 'node'
        - '--up'
        - '--url'
        - 'tcp://$HOSTNAME:61616'
    initialDelaySeconds: 5
    periodSeconds: 10
    timeoutSeconds: 3
    failureThreshold: 30
```

command

The startup probe command to run within the container. In the example, the startup probe uses the **artemis check node** command to verify that AMQ Broker has started in the container for a broker Pod.

initialDelaySeconds

The delay, in seconds, before the probe runs after the container starts. The default is **0**.

periodSeconds

The interval, in seconds, at which the probe runs. The default is **10**.

timeoutSeconds

Time, in seconds, that the startup probe command waits for a reply from the broker. If a response to the command is not received, the command is terminated. The default value is **1**.

failureThreshold

The minimum consecutive failures, including timeouts, of the startup probe after which the probe is deemed to have failed. When the probe is deemed to have failed, it restarts the Pod. The default value is **3**.

Depending on the resources of the cluster and the size of the broker journal, you might need to increase the failure threshold to allow the broker sufficient time to start and pass the probe check. Otherwise, the broker enters a loop condition whereby the failure threshold is reached repeatedly and the broker is restarted each time by the startup probe. For example, if you set the **failureThreshold** to **30** and the probe runs at the default interval of 10 seconds, the broker has 300 seconds to start and pass the probe check.

3. Save the CR.

Additional resources

For more information about liveness and readiness probes in OpenShift Container Platform, see Monitoring application health by using health checks in the OpenShift Container Platform documentation.

4.12.2. Configuring liveness and readiness probes

The following example shows how to configure the main Custom Resource (CR) instance for your broker deployment to run health checks by using liveness and readiness probes.

Prerequisites

- You should be familiar with how to use a CR instance to create a basic broker deployment. See Section 3.4.1, “Deploying a basic broker instance” .

Procedure

1. Edit the CR instance for the broker deployment.

   a. Using the OpenShift command-line interface:

      i. Log in to OpenShift Container Platform as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. Edit the CR for your deployment.

      ```
      oc edit ActiveMQArtemis <CR instance name> -n <namespace>
      ```

   b. Using the OpenShift Container Platform web console:

      i. Log in to OpenShift Container Platform as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. In the left pane, click **Administration → Custom Resource Definitions**

      iii. Click the **ActiveMQArtemis** CRD.

      iv. Click the **Instances** tab.

      v. Click the instance for your broker deployment.

      vi. Click the **YAML** tab.

2. To configure a liveness probe, in the **deploymentPlan** section of the CR, add a **livenessProbe** section. For example:

   ```
   spec:
     deploymentPlan:
       livenessProbe:
         initialDelaySeconds: 5
         periodSeconds: 5
         failureThreshold: 30
   ```

   initialDelaySeconds

   The delay, in seconds, before the probe runs after the container starts. The default is **5**.

   > **NOTE**
   >
   > If the deployment also has a startup probe configured, you can set the delay to 0 for both a liveness and a readiness probe. Both of these probes run only after the startup probe has passed. If the startup probe has already passed, it confirms that the broker has started successfully, so a delay in running the liveness and readiness probes is not required.

   periodSeconds

The interval, in seconds, at which the probe runs. The default is **5**.

failureThreshold

The minimum consecutive failures, including timeouts, of the liveness probe that signify the probe has failed. When the probe fails, it restarts the Pod. The default value is 3.
If your deployment does not have a startup probe configured, which verifies that the broker application is started before the liveness probe runs, you might need to increase the failure threshold to allow the broker sufficient time to start and pass the liveness probe check. Otherwise, the broker can enter a loop condition whereby the failure threshold is reached repeatedly and the broker Pod is restarted each time by the liveness probe.

The time required by the broker to start and pass a liveness probe check depends on the resources of the cluster and the size of the broker journal. For example, if you set the **failureThreshold** to 30 and the probe runs at the default interval of 5 seconds, the broker has 150 seconds to start and pass the liveness probe check.

NOTE

If you do not configure a liveness probe or if the handler is missing from a configured probe, the AMQ Broker Operator creates a default TCP probe that has the following configuration. The default TCP probe attempts to open a socket to the broker container on the specified port.

```
spec:
  deploymentPlan:
    livenessProbe:
      tcpSocket:
        port: 8181
      initialDelaySeconds: 30
      timeoutSeconds: 5
```

3. To configure a readiness probe, in the **deploymentPlan** section of the CR, add a **readinessProbe** section. For example:

```
spec:
  deploymentPlan:
    readinessProbe:
      initialDelaySeconds: 5
      periodSeconds: 5
```

If you don't configure a readiness probe, a built-in script checks if all acceptors can accept connections.

4. If you want to configure more comprehensive health checks, add the **artemis check** command-line utility to the liveness or readiness probe configuration.

   a. If you want to configure a health check that creates a full client connection to the broker, in the **livenessProbe** or **readinessProbe** section, add an **exec** section. In the **exec** section, add a **command** section. In the **command** section, add the **artemis check node** command syntax. For example:

```
spec:
  deploymentPlan:
    readinessProbe:
      exec:
        command:
          - bash
          - '-c'
          - /home/jboss/amq-broker/bin/artemis
          - check
          - node
          - '--silent'
          - '--acceptor'
          - <acceptor name>
          - '--user'
          - $AMQ_USER
          - '--password'
          - $AMQ_PASSWORD
      initialDelaySeconds: 30
      timeoutSeconds: 5
```

By default, the **artemis check node** command uses the URI of an acceptor called **artemis**. If the broker has an acceptor called **artemis**, you can exclude the **--acceptor <acceptor name>** option from the command.

NOTE

$AMQ_USER and **$AMQ_PASSWORD** are environment variables that are configured by the AMQ Operator.

b. If you want to configure a health check that produces and consumes messages, which also validates the health of the broker's file system, in the **livenessProbe** or **readinessProbe** section, add an **exec** section. In the **exec** section, add a **command** section. In the **command** section, add the **artemis check queue** command syntax. For example:

```
spec:
  deploymentPlan:
    readinessProbe:
      exec:
        command:
          - bash
          - '-c'
          - /home/jboss/amq-broker/bin/artemis
          - check
          - queue
          - '--name'
          - livenessqueue
          - '--produce'
          - "1"
          - '--consume'
          - "1"
          - '--silent'
          - '--user'
          - $AMQ_USER
          - '--password'
          - $AMQ_PASSWORD
      initialDelaySeconds: 30
      timeoutSeconds: 5
```

NOTE

The queue name that you specify must be configured on the broker and have a **routingType** of **anycast**. For example:

```
apiVersion: broker.amq.io/v1beta1
kind: ActiveMQArtemisAddress
metadata:
  name: livenessqueue
  namespace: activemq-artemis-operator
spec:
  addressName: livenessqueue
  queueConfiguration:
    purgeOnNoConsumers: false
    maxConsumers: -1
    durable: true
    enabled: true
  queueName: livenessqueue
  routingType: anycast
```

5. Save the CR.

Additional resources

For more information about liveness and readiness probes in OpenShift Container Platform, see Monitoring application health by using health checks in the OpenShift Container Platform documentation.

4.13. ENABLING MESSAGE MIGRATION TO SUPPORT CLUSTER SCALEDOWN

If you want to be able to scale down the number of brokers in a cluster and migrate messages to remaining Pods in the cluster, you must enable message migration.

When you scale down a cluster that has message migration enabled, a scaledown controller manages the message migration process.

4.13.1. Steps in message migration process

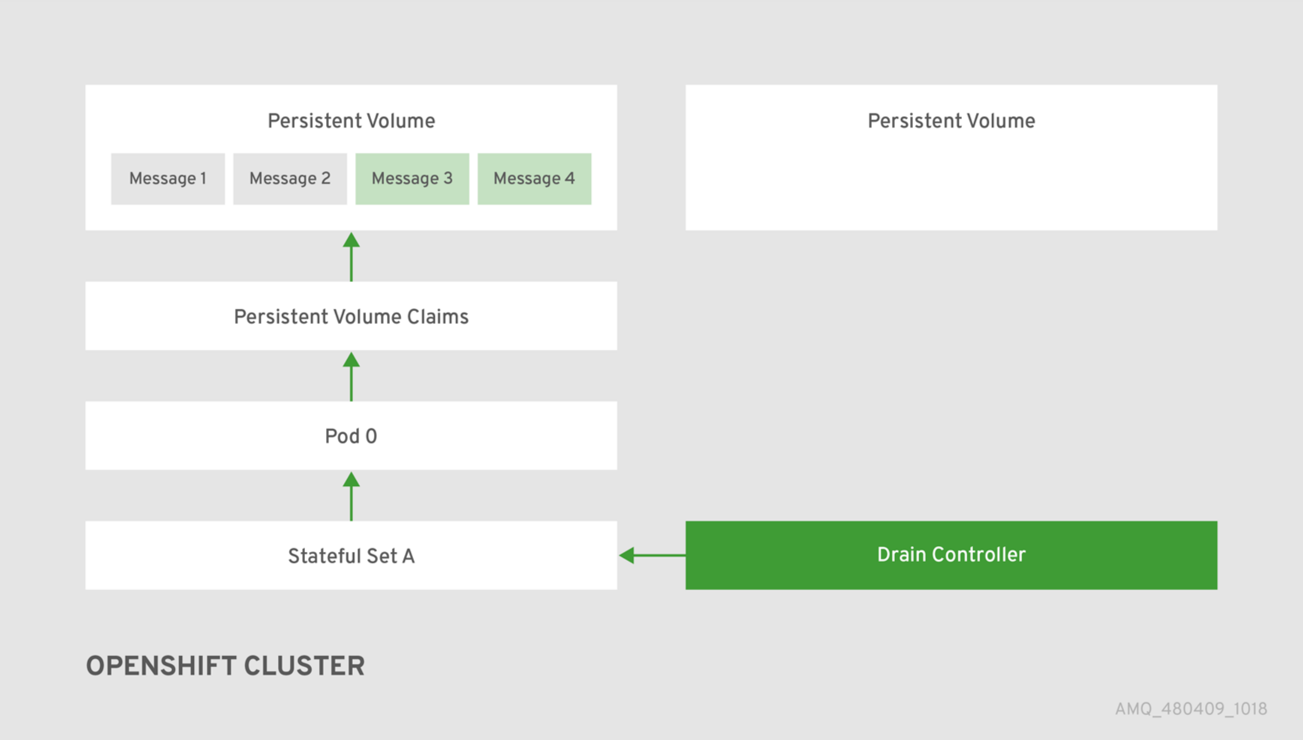
The message migration process follows these steps:

1. When a broker Pod in the deployment shuts down due to an intentional scaledown of the deployment, the Operator automatically deploys a scaledown Custom Resource to prepare for message migration.

2. To check for Persistent Volumes (PVs) that have been orphaned, the scaledown controller looks at the ordinal on the volume claim. The controller compares the ordinal on the volume claim to that of the broker Pods that are still running in the StatefulSet (that is, the broker cluster) in the project.
   If the ordinal on the volume claim is higher than the ordinal on any of the broker Pods still running in the broker cluster, the scaledown controller determines that the broker Pod at that ordinal has been shut down and that messaging data must be migrated to another broker Pod.

3. The scaledown controller starts a drainer Pod. The drainer Pod connects to one of the other live broker Pods in the cluster and migrates messages to that live broker Pod.

The following figure illustrates how the scaledown controller (also known as a *drain controller*) migrates messages to a running broker Pod.



After the messages are migrated successfully to an operational broker Pod, the drainer Pod shuts down and the scaledown controller removes the PVC for the orphaned PV. The PV is returned to a "Released" state.

NOTE

If the reclaim policy for the PV is set to **retain**, the PV cannot be used by another Pod until you delete and recreate the PV. For example, if you scale the cluster up after scaling it down, the PV is not available to a Pod started until you delete and recreate the PV.

Additional resources

- For an example of message migration when you scale down a broker deployment, see Section 4.13.2, “Enabling message migration” .

4.13.2. Enabling message migration

You can enable message migration in the **ActiveMQArtemis** Custom Resource (CR).

Prerequisites

- You already have a basic broker deployment. See Section 3.4.1, “Deploying a basic broker instance”.
- You understand how message migration works. For more information, see Section 4.13.1, “Steps in message migration process”.

NOTE

- A scaledown controller operates only within a single OpenShift project. The controller cannot migrate messages between brokers in separate projects.

- If you scale a broker deployment down to 0 (zero), message migration does not occur, since there is no running broker Pod to which messaging data can be migrated. However, if you scale a deployment down to zero and then back up to a size that is smaller than the original deployment, drainer Pods are started for the brokers that remain shut down.

Procedure

1. Edit the CR instance for the broker deployment.

   a. Using the OpenShift command-line interface:

      i. Log in to OpenShift Container Platform as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. Edit the CR for your deployment.

      ```
      oc edit ActiveMQArtemis <CR instance name> -n <namespace>
      ```

   b. Using the OpenShift Container Platform web console:

      i. Log in to OpenShift Container Platform as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. In the left pane, click **Administration** → **Custom Resource Definitions**

      iii. Click the **ActiveMQArtemis** CRD.

      iv. Click the **Instances** tab.

      v. Click the instance for your broker deployment.

      vi. Click the **YAML** tab.
      Within the console, a YAML editor opens, enabling you to edit the CR instance.

2. In the **deploymentPlan** section of the CR, add a **messageMigration** attribute and set to **true**. If not already configured, add a **persistenceEnabled** attribute and also set to **true**. For example:

   ```
   spec:
     deploymentPlan:
       messageMigration: true
       persistenceEnabled: true
     ...
   ```

   These settings mean that when you later scale down the size of your clustered broker deployment, the Operator automatically starts a scaledown controller and migrates messages to a broker Pod that is still running.

3. Save the CR.

4. (Optional) Complete the following steps to scale down the cluster and view the message migration process.

a. In your existing broker deployment, verify which Pods are running.

```
$ oc get pods
```

You see output that looks like the following.

```
activemq-artemis-operator-8566d9bf58-9g25l   1/1   Running   0   3m38s
ex-aao-ss-0                                  1/1   Running   0   112s
ex-aao-ss-1                                  1/1   Running   0   8s
```

The preceding output shows that there are three Pods running; one for the broker Operator itself, and a separate Pod for each broker in the deployment.

b. Log into each Pod and send some messages to each broker.

   i. Supposing that Pod **ex-aao-ss-0** has a cluster IP address of **172.17.0.6**, run the following command:

   ```
   $ /opt/amq/bin/artemis producer --url tcp://172.17.0.6:61616 --user admin --password admin
   ```

c. Supposing that Pod **ex-aao-ss-1** has a cluster IP address of **172.17.0.7**, run the following command:

```
$ /opt/amq/bin/artemis producer --url tcp://172.17.0.7:61616 --user admin --password admin
```

The preceding commands create a queue called **TEST** on each broker and add 1000 messages to each queue.

d. Scale the cluster down from two brokers to one.

   i. Open the main broker CR, **broker_activemqartemis_cr.yaml**.

   ii. In the CR, set **deploymentPlan.size** to **1**.

   iii. At the command line, apply the change:

   ```
   $ oc apply -f deploy/crs/broker_activemqartemis_cr.yaml
   ```

   You see that the Pod **ex-aao-ss-1** starts to shut down. The scaledown controller starts a new drainer Pod of the same name. This drainer Pod also shuts down after it migrates all messages from broker Pod **ex-aao-ss-1** to the other broker Pod in the cluster, **ex-aao-ss-0**.

e. When the drainer Pod is shut down, check the message count on the **TEST** queue of broker Pod **ex-aao-ss-0**. You see that the number of messages in the queue is 2000, indicating that the drainer Pod successfully migrated 1000 messages from the broker Pod that shut down.

4.14. CONTROLLING PLACEMENT OF BROKER PODS ON OPENSHIFT CONTAINER PLATFORM NODES

You can control the placement of AMQ Broker pods on OpenShift Container Platform nodes by using node selectors, tolerations, or affinity and anti-affinity rules.

Node selectors

A node selector allows you to schedule a broker pod on a specific node.

Tolerations

A toleration enables a broker pod to be scheduled on a node if the toleration matches a taint configured for the node. Without a matching pod toleration, a taint allows a node to refuse to accept a pod.

Affinity/Anti-affinity

Node affinity rules control which nodes a pod can be scheduled on based on the node's labels. Pod affinity and anti-affinity rules control which nodes a pod can be scheduled on based on the pods already running on that node.

4.14.1. Placing pods on specific nodes using node selectors

A node selector specifies a key-value pair that requires the broker pod to be scheduled on a node that has matching key-value pair in the node label.

The following example shows how to configure a node selector to schedule a broker pod on a specific node.

Prerequisites

- You should be familiar with how to use a CR instance to create a basic broker deployment. See Section 3.4.1, "Deploying a basic broker instance" .
- Add a label to the OpenShift Container Platform node on which you want to schedule the broker pod. For more information about adding node labels, see Using node selectors to control pod placement in the OpenShift Container Platform documentation.

Procedure

1. Create a Custom Resource (CR) instance based on the main broker CRD.
   a. Using the OpenShift command-line interface:
      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

```
oc login -u <user> -p <password> --server=<host:port>
```

      ii. Open the sample CR file called **broker_activemqartemis_cr.yaml** that was included in the **deploy/crs** directory of the Operator installation archive that you downloaded and extracted.
   b. Using the OpenShift Container Platform web console:
      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.
      ii. Start a new CR instance based on the main broker CRD. In the left pane, click **Administration → Custom Resource Definitions**

iii. Click the **ActiveMQArtemis** CRD.

iv. Click the **Instances** tab.

v. Click **Create ActiveMQArtemis**.
Within the console, a YAML editor opens, enabling you to configure a CR instance.

2. In the **deploymentPlan** section of the CR, add a **nodeSelector** section and add the node label that you want to match to select a node for the pod. For example:

```
spec:
    deploymentPlan:
      nodeSelector:
        app: broker1
```

In this example, the broker pod is scheduled on a node that has a **app: broker1** label.

3. Deploy the CR instance.

a. Using the OpenShift command-line interface:

i. Save the CR file.

ii. Switch to the project in which you are creating the broker deployment.

```
$ oc project <project_name>
```

iii. Create the CR instance.

```
$ oc create -f <path/to/custom_resource_instance>.yaml
```

b. Using the OpenShift web console:

i. When you have finished configuring the CR, click **Create**.

Additional resources

For more information about node selectors in OpenShift Container Platform, see Placing pods on specific nodes using node selectors in the OpenShift Container Platform documentation.

4.14.2. Controlling pod placement using tolerations

Taints and tolerations control whether pods can or cannot be scheduled on specific nodes. A taint allows a node to refuse to schedule a pod unless the pod has a matching toleration. You can use taints to exclude pods from a node so the node is reserved for specific pods, such as broker pods, that have a matching toleration.

Having a matching toleration permits a broker pod to be scheduled on a node but does not guarantee that the pod is scheduled on that node. To guarantee that the broker pod is scheduled on the node that has a taint configured, you can configure affinity rules. For more information, see Section 4.14.3, "Controlling pod placement using affinity and anti-affinity rules"

The following example shows how to configure a toleration to match a taint that is configured on a node.

Prerequisites

- You should be familiar with how to use a CR instance to create a basic broker deployment. See Section 3.4.1, "Deploying a basic broker instance" .
- Apply a taint to the nodes which you want to reserve for scheduling broker pods. A taint consists of a key, value, and effect. The taint effect determines if:
  - existing pods on the node are evicted
  - existing pods are allowed to remain on the node but new pods cannot be scheduled unless they have a matching toleration
  - new pods can be scheduled on the node if necessary, but preference is to not schedule new pods on the node.

For more information about applying taints, see Controlling pod placement using node taints in the OpenShift Container Platform documentation.

Procedure

1. Create a Custom Resource (CR) instance based on the main broker CRD.
   a. Using the OpenShift command-line interface:
      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

      ```
      oc login -u <user> -p <password> --server=<host:port>
      ```

      ii. Open the sample CR file called **broker_activemqartemis_cr.yaml** that was included in the **deploy/crs** directory of the Operator installation archive that you downloaded and extracted.

   b. Using the OpenShift Container Platform web console:
      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.
      ii. Start a new CR instance based on the main broker CRD. In the left pane, click **Administration → Custom Resource Definitions**.
      iii. Click the **ActiveMQArtemis** CRD.
      iv. Click the **Instances** tab.
      v. Click **Create ActiveMQArtemis**.
      Within the console, a YAML editor opens, enabling you to configure a CR instance.
2. In the **deploymentPlan** section of the CR, add a **tolerations** section. In the **tolerations** section, add a toleration for the node taint that you want to match. For example:

```
spec:
    deploymentPlan:
      tolerations:
      - key: "app"
        value: "amq-broker"
        effect: "NoSchedule"
```

In this example, the toleration matches a node taint of **app=amq-broker:NoSchedule**, so the pod can be scheduled on a node that has this taint configured.

NOTE

To ensure that the broker pods are scheduled correctly, do not specify a **tolerationsSeconds** attribute in the **tolerations** section of the CR.

1. Deploy the CR instance.
    a. Using the OpenShift command-line interface:
        i. Save the CR file.
        ii. Switch to the project in which you are creating the broker deployment.

        ```
        $ oc project <project_name>
        ```

        iii. Create the CR instance.

        ```
        $ oc create -f <path/to/custom_resource_instance>.yaml
        ```

    b. Using the OpenShift web console:
        i. When you have finished configuring the CR, click **Create**.

Additional resources

For more information about taints and tolerations in OpenShift Container Platform, see Controlling pod placement using node taints in the OpenShift Container Platform documentation.

4.14.3. Controlling pod placement using affinity and anti-affinity rules

You can control pod placement using node affinity, pod affinity, or pod anti-affinity rules. Node affinity allows a pod to specify an affinity towards a group of target nodes. Pod affinity and anti-affinity allows you to specify rules about how pods can or cannot be scheduled relative to other pods that are already running on a node.

4.14.3.1. Controlling pod placement using node affinity rules

Node affinity allows a broker pod to specify an affinity towards a group of nodes that it can be placed on. A broker pod can be scheduled on any node that has a label with the same key-value pair as the affinity rule that you create for a pod.

The following example shows how to configure a broker to control pod placement by using node affinity rules.

Prerequisites

- You should be familiar with how to use a CR instance to create a basic broker deployment. See Section 3.4.1, “Deploying a basic broker instance” .
- Assign a common label to the nodes in your OpenShift Container Platform cluster that can schedule the broker pod, for example, **zone: emea**.

Procedure

1. Create a Custom Resource (CR) instance based on the main broker CRD.
   a. Using the OpenShift command-line interface:
      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

      ```
      oc login -u <user> -p <password> --server=<host:port>
      ```

      ii. Open the sample CR file called **broker_activemqartemis_cr.yaml** that was included in the **deploy/crs** directory of the Operator installation archive that you downloaded and extracted.
   b. Using the OpenShift Container Platform web console:
      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.
      ii. Start a new CR instance based on the main broker CRD. In the left pane, click **Administration → Custom Resource Definitions**
      iii. Click the **ActiveMQArtemis** CRD.
      iv. Click the **Instances** tab.
      v. Click **Create ActiveMQArtemis**.
      Within the console, a YAML editor opens, enabling you to configure a CR instance.
2. In the **deploymentPlan** section of the CR, add the following sections: **affinity**, **nodeAffinity**, **requiredDuringSchedulingIgnoredDuringExecution**, and **nodeSelectorTerms**. In the **nodeSelectorTerms** section, add the **- matchExpressions** parameter and specify the key-value string of a node label to match. For example:

   ```
   spec:
     deploymentPlan:
       affinity:
         nodeAffinity:
           requiredDuringSchedulingIgnoredDuringExecution:
             nodeSelectorTerms:
             - matchExpressions:
               - key: zone
                 operator: In
                 values:
                 - emea
   ```

   In this example, the affinity rule allows the pod to be scheduled on any node that has a label with a key of **zone** and a value of **emea**.
3. Deploy the CR instance.
   a. Using the OpenShift command-line interface:
      i. Save the CR file.
      ii. Switch to the project in which you are creating the broker deployment.

```
$ oc project <project_name>
```

iii. Create the CR instance.

```
$ oc create -f <path/to/custom_resource_instance>.yaml
```

b. Using the OpenShift web console:

i. When you have finished configuring the CR, click **Create**.

Additional resources

For more information about affinity rules in OpenShift Container Platform, see Controlling pod placement on nodes using node affinity rules in the OpenShift Container Platform documentation.

4.14.3.2. Placing pods relative to other pods using anti-affinity rules

Anti-affinity rules allow you to constrain which nodes the broker pods can be scheduled on based on the labels of pods already running on that node.

A use case for using anti-affinity rules is to ensure that multiple broker pods in a cluster are not scheduled on the same node, which creates a single point of failure. If you do not control the placement of pods, 2 or more broker pods in a cluster can be scheduled on the same node.

The following example shows how to configure anti-affinity rules to prevent 2 broker pods in a cluster from being scheduled on the same node.

Prerequisites

- You should be familiar with how to use a CR instance to create a basic broker deployment. See Section 3.4.1, “Deploying a basic broker instance” .

Procedure

1. Create a CR instance for the first broker in the cluster based on the main broker CRD.

   a. Using the OpenShift command-line interface:

      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

```
oc login -u <user> -p <password> --server=<host:port>
```

      ii. Open the sample CR file called **broker_activemqartemis_cr.yaml** that was included in the **deploy/crs** directory of the Operator installation archive that you downloaded and extracted.

   b. Using the OpenShift Container Platform web console:

      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. Start a new CR instance based on the main broker CRD. In the left pane, click **Administration → Custom Resource Definitions**

      iii. Click the **ActiveMQArtemis** CRD.

iv. Click the **Instances** tab.

v. Click **Create ActiveMQArtemis**.
Within the console, a YAML editor opens, enabling you to configure a CR instance.

2. In the **deploymentPlan** section of the CR, add a **labels** section. Create an identifying label for the first broker pod so that you can create an anti-affinity rule on the second broker pod to prevent both pods from being scheduled on the same node. For example:

```
spec:
    deploymentPlan:
      labels:
        name: broker1
```

3. Deploy the CR instance.

   a. Using the OpenShift command-line interface:

      i. Save the CR file.

      ii. Switch to the project in which you are creating the broker deployment.

      ```
      $ oc project <project_name>
      ```

      iii. Create the CR instance.

      ```
      $ oc create -f <path/to/custom_resource_instance>.yaml
      ```

   b. Using the OpenShift web console:

      i. When you have finished configuring the CR, click **Create**.

4. Create a CR instance for the second broker in the cluster based on the main broker CRD.

   a. In the **deploymentPlan** section of the CR, add the following sections: **affinity**, **podAntiAffinity**, **requiredDuringSchedulingIgnoredDuringExecution**, and **labelSelector**. In the **labelSelector** section, add the **- matchExpressions** parameter and specify the key-value string of the broker pod label to match, so this pod is not scheduled on the same node.

   ```
   spec:
       deploymentPlan:
         affinity:
           podAntiAffinity:
             requiredDuringSchedulingIgnoredDuringExecution:
               labelSelector:
                 - matchExpressions:
                 - key: name
                   operator: In
                   values:
                     - broker1
               topologyKey: topology.kubernetes.io/zone
   ```

   In this example, the pod anti-affinity rule prevents the pod from being placed on the same node as a pod that has a label with a key of **name** and a value of **broker1**, which is the label assigned to the first broker in the cluster.

5. Deploy the CR instance.
   a. Using the OpenShift command-line interface:
      i. Save the CR file.
      ii. Switch to the project in which you are creating the broker deployment.

      ```
      $ oc project <project_name>
      ```

      iii. Create the CR instance.

      ```
      $ oc create -f <path/to/custom_resource_instance>.yaml
      ```

   b. Using the OpenShift web console:
      i. When you have finished configuring the CR, click **Create**.

Additional resources

For more information about affinity rules in OpenShift Container Platform, see Controlling pod placement on nodes using node affinity rules in the OpenShift Container Platform documentation.

4.15. CONFIGURING LOGGING FOR BROKERS

AMQ Broker uses the Log4j 2 logging utility to provide message logging. When you deploy a broker, it uses a default Log4j 2 configuration. If you want to change the default configuration, you must create a new Log4j 2 configuration in either a secret or a configMap. After you add the name of the secret or configMap to the main broker Custom Resource (CR), the Operator configures each broker to use the new logging configuration, which is stored in a file that the Operator mounts on each Pod.

Prerequisite

- You are familiar with the Log4j 2 configuration options.

Procedure

1. Prepare a file that contains the log4j 2 configuration that you want to use with AMQ Broker.
   The default Log4j 2 configuration file that is used by a broker is located in the **/home/jboss/amq-broker/etc/log4j2.properties** file on each broker Pod. You can use the contents of the default configuration file as the basis for creating a new Log4j 2 configuration in a secret or configMap. To get the contents of the default Log4j 2 configuration file, complete the following steps.
   a. Using the OpenShift Container Platform web console:
      i. Click **Workloads** → **Pods**.
      ii. Click the **ex-aao-ss** Pod.
      iii. Click the **Terminal** tab.
      iv. Use the **cat** command to display the contents of the **/home/jboss/amq-broker/etc/log4j2.properties** file on a broker Pod and copy the contents.

v. Paste the contents into a local file, where the OpenShift Container Platform CLI is installed, and save the file as **logging.properties**.

b. Using the OpenShift command-line interface:

i. Get the name of a Pod in your deployment.

```
$ oc get pods -o wide

NAME                           STATUS   IP
amq-broker-operator-54d996c   Running  10.129.2.14
ex-aao-ss-0                    Running  10.129.2.15
```

ii. Use the **oc cp** command to copy the log configuration file from a Pod to your local directory.

```
$ oc cp <pod name>:/home/jboss/amq-broker/etc/log4j2.properties
logging.properties -c <name>-container
```

Where the *<name>* part of the container name is the prefix before the **-ss** string in the Pod name. For example:

```
$ oc cp ex-aao-ss-0:/home/jboss/amq-broker/etc/log4j2.properties logging.properties
-c ex-aao-container
```

NOTE

When you create a configMap or secret from a file, the key in the configMap or secret defaults to the file name and the value defaults to the file content. By creating a secret from a file named **logging.properties**, the required key for the new logging configuration is inserted in the secret or configMap.

2. Edit the **logging.properties** file and create the Log4j 2 configuration that you want to use with AMQ Broker.
For example, with the default configuration, AMQ Broker logs messages to the console only. You might want to update the configuration so that AMQ Broker logs messages to disk also.

3. Add the updated Log4j 2 configuration to a secret or a ConfigMap.

a. Log in to OpenShift as a user that has privileges to create secrets or ConfigMaps in the project for the broker deployment.

```
oc login -u <user> -p <password> --server=<host:port>
```

b. If you want to configure the log settings in a secret, use the **oc create secret** command. For example:

```
oc create secret generic newlog4j-logging-config --from-file=logging.properties
```

c. If you want to configure the log settings in a ConfigMap, use the **oc create configmap** command. For example:

```
oc create configmap newlog4j-logging-config --from-file=logging.properties
```

- The configMap or secret name must have a suffix of **-logging-config**, so the Operator can recognize that the secret contains new logging configuration.

4. Add the secret or ConfigMap to the Custom Resource (CR) instance for your broker deployment.

   a. Using the OpenShift command-line interface:

      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

      ```
      oc login -u <user> -p <password> --server=<host:port>
      ```

      ii. Edit the CR.

      ```
      oc edit ActiveMQArtemis <CR instance name> -n <namespace>
      ```

   b. Using the OpenShift Container Platform web console:

      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. In the left pane, click **Operators → Installed Operator**.

      iii. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**operator.

      iv. Click the **AMQ Broker** tab.

      v. Click the name of the ActiveMQArtemis instance name

      vi. Click the **YAML** tab.
      Within the console, a YAML editor opens, enabling you to configure a CR instance.

   c. Add the secret or configMap that contains the Log4j 2 logging configuration to the CR. The following examples show a secret and a configMap added to the CR.

   ```
   apiVersion: broker.amq.io/v1beta1
   kind: ActiveMQArtemis
   metadata:
     name: ex-aao
   spec:
     deploymentPlan:
       ...
       extraMounts:
         secrets:
         - "newlog4j-logging-config"
       ...
   ```

   ```
   apiVersion: broker.amq.io/v1beta1
   kind: ActiveMQArtemis
   metadata:
     name: ex-aao
   spec:
     deploymentPlan:
       ...
   ```

```
extraMounts:
  configMaps:
  - "newlog4j-logging-config"
...
```

5. Save the CR.

In each broker Pod, the Operator mounts a **logging.properties** file that contains the logging configuration in the secret or configMap that you created. In addition, the Operator configures each broker to use the mounted log configuration file instead of the default log configuration file.

NOTE

If you update the logging configuration in a configMap or secret, each broker automatically uses the updated logging configuration.

4.16. CONFIGURING A POD DISRUPTION BUDGET

A Pod disruption budget specifies the minimum number of Pods in a cluster that must be available simultaneously during a voluntary disruption, such as a maintenance window.

Procedure

1. Edit the CR instance for the broker deployment.

   a. Using the OpenShift command-line interface:

      i. Log in to OpenShift Container Platform as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. Edit the CR for your deployment.

      ```
      oc edit ActiveMQArtemis <CR instance name> -n <namespace>
      ```

   b. Using the OpenShift Container Platform web console:

      i. Log in to OpenShift Container Platform as a user that has privileges to deploy CRs in the project for the broker deployment.

      ii. In the left pane, click **Administration → Custom Resource Definitions**

      iii. Click the **ActiveMQArtemis** CRD.

      iv. Click the **Instances** tab.

      v. Click the instance for your broker deployment.

      vi. Click the **YAML** tab.
      Within the console, a YAML editor opens, enabling you to edit the CR instance.

2. In the **spec** section of the CR, add a **podDisruptionBudget** element and specify the minimum number of Pods in your deployment that must be available during a voluntary disruption. In the following example, a minimum of one Pod must be available:

   ```
   spec:
   ```

```
...
podDisruptionBudget:
  minAvailable: 1
...
```

3. Save the CR.

Additional resources

For more information about Pod disruption budgets, see Understanding how to use pod disruption budgets to specify the number of pods that must be up in the OpenShift Container Platform documentation.

4.17. CONFIGURING ITEMS NOT EXPOSED IN THE CUSTOM RESOURCE DEFINITION

A Custom Resource Definition (CRD) is a schema of configuration items that you can modify for AMQ Broker. You can specify values for configuration items that are in the CRD in a corresponding Custom Resource (CR) instance. The Operator generates the configuration for each broker container from the CR instance.

You can include configuration items in the CR that are not exposed in the CRD by adding the items to a **brokerProperties** attribute. Items included in a **brokerProperties** attribute are stored in a secret, which is mounted as a properties file on the broker Pod. At startup, the properties file is applied to the internal java configuration bean after the XML configuration is applied.

In the following example, a single property is applied to the configuration bean.

```
spec:
  ...
  brokerProperties:
  - globalMaxSize=500m
  ...
```

In the following example, multiple properties are applied to nested collections of configuration beans to create a broker connection named **target** that mirror messages with another broker.

```
spec:
  ...
  brokerProperties
  - "AMQPConnections.target.uri=tcp://<hostname>:<port>"
  - "AMQPConnections.target.connectionElements.mirror.type=MIRROR"
  - "AMQPConnections.target.connectionElements.mirror.messageAcknowledgements=true"
  - "AMQPConnections.target.connectionElements.mirror.queueCreation=true"
  - "AMQPConnections.target.connectionElements.mirror.queueRemoval=true"
  ...
```

IMPORTANT

Using the **brokerProperties** attribute provides access to many configuration items that you cannot otherwise configure for AMQ Broker on OpenShift Container Platform. If used incorrectly, some properties can have serious consequences for your deployment. Always exercise caution when configuring properties by using this method.

Procedure

1. Edit the CR for your deployment.

    a. Using the OpenShift web console:

        i. Enter the following command:

        ```
        oc edit ActiveMQArtemis <CR instance name> -n <namespace>
        ```

    b. Using the OpenShift Container Platform web console:

        i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

        ii. In the left pane, click **Operators → Installed Operator**.

        iii. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**operator.

        iv. Click the **AMQ Broker** tab.

        v. Click the name of the ActiveMQArtemis instance name.

        vi. Click the **YAML** tab.
        Within the console, a YAML editor opens, enabling you to edit the CR instance.

2. In the **spec** section of the CR, add a **brokerProperties** element and add a list of properties in camel-case format. For example:

    ```
    spec:
      ...
      brokerProperties:
      - globalMaxSize=500m
      - maxDiskUsage=85
      ...
    ```

3. Save the CR.

4. (Optional) Check the status of the configuration.

    a. Using the OpenShift command-line interface:

        i. Get the status conditions for your brokers.

        ```
        $ oc get activemqartemis -o yaml
        ```

    b. Using the OpenShift web console:

        i. Navigate to the status section of the CR for your broker deployment.

    c. Check the value of the **reason** field in the **BrokerPropertiesApplied** status information. For example:

    ```
    - lastTransitionTime: "2023-02-06T20:50:01Z"
      message: ""
      reason: Applied
    ```

```
status: "True"
type: BrokerPropertiesApplied
```

The possible values are:

Applied

OpenShift Container Platform propagated the updated secret to the properties file on each broker Pod.

AppliedWithError

OpenShift Container Platform propagated the updated secret to the properties file on each broker Pod. However, an error was found in the **brokerProperties** configuration. In the **status** section of the CR, check the **message** field to identify the invalid property and correct it in the CR.

OutOfSync

OpenShift Container Platform has not yet propagated the updated secret to the properties file on each broker Pod. When OpenShift Container Platform propagates the updated secret to each Pod, the status is updated.

NOTE

The broker checks periodically for configuration changes, including updates to the properties file that is mounted on the Pod, and reloads the configuration if it detects any changes. However, updates to properties that are read only when the broker starts, for example, JVM settings, are not reloaded until you restart the broker. For more information about which properties are reloaded, see Reloading configuration updates in *Configuring AMQ Broker*.

Additional Information

For a list of properties that you can configure in the **brokerProperties** element in a CR, see Broker Properties in *Configuring AMQ Broker*.

CHAPTER 5. CONNECTING TO AMQ MANAGEMENT CONSOLE FOR AN OPERATOR-BASED BROKER DEPLOYMENT

Each broker Pod in an Operator-based deployment hosts its own instance of AMQ Management Console at port 8161.

The following procedures describe how to connect to AMQ Management Console for a deployed broker.

Prerequisites

- You created a broker deployment using the AMQ Broker Operator. For example, to learn how to use a sample CR to create a basic broker deployment, see Section 3.4.1, “Deploying a basic broker instance”.

- You enabled access to AMQ Management Console for the brokers in your deployment. For more information about enabling access to AMQ Management Console, see Section 4.6, “Enabling access to AMQ Management Console”.

5.1. CONNECTING TO AMQ MANAGEMENT CONSOLE

When you enable access to AMQ Management Console in the Custom Resource (CR) instance for your broker deployment, the Operator automatically creates a dedicated Service and Route for each broker Pod to provide access to AMQ Management Console.

The default name of the automatically-created Service is in the form ***<custom-resource-name>*-wconsj-*<broker-pod-ordinal>*-svc**. For example, **my-broker-deployment-wconsj-0-svc**. The default name of the automatically-created Route is in the form ***<custom-resource-name>*-wconsj-*<broker-pod-ordinal>*-svc-rte**. For example, **my-broker-deployment-wconsj-0-svc-rte**.

This procedure shows you how to access the console for a running broker Pod.

Procedure

1. In the OpenShift Container Platform web console, click **Networking** → **Routes**.
   On the **Routes** page, identify the **wconsj** Route for the given broker Pod. For example, **my-broker-deployment-wconsj-0-svc-rte**.

2. Under **Location**, click the link that corresponds to the Route.
   A new tab opens in your web browser.

3. Click the **Management Console** link.
   The AMQ Management Console login page opens.

   NOTE

   Credentials are required to log in to AMQ Management Console **only** if the **requireLogin** property of the CR is set to **true**. This property specifies whether login credentials are required to log in to the broker **and** AMQ Management Console. By default, the **requireLogin** property is set to **false**. If **requireLogin** is set to **false**, you can log in to AMQ Management Console without supplying a valid username and password by entering any text when prompted for a username and password.

4. If the **requireLogin** property is set to **true**, enter a username and password.
   You can enter the credentials for a preconfigured user that is available for connecting to the broker and AMQ Management Console. You can find these credentials in the **adminUser** and **adminPassword** properties if these properties are configured in the Custom Resource (CR) instance. It these properties are not configured in the CR, the Operator automatically generates the credentials. To obtain the automatically generated credentials, see Section 5.2, "Accessing AMQ Management Console login credentials".

   If you want to log in as any other user, note that a user must belong to a security role specified for the **hawtio.role** system property to have the permissions required to log in to AMQ Management Console. The default role for the **hawtio.role** system property is **admin**, which the preconfigured user belongs to.

5.2. ACCESSING AMQ MANAGEMENT CONSOLE LOGIN CREDENTIALS

If you do not specify a value for **adminUser** and **adminPassword** in the Custom Resource (CR) instance used for your broker deployment, the Operator automatically generates these credentials and stores them in a secret. The default secret name is in the form ***<custom-resource-name>*-credentials-secret**, for example, **my-broker-deployment-credentials-secret**.

> NOTE
>
> Values for **adminUser** and **adminPassword** are required to log in to the management console **only** if the **requireLogin** parameter of the CR is set to **true**.
>
> If **requireLogin** is set to **false**, you can log in to the console without supplying a valid username password by entering any text when prompted for username and password.

This procedure shows how to access the login credentials.

Procedure

1. See the complete list of secrets in your OpenShift project.
   a. From the OpenShift Container Platform web console, click **Workload → Secrets**.
   b. From the command line:

      ```
      $ oc get secrets
      ```

2. Open the appropriate secret to reveal the Base64-encoded console login credentials.
   a. From the OpenShift Container Platform web console, click the secret that includes your broker Custom Resource instance in its name. Click the **YAML** tab.
   b. From the command line:

      ```
      $ oc edit secret <my-broker-deployment-credentials-secret>
      ```

3. To decode a value in the secret, use a command such as the following:

   ```
   $ echo 'dXNlcl9uYW1l' | base64 --decode
   console_admin
   ```

Additional resources

- To learn more about using AMQ Management Console to view and manage brokers, see Managing brokers using AMQ Management Console in *Managing AMQ Broker*.

CHAPTER 6. UPGRADING AN OPERATOR-BASED BROKER DEPLOYMENT

The procedures in this section show how to upgrade:

- The AMQ Broker Operator version, using both the OpenShift command-line interface (CLI) and OperatorHub
- The broker container image for an Operator-based broker deployment

6.1. BEFORE YOU BEGIN

This section describes some important considerations before you upgrade the Operator and broker container images for an Operator-based broker deployment.

- Upgrading the Operator using either the OpenShift command-line interface (CLI) or OperatorHub requires cluster administrator privileges for your OpenShift cluster.
- If you originally used the CLI to *install* the Operator, you should also use the CLI to *upgrade* the Operator. If you originally used OperatorHub to install the Operator (that is, it appears under **Operators → Installed Operators** for your project in the OpenShift Container Platform web console), you should also use OperatorHub to upgrade the Operator. For more information about these upgrade methods, see:
    - Section 6.2, “Upgrading the Operator using the CLI”
    - Section 6.3, “Upgrading the Operator using OperatorHub”
- If the **redeliveryDelayMultiplier** and the **redeliveryCollisionAvoidanceFactor** attributes are configured in the main broker CR in a 7.8.x or 7.9.x deployment, the new Operator is unable to reconcile any CR after you upgrade to 7.10.x. The reconcile fails because the data type of both attributes changed from float to string in 7.10.x.
  You can work around this issue by deleting the **redeliveryDelayMultiplier** and the **redeliveryCollisionAvoidanceFactor** attributes from the **spec.deploymentPlan.addressSettings.addressSetting** attribute. Then, configure the attributes under the **brokerProperties** attribute. For example:

```
spec:
  ...
  brokerProperties:
  - "addressSettings.#.redeliveryMultiplier=2.1"
  - "addressSettings.#.redeliveryCollisionAvoidanceFactor=1.2"
```

NOTE

Under the **brokerProperties** attribute, use the **redeliveryMultiplier** attribute name instead of the **redeliveryDelayMultiplier** attribute name that you deleted.

6.2. UPGRADING THE OPERATOR USING THE CLI

The procedures in this section show how to use the OpenShift command-line interface (CLI) to upgrade different versions of the Operator to the latest version available for AMQ Broker 7.11.

6.2.1. Prerequisites

- You should use the CLI to upgrade the Operator only if you originally used the CLI to *install* the Operator. If you originally used OperatorHub to install the Operator (that is, the Operator appears under **Operators → Installed Operators** for your project in the OpenShift Container Platform web console), you should use OperatorHub to upgrade the Operator. To learn how to upgrade the Operator using OperatorHub, see Section 6.3, “Upgrading the Operator using OperatorHub”.

6.2.2. Upgrading the Operator using the CLI

You can use the OpenShift command-line interface (CLI) to upgrade the Operator to the latest version for AMQ Broker 7.11.

Procedure

1. In your web browser, navigate to the **Software Downloads** page for AMQ Broker 7.11.6.

2. Ensure that the value of the **Version** drop-down list is set to **7.11.6** and the **Patches** tab is selected.

3. Next to **AMQ Broker 7.11.6 Operator Installation and Example Files**, click **Download**.
   Download of the **amq-broker-operator-7.11.6-ocp-install-examples.zip** compressed archive automatically begins.

4. When the download has completed, move the archive to your chosen installation directory. The following example moves the archive to a directory called **~/broker/operator**.

   ```
   $ mkdir ~/broker/operator
   $ mv amq-broker-operator-7.11.6-ocp-install-examples.zip ~/broker/operator
   ```

5. In your chosen installation directory, extract the contents of the archive. For example:

   ```
   $ cd ~/broker/operator
   $ unzip amq-broker-operator-operator-7.11.6-ocp-install-examples.zip
   ```

6. Log in to OpenShift Container Platform as an administrator for the project that contains your existing Operator deployment.

   ```
   $ oc login -u <user>
   ```

7. Switch to the OpenShift project in which you want to upgrade your Operator version.

   ```
   $ oc project <project-name>
   ```

8. In the **deploy** directory of the latest Operator archive that you downloaded and extracted, open the **operator.yaml** file.

   NOTE

   In the **operator.yaml** file, the Operator uses an image that is represented by a *Secure Hash Algorithm* (SHA) value. The comment line, which begins with a number sign (**#**) symbol, denotes that the SHA value corresponds to a specific container image tag.

9. Open the **operator.yaml** file for your **previous** Operator deployment. Check that any non-default values that you specified in your previous configuration are replicated in the **new operator.yaml** configuration file.

10. In the **new operator.yaml** file, the Operator is named **amq-broker-controller-manager** by default. If the name of the Operator in your previous deployment is not **amq-broker-controller-manager**, replace all instances of **amq-broker-controller-manager** with the previous Operator name. For example:

    ```
    spec:
      ...
      selector
        matchLabels
          name: amq-broker-operator
      ...
    ```

11. In the **new operator.yaml** file, the service account for the Operator is named **amq-broker-controller-manager**. In previous versions, the service account for the Operator was named **amq-broker-operator**.

    a. If you want to use the service account name in your previous deployment, replace the name of the service account in the **new operator.yaml** file with the name used in the previous deployment. For example:

    ```
    spec:
      ...
      serviceAccountName: amq-broker-operator
      ...
    ```

    b. If you want to use the new service account name, **amq-broker-controller-manager** for the Operator, update the service account, role, and role binding in your project.

    ```
    $ oc apply -f deploy/service_account.yaml
    ```

    ```
    $ oc apply -f deploy/role.yaml
    ```

    ```
    $ oc apply -f deploy/role_binding.yaml
    ```

12. Update the CRDs that are included with the Operator.

    a. Update the main broker CRD.

    ```
    $ oc apply -f deploy/crds/broker_activemqartemis_crd.yaml
    ```

    b. Update the address CRD.

    ```
    $ oc apply -f deploy/crds/broker_activemqartemisaddress_crd.yaml
    ```

    c. Update the scaledown controller CRD.

    ```
    $ oc apply -f deploy/crds/broker_activemqartemisscaledown_crd.yaml
    ```

    d. Update the security CRD.

```
$ oc apply -f deploy/crds/broker_activemqartemissecurity_crd.yaml
```

13. If you are upgrading from AMQ Broker Operator 7.10.0 only, delete the Operator and the StatefulSet.
    By default, the new Operator deletes the StatefulSet to remove custom and Operator metering labels, which were incorrectly added to the StatefulSet selector by the Operator in 7.10.0. When the Operator deletes the StatefulSet, it also deletes the existing broker Pods, which causes a temporary broker outage. If you want to avoid an outage, complete the following steps to delete the Operator and the StatefulSet without deleting the broker Pods.

    a. Delete the Operator.

    ```
    $ oc delete -f deploy/operator.yaml
    ```

    b. Delete the StatefulSet with the **--cascade=orphan** option to orphan the broker Pods. The orphaned broker Pods continue to run after the StatefulSet is deleted.

    ```
    $ oc delete statefulset <statefulset-name> --cascade=orphan
    ```

14. If you are upgrading from AMQ Broker Operator 7.10.0 or 7.10.1, check if your main broker CR has labels called **application** or **ActiveMQArtemis** configured in the **deploymentPlan.labels** attribute.
    These labels are reserved for the Operator to assign labels to Pods and are not permitted as custom labels after 7.10.1. If these custom labels were configured in the main broker CR, the Operator-assigned labels on the Pods were overwritten by the custom labels. If either of these custom labels are configured in the main broker CR, complete the following steps to restore the correct labels on the Pods and remove the labels from the CR.

    a. If you are upgrading from 7.10.0, you deleted the Operator in the previous step. If you are upgrading from 7.10.1, delete the Operator.

    ```
    $ oc delete -f deploy/operator.yaml
    ```

    b. Run the following command to restore the correct Pod labels. In the following example, 'ex-aao' is the name of the StatefulSet deployed.

    ```
    $ for pod in $(oc get pods | grep -o '^ex-aao[^ ]*'); do oc label --overwrite pods $pod
    ActiveMQArtemis=ex-aao application=ex-aao-app; done
    ```

    c. Delete the **application** and **ActiveMQArtemis** labels from the **deploymentPlan.labels** attribute in the CR.

        i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

        ```
        oc login -u <user> -p <password> --server=<host:port>
        ```

        ii. Open the sample CR file called **broker_activemqartemis_cr.yaml** that was included in the **deploy/crs** directory of the Operator installation archive that you downloaded and extracted.

        iii. In the **deploymentPlan.labels** attribute in the CR, delete any custom labels called **application** or **ActiveMQArtemis**.

iv. Save the CR file.

v. Deploy the CR instance.

A. Switch to the project for the broker deployment.

```
$ oc project <project_name>
```

B. Apply the CR.

```
$ oc apply -f <path/to/broker_custom_resource_instance>.yaml
```

d. If you deleted the previous Operator, deploy the new Operator.

```
$ oc create -f deploy/operator.yaml
```

15. Apply the updated Operator configuration.

```
$ oc apply -f deploy/operator.yaml
```

16. The new Operator can recognize and manage your previous broker deployments. If you set values in the **image** or **version** field in the CR, the Operator's reconciliation process upgrades the broker Pods to the corresponding images when the Operator starts. For more information, see Section 6.4, "Restricting automatic upgrades of broker container images" . Otherwise, the Operator upgrades each broker Pod to the latest container image.

NOTE

If the reconciliation process does not start, you can start the process by scaling the deployment. For more information, see Section 3.4.1, "Deploying a basic broker instance".

17. Add attributes to the CR for the new features that are available in the upgraded broker, as required.

6.3. UPGRADING THE OPERATOR USING OPERATORHUB

This section describes how to use OperatorHub to upgrade the Operator for AMQ Broker.

6.3.1. Prerequisites

- Use OperatorHub to upgrade the Operator only if you originally used OperatorHub to *install* the Operator (that is, the Operator appears under **Operators → Installed Operators** for your project in the OpenShift Container Platform web console). By contrast, if you originally used the OpenShift command-line interface (CLI) to install the Operator, you should also use the CLI to upgrade the Operator. To learn how to upgrade the Operator using the CLI, see Section 6.2, "Upgrading the Operator using the CLI".
- Upgrading the AMQ Broker Operator using OperatorHub requires cluster administrator privileges for your OpenShift cluster.

6.3.2. Before you begin

This section describes some important considerations before you use OperatorHub to upgrade an instance of the AMQ Broker Operator.

- The Operator Lifecycle Manager **automatically** updates the CRDs in your OpenShift cluster when you install the latest Operator version from OperatorHub. You do not need to remove existing CRDs. If you remove existing CRDs, all CRs and broker instances are also removed.
- When you update your cluster with the CRDs for the latest Operator version, this update affects **all** projects in the cluster. Any broker Pods deployed from previous versions of the Operator might become unable to update their status in the OpenShift Container Platform web console. When you click the **Logs** tab of a running broker Pod, you see messages indicating that 'UpdatePodStatus' has failed. However, the broker Pods and Operator in that project continue to work as expected. To fix this issue for an affected project, you must also upgrade that project to use the latest version of the Operator.
- The procedure to follow depends on the Operator version that you are upgrading from. Ensure that you follow the upgrade procedure that is for your current version.

6.3.3. Upgrading the Operator from pre-7.10.0 to 7.11.x

You must uninstall and reinstall the Operator to upgrade from pre-7.10.0 to 7.11.x.

Procedure

1. Log in to the OpenShift Container Platform web console as a cluster administrator.
2. Uninstall the existing AMQ Broker Operator from your project.
3. In the left navigation menu, click **Operators → Installed Operators**.
4. From the Project drop-down menu at the top of the page, select the project in which you want to uninstall the Operator.
5. Locate the **Red Hat Integration - AMQ Broker**instance that you want to uninstall.
6. For your Operator instance, click the **More Options** icon (three vertical dots) on the right-hand side. Select **Uninstall Operator**.
7. On the confirmation dialog box, click **Uninstall**.
8. Use OperatorHub to install the latest version of the Operator for AMQ Broker 7.11. For more information, see Section 3.3.2, “Deploying the Operator from OperatorHub” .
   The new Operator can recognize and manage your previous broker deployments. If you set values in the **image** or **version** field in the CR, the Operator’s reconciliation process upgrades the broker Pods to the corresponding container images when the Operator starts. For more information, see Section 6.4, “Restricting automatic upgrades of broker container images” . Otherwise, the Operator upgrades each broker Pod to the latest container image.

   NOTE

   If the reconciliation process does not start, you can start the process by scaling the deployment. For more information, see Section 3.4.1, “Deploying a basic broker instance”.

6.3.4. Upgrading the Operator from 7.10.0 to 7.11.x

You must uninstall and reinstall the Operator to upgrade from 7.10.0 to 7.11.x.

Procedure

1. Log in to the OpenShift Container Platform web console as a cluster administrator.

2. Uninstall the existing AMQ Broker Operator from your project.

   a. In the left navigation menu, click **Operators → Installed Operators**.

   b. From the Project drop-down menu at the top of the page, select the project in which you want to uninstall the Operator.

   c. Locate the **Red Hat Integration - AMQ Broker**instance that you want to uninstall.

   d. For your Operator instance, click the **More Options** icon (three vertical dots) on the right-hand side. Select **Uninstall Operator**.

   e. On the confirmation dialog box, click **Uninstall**.

3. When you upgrade a 7.10.0 Operator, the new Operator deletes the StatefulSet to remove custom and Operator metering labels, which were incorrectly added to the StatefulSet selector by the Operator in 7.10.0. When the Operator deletes the StatefulSet, it also deletes the existing broker pods, which causes a temporary broker outage. If you want to avoid the outage, complete the following steps to delete the StatefulSet and orphan the broker pods so that they continue to run.

   i. Log in to OpenShift Container Platform CLI as an administrator for the project that contains your existing Operator deployment:

   ```
   $ oc login -u <user>
   ```

   ii. Switch to the OpenShift project in which you want to upgrade your Operator version.

   ```
   $ oc project <project-name>
   ```

   iii. Delete the StatefulSet with the **--cascade=orphan** option to orphan the broker Pods. The orphaned broker Pods continue to run after the StatefulSet is deleted.

   ```
   $ oc delete statefulset <statefulset-name> --cascade=orphan
   ```

4. Check if your main broker CR has labels called **application** or **ActiveMQArtemis** configured in the **deploymentPlan.labels** attribute.
   In 7.10.0, it was possible to configure these custom labels in the CR. These labels are reserved for the Operator to assign labels to Pods and cannot be added as custom labels after 7.10.0. If these custom labels were configured in the main broker CR in 7.10.0, the Operator-assigned labels on the Pods were overwritten by the custom labels. If the CR has either of these labels, complete the following steps to restore the correct labels on the Pods and remove the labels from the CR.

   a. In the OpenShift command-line interface (CLI), run the following command to restore the correct Pod labels. In the following example, 'ex-aao' is the name of the StatefulSet deployed.

```
$ for pod in $(oc get pods | grep -o '^ex-aao[^ ]*'); do oc label --overwrite pods $pod
ActiveMQArtemis=ex-aao application=ex-aao-app; done
```

b. Delete the **application** and **ActiveMQArtemis** labels from the **deploymentPlan.labels** attribute in the CR.

i. Using the OpenShift command-line interface:

A. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

```
oc login -u <user> -p <password> --server=<host:port>
```

B. Edit the CR for your deployment.

```
oc edit ActiveMQArtemis <statefulset name> -n <namespace>
```

C. In the **deploymentPlan.labels** element in the CR, delete any custom labels called **application** or **ActiveMQArtemis**.

D. Save the CR.

ii. Using the OpenShift Container Platform web console:

A. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

B. In the left pane, click **Administration** → **Custom Resource Definitions**

C. Click the **ActiveMQArtemis** CRD.

D. Click the **Instances** tab.

E. Click the instance for your broker deployment.

F. Click the **YAML** tab.
Within the console, a YAML editor opens, enabling you to configure a CR instance.

G. In the **deploymentPlan.labels** element in the CR, delete any custom labels called **application** or **ActiveMQArtemis**.

H. Click **Save**.

5. Use OperatorHub to install the latest version of the Operator for AMQ Broker 7.11. For more information, see Section 3.3.2, “Deploying the Operator from OperatorHub”.
The new Operator can recognize and manage your previous broker deployments. If you set values in the **image** or **version** field in the CR, the Operator’s reconciliation process upgrades the broker Pods to the corresponding images when the Operator starts. For more information, see Section 6.4, “Restricting automatic upgrades of broker container images” . Otherwise, the Operator upgrades each broker Pod to the latest container image.

NOTE

If the reconciliation process does not start, you can start the process by scaling the deployment. For more information, see Section 3.4.1, “Deploying a basic broker instance”.

6. Add attributes to the CR for the new features that are available in the upgraded broker, as required.

6.3.5. Upgrading the Operator from 7.10.1 to 7.11.x

You must uninstall and reinstall the Operator to upgrade from 7.10.1 to 7.11.x.

Procedure

1. Log in to the OpenShift Container Platform web console as a cluster administrator.

2. Check if your main broker CR has labels called **application** or **ActiveMQArtemis** configured in the **deploymentPlan.labels** attribute.
   These labels are reserved for the Operator to assign labels to Pods and cannot be used after 7.10.1. If these custom labels were configured in the main broker CR, the Operator-assigned labels on the Pods were overwritten by the custom labels.

3. If these custom labels are not configured in the main broker CR, use OperatorHub to install the latest version of the Operator for AMQ Broker 7.11. For more information, see Section 3.3.2, “Deploying the Operator from OperatorHub”.

4. If either of these custom labels are configured in the main broker CR, complete the following steps to uninstall the existing Operator, restore the correct Pod labels and remove the labels from the CR, before you install the new Operator.

   > **NOTE**
   >
   > By uninstalling the Operator, you can remove the custom labels without the Operator deleting the StatefulSet, which also deletes the existing broker pods and causes a temporary broker outage.

   a. Uninstall the existing AMQ Broker Operator from your project.

      i. In the left navigation menu, click **Operators → Installed Operators**.

      ii. From the Project drop-down menu at the top of the page, select the project from which you want to uninstall the Operator.

      iii. Locate the **Red Hat Integration - AMQ Broker**instance that you want to uninstall.

      iv. For your Operator instance, click the **More Options** icon (three vertical dots) on the right-hand side. Select **Uninstall Operator**.

      v. On the confirmation dialog box, click **Uninstall**.

   b. In the OpenShift command-line interface (CLI), run the following command to restore the correct Pod labels. In the following example, 'ex-aao' is the name of the StatefulSet deployed.

   ```
   $ for pod in $(oc get pods | grep -o '^ex-aao[^ ]*'); do oc label --overwrite pods $pod
   ActiveMQArtemis=ex-aao application=ex-aao-app; done
   ```

   c. Delete the **application** and **ActiveMQArtemis** labels from the **deploymentPlan.labels** attribute in the CR.

i. Using the OpenShift command-line interface:

   A. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.

   ```
   oc login -u <user> -p <password> --server=<host:port>
   ```

   B. Edit the CR for your deployment.

   ```
   oc edit ActiveMQArtemis <statefulset name> -n <namespace>
   ```

   C. In the **deploymentPlan.labels** attribute in the CR, delete any custom labels called **application** or **ActiveMQArtemis**.

   D. Save the CR file.

ii. Using the OpenShift Container Platform web console:

   A. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

   B. In the left pane, click **Administration** → **Custom Resource Definitions**

   C. Click the **ActiveMQArtemis** CRD.

   D. Click the **Instances** tab.

   E. Click the instance for your broker deployment.

   F. Click the **YAML** tab.
   Within the console, a YAML editor opens, enabling you to configure a CR instance.

   G. In the **deploymentPlan.labels** attribute in the CR, delete any custom labels called **application** or **ActiveMQArtemis**.

   H. Click **Save**.

5. Use OperatorHub to install the latest version of the Operator for AMQ Broker 7.11. For more information, see Section 3.3.2, “Deploying the Operator from OperatorHub” .
   The new Operator can recognize and manage your previous broker deployments. If you set values in the **image** or **version** field in the CR, the Operator’s reconciliation process upgrades the broker Pods to the corresponding images when the Operator starts. For more information, see Section 6.4, “Restricting automatic upgrades of broker container images” . Otherwise, the Operator upgrades each broker Pod to the latest container image.

   NOTE

   If the reconciliation process does not start, you can start the process by scaling the deployment. For more information, see Section 3.4.1, “Deploying a basic broker instance”.

6. Add attributes to the CR for the new features that are available in the upgraded broker, as required.

6.3.6. Upgrading the Operator from 7.10.2 or later to 7.11.x

You must uninstall and reinstall the Operator to upgrade from 7.10.2 or later to 7.11.x.

Procedure

1. Log in to the OpenShift Container Platform web console as a cluster administrator.
2. Uninstall the existing AMQ Broker Operator from your project.
3. In the left navigation menu, click **Operators → Installed Operators**.
4. From the Project drop-down menu at the top of the page, select the project in which you want to uninstall the Operator.
5. Locate the **Red Hat Integration - AMQ Broker**instance that you want to uninstall.
6. For your Operator instance, click the **More Options** icon (three vertical dots) on the right-hand side. Select **Uninstall Operator**.
7. On the confirmation dialog box, click **Uninstall**.
8. Use OperatorHub to install the latest version of the Operator for AMQ Broker 7.11. For more information, see Section 3.3.2, “Deploying the Operator from OperatorHub” .
   The new Operator can recognize and manage your previous broker deployments. If you set values in the **image** or **version** field in the CR, the Operator’s reconciliation process upgrades the broker Pods to the corresponding images when the Operator starts. For more information, see Section 6.4, “Restricting automatic upgrades of broker container images” . Otherwise, the Operator upgrades each broker Pod to the latest container image.

   NOTE

   If the reconciliation process does not start, you can start the process by scaling the deployment. For more information, see Section 3.4.1, “Deploying a basic broker instance”.

6.4. RESTRICTING AUTOMATIC UPGRADES OF BROKER CONTAINER IMAGES

By default, the Operator automatically upgrades each broker in the deployment to use the latest available container images. In the Custom Resource (CR) for your deployment, you can restrict the ability of the Operator to upgrade the images by specifying a version number or the URLs of specific container images.

NOTE

If you want to restrict automatic upgrades of broker container images, ensure that your CR has **either** a version number or the combined URLs of the broker and init container images.

6.4.1. Restricting automatic upgrades of images by using version numbers

You can restrict the version of the container images to which the brokers are automatically upgraded as new versions become available.

> **NOTE**
>
> When you restrict upgrades based on version numbers, the Operator continues to automatically upgrade the brokers to use any new images that contain security fixes for the version deployed.

Procedure

1. Edit the main broker CR instance for the broker deployment.

    a. Using the OpenShift command-line interface:

    i. Log in to OpenShift as a user that has privileges to edit and deploy CRs in the project for the broker deployment.

    ```
    $ oc login -u <user> -p <password> --server=<host:port>
    ```

    ii. Edit the CR.

    ```
     oc edit ActiveMQArtemis <CR instance name> -n <namespace>
    ```

    b. Using the OpenShift Container Platform web console:

    i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

    ii. In the left pane, click **Operators → Installed Operator**.

    iii. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**operator.

    iv. Click the **AMQ Broker** tab.

    v. Click the name of the ActiveMQArtemis instance name.

    vi. Click the **YAML** tab.
    Within the console, a YAML editor opens, enabling you to edit the CR instance.

    > **NOTE**
    >
    > In the **status** section of the CR, the **.status.version.brokerVersion** field shows the version of AMQ Broker that is currently deployed.

2. In the **spec.version** attribute, specify the version to which the Operator can upgrade the broker and init container images in your deployment. The following are examples of values that you can specify.

    Examples

    In the following example, the Operator upgrades the current container images in your deployment to 7.11.0.

    ```
    spec:
      version: '7.11.0'
       ...
    ```

    In the following example, the Operator upgrades the current container images in your deployment to the latest available 7.10.x images. For example, if your deployment is using 7.10.1 container images, the Operator automatically upgrades the images to 7.10.2 but not to 7.11.6.

```
spec:
  version: '7.10'
  ...
```

In the following example, the Operator upgrades the current container images in your deployment to the latest 7.x.x images. For example, if your deployment is using 7.10.2 images, the Operator automatically upgrades the images to 7.11.6.

```
spec:
  version: '7'
  ...
```

NOTE

To upgrade between minor versions of the container images, for example, from 7.10.x to 7.11.x, you require an Operator that has the same minor version as that of the new container images. For example, to upgrade from 7.10.2 to 7.11.6, a 7.11.x Operator must be installed.

3. Save the CR.

IMPORTANT

Ensure that the CR does not contain a **spec.deploymentPlan.image** or a **spec.deploymentPlan.initImage** attribute in addition to a **spec.version** attribute. Both of these attributes override the **spec.version** attribute. If the CR has one of these attributes as well as the **spec.version** attribute, the versions of the broker and init images deployed can diverge, which might prevent the broker from running.

When you save the CR, the Operator first validates that an upgrade to the AMQ Broker version specified for **spec.version** is available for your existing deployment. If you specified an invalid version of AMQ Broker to which to upgrade, for example, a version that is not yet available, the Operator logs a warning message, and takes no further action.

However, if an upgrade to the specified version **is** available, then the Operator upgrades each broker in the deployment to use the broker container images that correspond to the new AMQ Broker version.

The broker container image that the Operator uses is defined in an environment variable in the **operator.yaml** configuration file of the Operator deployment. The environment variable name includes an identifier for the AMQ Broker version. For example, the environment variable **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_7116** corresponds to AMQ Broker 7.11.6.

When the Operator has applied the CR change, it restarts each broker Pod in your deployment so that each Pod uses the specified image version. If you have multiple brokers in your deployment, only one broker Pod shuts down and restarts at a time.

Additional resources

- To learn how the Operator uses environment variables to choose a broker container image, see Section 2.6, “How the Operator chooses container images”.
- To view the status of the deployment, see Section 6.4.3, “Validation of restrictions applied to automatic upgrades”

6.4.2. Restricting automatic upgrades of images by using image URLs

If you want to upgrade the brokers in your deployment to use specific container images, you can specify the registry URLs of the images in the CR. After the Operator upgrades the brokers to the specified container images, no further upgrades occur until you replace the image URLs in the CR. For example, the Operator does not automatically upgrade the brokers to use newer images that contain security fixes for the images deployed.

IMPORTANT

If you want to restrict automatic upgrades by using image URLs, specify URLs for both the **spec.deploymentPlan.image** and the **spec.deploymentPlan.initImage** attributes in the CR to ensure that the broker and init container images match. If you specify the URL of one container image only, the broker and init container image can diverge, which might prevent the broker from running.

NOTE

If a CR has a **spec.version** attribute in addition to **spec.deploymentPlan.image** and **spec.deploymentPlan.initImage** attributes, the Operator ignores the **spec.version** attribute.

Procedure

1. Obtain the URLs of the broker and init container images to which the Operator can upgrade the current images.
    a. In the Red Hat Catalog, open the broker container component page: AMQ Broker for RHEL 8 (Multiarch).
    b. In the **Architecture** drop-down, select your architecture.
    c. In the **Tag** drop-down, select the tag that corresponds to the image you want to install. Tags are displayed in chronological order based on the release date. A tag consists of the release version and an assigned tag.
    d. Open the **Get this image** tab.
    e. In the **Manifest field**, click the **Copy** icon.
    f. Paste the URL into a text file.
    g. In the Red Hat Catalog, open the init container component page: AMQ Broker Init for RHEL 8 (Multiarch)
    h. To obtain the URL of the init container image, repeat the steps that you followed to obtain the URL of the broker container image.
2. Edit the main broker CR instance for the broker deployment.

a. Using the OpenShift command-line interface:

   i. Log in to OpenShift as a user that has privileges to edit and deploy CRs in the project for the broker deployment.

   ```
   $ oc login -u <user> -p <password> --server=<host:port>
   ```

   ii. Edit the CR.

   ```
    oc edit ActiveMQArtemis <CR instance name> -n <namespace>
   ```

b. Using the OpenShift Container Platform web console:

   i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.

   ii. In the left pane, click **Operators → Installed Operator**.

   iii. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**operator.

   iv. Click the **AMQ Broker** tab.

   v. Click the name of the ActiveMQArtemis instance name.

   vi. Click the **YAML** tab.
   Within the console, a YAML editor opens, which enables you to configure the CR instance

c. Copy the URLs of the broker and init container images that you recorded in the text file and insert them in the **spec.deploymentPlan.image** and **spec.deploymentPlan.initImage** fields in the CR. For example:

```
spec:
  ...
  deploymentPlan:
    image: registry.redhat.io/amq7/amq-broker-
rhel8@e8fa2a00e576ecb95561ffbdbf87b1c82d479c8791ab2c6ce741dd0d0b496d15
    initImage: registry.redhat.io/amq7/amq-broker-init-
rhel8@f8c1fc7a4298ec691855c5067ed92b4859a92cea7b7ed9af1bba04469b5a315f
  ...
```

3. Save the CR.
When you save the CR, the Operator upgrades the brokers to use the new images and uses these images until you update the values of the **spec.deploymentPlan.image** and **spec.deploymentPlan.initImage** attributes again.

NOTE

If you already deployed AMQ Broker without setting image URLs, you can set the image URLs retrospectively to prevent the Operator from upgrading the current images deployed. You can find the registry URLs for the images deployed in the **.status.version.image** and **.status.version.initImage** attributes, which are in the **status** section of the CR.

If you copy the image URLs from the **.status.version.image** and **.status.version.initImage** attributes and insert them in the **spec.deploymentPlan.image** and the **spec.deploymentPlan.initImage** attributes respectively, the Operator does not upgrade the images currently deployed.

Additional Resources

- To view the status of the deployment, see Section 6.4.3, “Validation of restrictions applied to automatic upgrades”.

6.4.3. Validation of restrictions applied to automatic upgrades

After you save a CR, the Operator validates that the CR does not contain either of the following:

- A **spec.deploymentPlan.image** attribute without a **spec.deploymentPlan.initImage** attribute or vice versa.
- A **spec.version** attribute with either a **spec.deploymentPlan.image** and a **spec.deploymentPlan.initImage** attribute, or both.

Either of these configurations can result in different versions of the broker and init container images after an upgrade, which might prevent your broker from starting. If a CR has either of these configurations, the Operator sets the status of the **Valid** condition to **Unknown** as a warning. For example, if a CR has a **spec.deploymentPlan.image** attribute without a **spec.deploymentPlan.initImage** attribute or vice versa, the Operator displays the following status information for the **Valid** condition in the CR.

```
status:
  conditions:
  - lastTransitionTime: "2023-05-18T15:17:22Z"
    message: Init image and broker image must both be configured as an interdependent pair
    observedGeneration: 1
    reason: InitImageMustBePairedWithBrokerImage
    status: "Unknown"
    type: Valid
```

A **Valid** condition that has a status value of **Unknown** does not prevent the Operator from updating the StatefulSet. However, Red Hat recommends that you fix the status of the **Valid** condition by specifying the combined **spec.deploymentPlan.image `and `spec.deploymentPlan.initImage** attributes or the **spec.version attribute**, but not both, in the CR.

NOTE

If a CR has a **spec.version** attribute, the Operator also validates that the version format is correct and that the version is within the valid range that the Operator supports.

CHAPTER 7. MONITORING YOUR BROKERS

7.1. VIEWING BROKERS IN FUSE CONSOLE

You can configure an Operator-based broker deployment to use Fuse Console for OpenShift instead of the AMQ Management Console. When you have configured your broker deployment appropriately, Fuse Console discovers the brokers and displays them on a dedicated **Artemis** tab. You can view the same broker runtime data that you do in the AMQ Management Console. You can also perform the same basic management operations, such as creating addresses and queues.

The following procedure describes how to configure the Custom Resource (CR) instance for a broker deployment to enable Fuse Console for OpenShift to discover and display brokers in the deployment.

Prerequisites

- Fuse Console for OpenShift must be deployed to an OCP cluster, or to a specific namespace on that cluster. If you have deployed the console to a specific namespace, your broker deployment must be in the **same** namespace, to enable the console to discover the brokers. Otherwise, it is sufficient for Fuse Console and the brokers to be deployed on the same OCP cluster. For more information on installing Fuse Online on OCP, see Installing and Operating Fuse Online on OpenShift Container Platform.

- You must have already created a broker deployment. For example, to learn how to use a Custom Resource (CR) instance to create a basic Operator-based deployment, see Section 3.4.1, "Deploying a basic broker instance" .

Procedure

1. Open the CR instance that you used for your broker deployment. For example, the CR for a basic deployment might resemble the following:

```
apiVersion: broker.amq.io/v1beta1
kind: ActiveMQArtemis
metadata:
  name: ex-aao
spec:
  deploymentPlan:
    size: 4
    image: registry.redhat.io/amq7/amq-broker-rhel8:7.11
      ...
```

2. In the **deploymentPlan** section, add the **jolokiaAgentEnabled** and **managementRBACEnabled** properties and specify values, as shown below.

```
apiVersion: broker.amq.io/v1beta1
kind: ActiveMQArtemis
metadata:
  name: ex-aao
spec:
  deploymentPlan:
    size: 4
    image: registry.redhat.io/amq7/amq-broker-rhel8:7.11
```

```
...
jolokiaAgentEnabled: true
managementRBACEnabled: false
```

jolokiaAgentEnabled

Specifies whether Fuse Console can discover and display runtime data for the brokers in the deployment. To use Fuse Console, set the value to **true**.

managementRBACEnabled

Specifies whether role-based access control (RBAC) is enabled for the brokers in the deployment. You **must** set the value to **false** to use Fuse Console because Fuse Console uses its own role-based access control.

> IMPORTANT
>
> If you set the value of **managementRBACEnabled** to **false** to enable use of Fuse Console, management MBeans for the brokers no longer require authorization. You **should not** use the AMQ management console while **managementRBACEnabled** is set to **false** because this potentially exposes all management operations on the brokers to unauthorized use.

3. Save the CR instance.

4. Switch to the project in which you previously created your broker deployment.

```
$ oc project <project_name>
```

5. At the command line, apply the change.

```
$ oc apply -f <path/to/custom_resource_instance>.yaml
```

6. In Fuse Console, to view Fuse applications, click the **Online** tab. To view running brokers, in the left navigation menu, click **Artemis**.

Additional resources

- For more information about using Fuse Console for OpenShift, see Monitoring and managing Red Hat Fuse applications on OpenShift.

- To learn about using AMQ Management Console to view and manage brokers in the same way that you can in Fuse Console, see Managing brokers using AMQ Management Console .

7.2. MONITORING BROKER RUNTIME METRICS USING PROMETHEUS

The sections that follow describe how to configure the Prometheus metrics plugin for AMQ Broker on OpenShift Container Platform. You can use the plugin to monitor and store broker runtime metrics. You might also use a graphical tool such as Grafana to configure more advanced visualizations and dashboards of the data that the Prometheus plugin collects.

NOTE

The Prometheus metrics plugin enables you to collect and export broker metrics in Prometheus **format**. However, Red Hat **does not** provide support for installation or configuration of Prometheus itself, nor of visualization tools such as Grafana. If you require support with installing, configuring, or running Prometheus or Grafana, visit the product websites for resources such as community support and documentation.

7.2.1. Metrics overview

To monitor the health and performance of your broker instances, you can use the Prometheus plugin for AMQ Broker to monitor and store broker runtime metrics. The AMQ Broker Prometheus plugin exports the broker runtime metrics to Prometheus format, enabling you to use Prometheus itself to visualize and run queries on the data.

You can also use a graphical tool, such as Grafana, to configure more advanced visualizations and dashboards for the metrics that the Prometheus plugin collects.

The metrics that the plugin exports to Prometheus format are described below.

Broker metrics

artemis_address_memory_usage

Number of bytes used by all addresses on this broker for in-memory messages.

artemis_address_memory_usage_percentage

Memory used by all the addresses on this broker as a percentage of the **global-max-size** parameter.

artemis_connection_count

Number of clients connected to this broker.

artemis_total_connection_count

Number of clients that have connected to this broker since it was started.

Address metrics

artemis_routed_message_count

Number of messages routed to one or more queue bindings.

artemis_unrouted_message_count

Number of messages *not* routed to any queue bindings.

Queue metrics

artemis_consumer_count

Number of clients consuming messages from a given queue.

artemis_delivering_durable_message_count

Number of durable messages that a given queue is currently delivering to consumers.

artemis_delivering_durable_persistent_size

Persistent size of durable messages that a given queue is currently delivering to consumers.

artemis_delivering_message_count

Number of messages that a given queue is currently delivering to consumers.

artemis_delivering_persistent_size

Persistent size of messages that a given queue is currently delivering to consumers.

artemis_durable_message_count

Number of durable messages currently in a given queue. This includes scheduled, paged, and in-delivery messages.

artemis_durable_persistent_size

Persistent size of durable messages currently in a given queue. This includes scheduled, paged, and in-delivery messages.

artemis_messages_acknowledged

Number of messages acknowledged from a given queue since the queue was created.

artemis_messages_added

Number of messages added to a given queue since the queue was created.

artemis_message_count

Number of messages currently in a given queue. This includes scheduled, paged, and in-delivery messages.

artemis_messages_killed

Number of messages removed from a given queue since the queue was created. The broker kills a message when the message exceeds the configured maximum number of delivery attempts.

artemis_messages_expired

Number of messages expired from a given queue since the queue was created.

artemis_persistent_size

Persistent size of all messages (both durable and non-durable) currently in a given queue. This includes scheduled, paged, and in-delivery messages.

artemis_scheduled_durable_message_count

Number of durable, scheduled messages in a given queue.

artemis_scheduled_durable_persistent_size

Persistent size of durable, scheduled messages in a given queue.

artemis_scheduled_message_count

Number of scheduled messages in a given queue.

artemis_scheduled_persistent_size

Persistent size of scheduled messages in a given queue.

For higher-level broker metrics that are not listed above, you can calculate these by aggregating lower-level metrics. For example, to calculate total message count, you can aggregate the **artemis_message_count** metrics from all queues in your broker deployment.

For an on-premise deployment of AMQ Broker, metrics for the Java Virtual Machine (JVM) hosting the broker are also exported to Prometheus format. This does not apply to a deployment of AMQ Broker on OpenShift Container Platform.

7.2.2. Enabling the Prometheus plugin using a CR

When you install AMQ Broker, a Prometheus metrics plugin is included in your installation. When enabled, the plugin collects runtime metrics for the broker and exports these to Prometheus format.

The following procedure shows how to enable the Prometheus plugin for AMQ Broker using a CR. This procedure supports new and existing deployments of AMQ Broker 7.9 or later.

See Section 7.2.3, “Enabling the Prometheus plugin for a running broker deployment using an environment variable” for an alternative procedure with running brokers.

Procedure

1. Open the CR instance that you use for your broker deployment. For example, the CR for a basic deployment might resemble the following:

   ```
   apiVersion: broker.amq.io/v1beta1
   kind: ActiveMQArtemis
   metadata:
     name: ex-aao
   spec:
     deploymentPlan:
       size: 4
       image: registry.redhat.io/amq7/amq-broker-rhel8:7.11
     ...
   ```

2. In the **deploymentPlan** section, add the **enableMetricsPlugin** property and set the value to **true**, as shown below.

   ```
   apiVersion: broker.amq.io/v1beta1
   kind: ActiveMQArtemis
   metadata:
     name: ex-aao
   spec:
     deploymentPlan:
       size: 4
       image: registry.redhat.io/amq7/amq-broker-rhel8:7.11
       ...
       enableMetricsPlugin: true
   ```

   enableMetricsPlugin

   Specifies whether the Prometheus plugin is enabled for the brokers in the deployment.

3. Save the CR instance.

4. Switch to the project in which you previously created your broker deployment.

   ```
   $ oc project <project_name>
   ```

5. At the command line, apply the change.

   ```
   $ oc apply -f <path/to/custom_resource_instance>.yaml
   ```

   The metrics plugin starts to gather broker runtime metrics in Prometheus format.

Additional resources

- For information about updating a running broker, see Section 3.4.3, “Applying Custom Resource changes to running broker deployments”.

7.2.3. Enabling the Prometheus plugin for a running broker deployment using an environment variable

The following procedure shows how to enable the Prometheus plugin for AMQ Broker using an environment variable. See Section 7.2.2, "Enabling the Prometheus plugin using a CR" for an alternative procedure.

Prerequisites

- You can enable the Prometheus plugin for a broker Pod created with the AMQ Broker Operator. However, your deployed broker must use the broker container image for AMQ Broker 7.7 or later.

Procedure

1. Log in to the OpenShift Container Platform web console with administrator privileges for the project that contains your broker deployment.
2. In the web console, click **Home → Projects**. Choose the project that contains your broker deployment.
3. To see the StatefulSets or DeploymentConfigs in your project, click **Workloads → StatefulSets** or **Workloads → DeploymentConfigs**.
4. Click the StatefulSet or DeploymentConfig that corresponds to your broker deployment.
5. To access the environment variables for your broker deployment, click the **Environment** tab.
6. Add a new environment variable, **AMQ_ENABLE_METRICS_PLUGIN**. Set the value of the variable to **true**.
   When you set the **AMQ_ENABLE_METRICS_PLUGIN** environment variable, OpenShift restarts each broker Pod in the StatefulSet or DeploymentConfig. When there are multiple Pods in the deployment, OpenShift restarts each Pod in turn. When each broker Pod restarts, the Prometheus plugin for that broker starts to gather broker runtime metrics.

7.2.4. Accessing Prometheus metrics for a running broker Pod

This procedure shows how to access Prometheus metrics for a running broker Pod.

Prerequisites

- You must have already enabled the Prometheus plugin for your broker Pod. See Section 7.2.3, "Enabling the Prometheus plugin for a running broker deployment using an environment variable".

Procedure

1. For the broker Pod whose metrics you want to access, you need to identify the Route you previously created to connect the Pod to the AMQ Broker management console. The Route name forms part of the URL needed to access the metrics.
   a. Click **Networking → Routes**.

b. For your chosen broker Pod, identify the Route created to connect the Pod to the AMQ Broker management console. Under **Hostname**, note the complete URL that is shown. For example:

```
http://rte-console-access-pod1.openshiftdomain
```

2. To access Prometheus metrics, in a web browser, enter the previously noted Route name appended with **“/metrics”**. For example:

```
http://rte-console-access-pod1.openshiftdomain/metrics
```

NOTE

If your console configuration does not use SSL, specify **http** in the URL. In this case, DNS resolution of the host name directs traffic to port 80 of the OpenShift router. If your console configuration uses SSL, specify **https** in the URL. In this case, your browser defaults to port 443 of the OpenShift router. This enables a successful connection to the console if the OpenShift router also uses port 443 for SSL traffic, which the router does by default.

7.3. MONITORING BROKER RUNTIME DATA USING JMX

This example shows how to monitor a broker using the Jolokia REST interface to JMX.

Prerequisites

- Completion of Deploying a basic broker is recommended.

Procedure

1. Get the list of running pods:

```
$ oc get pods

NAME           READY    STATUS    RESTARTS   AGE
ex-aao-ss-1   1/1      Running   0          14d
```

2. Run the **oc logs** command:

```
$ oc logs -f ex-aao-ss-1

...
Running Broker in /home/jboss/amq-broker
...
2021-09-17 09:35:10,813 INFO  [org.apache.activemq.artemis.integration.bootstrap]
AMQ101000: Starting ActiveMQ Artemis Server
2021-09-17 09:35:10,882 INFO  [org.apache.activemq.artemis.core.server] AMQ221000: live
Message Broker is starting with configuration Broker Configuration
(clustered=true,journalDirectory=data/journal,bindingsDirectory=data/bindings,largeMessagesDi
rectory=data/large-messages,pagingDirectory=data/paging)
2021-09-17 09:35:10,971 INFO  [org.apache.activemq.artemis.core.server] AMQ221013:
Using NIO Journal
2021-09-17 09:35:11,114 INFO  [org.apache.activemq.artemis.core.server] AMQ221057:
```

```
Global Max Size is being adjusted to 1/2 of the JVM max size (-Xmx). being defined as
2,566,914,048
2021-09-17 09:35:11,369 WARNING [org.jgroups.stack.Configurator] JGRP000014:
BasicTCP.use_send_queues has been deprecated: will be removed in 4.0
2021-09-17 09:35:11,385 WARNING [org.jgroups.stack.Configurator] JGRP000014:
Discovery.timeout has been deprecated: GMS.join_timeout should be used instead
2021-09-17 09:35:11,480 INFO  [org.jgroups.protocols.openshift.DNS_PING] serviceName
[ex-aao-ping-svc] set; clustering enabled
2021-09-17 09:35:24,540 INFO  [org.openshift.ping.common.Utils] 3 attempt(s) with a
1000ms sleep to execute [GetServicePort] failed. Last failure was
[javax.naming.CommunicationException: DNS error]
...
2021-09-17 09:35:25,044 INFO  [org.apache.activemq.artemis.core.server] AMQ221034:
Waiting indefinitely to obtain live lock
2021-09-17 09:35:25,045 INFO  [org.apache.activemq.artemis.core.server] AMQ221035:
Live Server Obtained live lock
2021-09-17 09:35:25,206 INFO  [org.apache.activemq.artemis.core.server] AMQ221080:
Deploying address DLQ supporting [ANYCAST]
2021-09-17 09:35:25,240 INFO  [org.apache.activemq.artemis.core.server] AMQ221003:
Deploying ANYCAST queue DLQ on address DLQ
2021-09-17 09:35:25,360 INFO  [org.apache.activemq.artemis.core.server] AMQ221080:
Deploying address ExpiryQueue supporting [ANYCAST]
2021-09-17 09:35:25,362 INFO  [org.apache.activemq.artemis.core.server] AMQ221003:
Deploying ANYCAST queue ExpiryQueue on address ExpiryQueue
2021-09-17 09:35:25,656 INFO  [org.apache.activemq.artemis.core.server] AMQ221020:
Started EPOLL Acceptor at ex-aao-ss-1.ex-aao-hdls-svc.broker.svc.cluster.local:61616 for
protocols [CORE]
2021-09-17 09:35:25,660 INFO  [org.apache.activemq.artemis.core.server] AMQ221007:
Server is now live
2021-09-17 09:35:25,660 INFO  [org.apache.activemq.artemis.core.server] AMQ221001:
Apache ActiveMQ Artemis Message Broker version 2.16.0.redhat-00022 [amq-broker,
nodeID=8d886031-179a-11ec-9e02-0a580ad9008b]
2021-09-17 09:35:26,470 INFO  [org.apache.amq.hawtio.branding.PluginContextListener]
Initialized amq-broker-redhat-branding plugin
2021-09-17 09:35:26,656 INFO  [org.apache.activemq.hawtio.plugin.PluginContextListener]
Initialized artemis-plugin plugin
...
```

3. Run your query to monitor your broker for **MaxConsumers**:

```
$ curl -k -u admin:admin http://console-broker.amq-
demo.apps.example.com/console/jolokia/read/org.apache.activemq.artemis:broker=%22amq-
broker%22,component=addresses,address=%22TESTQUEUE%22,subcomponent=queues,ro
uting-type=%22anycast%22,queue=%22TESTQUEUE%22/MaxConsumers

{"request":{"mbean":"org.apache.activemq.artemis:address=\"TESTQUEUE\",broker=\"amq-
broker\",component=addresses,queue=\"TESTQUEUE\",routing-
type=\"anycast\",subcomponent=queues","attribute":"MaxConsumers","type":"read"},"value":-
1,"timestamp":1528297825,"status":200}
```

CHAPTER 8. REFERENCE

8.1. CUSTOM RESOURCE CONFIGURATION REFERENCE

A Custom Resource Definition (CRD) is a schema of configuration items for a custom OpenShift object deployed with an Operator. By deploying a corresponding Custom Resource (CR) instance, you specify values for configuration items shown in the CRD.

The following sub-sections detail the configuration items that you can set in Custom Resource instances based on the main broker CRD.

8.1.1. Broker Custom Resource configuration reference

A CR instance based on the main broker CRD enables you to configure brokers for deployment in an OpenShift project. The following table describes the items that you can configure in the CR instance.

IMPORTANT

Configuration items marked with an asterisk (*****) are required in any corresponding Custom Resource (CR) that you deploy. If you do not explicitly specify a value for a non-required item, the configuration uses the default value.

Entry	Sub-entry	Description and usage
adminUser*		Administrator user name required for connecting to the broker and management console. If you do not specify a value, the value is automatically generated and stored in a secret. The default secret name has a format of ***<custom_resource_name>*-credentials-secret**. For example, **my-broker-deployment-credentials-secret**. **Type**: string **Example**: my-user **Default value**: Automatically-generated, random value

Entry	Sub-entry	Description and usage
adminPassword*		Administrator password required for connecting to the broker and management console. If you do not specify a value, the value is automatically generated and stored in a secret. The default secret name has a format of ***<custom_resource_name>*-credentials-secret**. For example, **my-broker-deployment-credentials-secret**. **Type**: string **Example**: my-password **Default value**: Automatically-generated, random value
deploymentPlan*		Broker deployment configuration

Entry	Sub-entry	Description and usage
	image*	Full path of the broker container image used for each broker in the deployment. You do not need to explicitly specify a value for **image** in your CR. The default value of **placeholder** indicates that the Operator has not yet determined the appropriate image to use. To learn how the Operator chooses a broker container image to use, see Section 2.6, “How the Operator chooses container images”. **Type**: string **Example**: registry.redhat.io/amq7/amq-broker-rhel8@sha256:e8fa2a00e576ecb95561ffbdbf87b1c82d479c8791ab2c6ce741dd0d0b496d15 **Default value**: placeholder
	size*	Number of broker Pods to create in the deployment. If you specify a value of 2 or greater, your broker deployment is clustered by default. The cluster user name and password are automatically generated and stored in the same secret as **adminUser** and **adminPassword**, by default. **Type**: int **Example**: 1 **Default value**: 1

Entry	Sub-entry	Description and usage
	requireLogin	Specify whether login credentials are required to connect to the broker. **Type**: Boolean **Example**: false **Default value**: true
	persistenceEnabled	Specify whether to use journal storage for each broker Pod in the deployment. If set to **true**, each broker Pod requires an available Persistent Volume (PV) that the Operator can claim using a Persistent Volume Claim (PVC). **Type**: Boolean **Example**: false **Default value**: true

Entry	Sub-entry	Description and usage
	initImage	Init Container image used to configure the broker. You do not need to explicitly specify a value for **initImage** in your CR, unless you want to provide a custom image. To learn how the Operator chooses a built-in Init Container image to use, see Section 2.6, “How the Operator chooses container images”. To learn how to specify a *custom* Init Container image, see Section 4.9, “Specifying a custom Init Container image”. **Type**: string **Example**: registry.redhat.io/amq7/amq-broker-init-rhel8@sha256:f8c1fc7a4298ec691855c5067ed92b4859a92cea7b7ed9af1bba04469b5a315f **Default value**: Not specified
	journalType	Specify whether to use asynchronous I/O (AIO) or non-blocking I/O (NIO). **Type**: string **Example**: aio **Default value**: nio

Entry	Sub-entry	Description and usage
	messageMigration	When a broker Pod shuts down due to an intentional scaledown of the broker deployment, specify whether to migrate messages to another broker Pod that is still running in the broker cluster. **Type**: Boolean **Example**: false **Default value**: true
	resources.limits.cpu	Maximum amount of host-node CPU, in millicores, that each broker container running in a Pod in a deployment can consume. **Type**: string **Example**: "500m" **Default value**: Uses the same default value that your version of OpenShift Container Platform uses. Consult a cluster administrator.
	resources.limits.memory	Maximum amount of host-node memory, in bytes, that each broker container running in a Pod in a deployment can consume. Supports byte notation (for example, K, M, G), or the binary equivalents (Ki, Mi, Gi). **Type**: string **Example**: "1024M" **Default value**: Uses the same default value that your version of OpenShift Container Platform uses. Consult a cluster administrator.

Entry	Sub-entry	Description and usage
	resources.requests.cpu	Amount of host-node CPU, in millicores, that each broker container running in a Pod in a deployment explicitly requests. **Type**: string **Example**: "250m" **Default value**: Uses the same default value that your version of OpenShift Container Platform uses. Consult a cluster administrator.
	resources.requests.memory	Amount of host-node memory, in bytes, that each broker container running in a Pod in a deployment explicitly requests. Supports byte notation (for example, K, M, G), or the binary equivalents (Ki, Mi, Gi). **Type**: string **Example**: "512M" **Default value**: Uses the same default value that your version of OpenShift Container Platform uses. Consult a cluster administrator.

Entry	Sub-entry	Description and usage
	storage.size	Size, in bytes, of the Persistent Volume Claim (PVC) that each broker in a deployment requires for persistent storage. This property applies only when **persistenceEnabled** is set to **true**. The value that you specify **must** include a unit. Supports byte notation (for example, K, M, G), or the binary equivalents (Ki, Mi, Gi). **Type**: string **Example**: 4Gi **Default value**: 2Gi
	jolokiaAgentEnabled	Specifies whether the Jolokia JVM Agent is enabled for the brokers in the deployment. If the value of this property is set to **true**, Fuse Console can discover and display runtime data for the brokers. **Type**: Boolean **Example**: true **Default value**: false

Entry	Sub-entry	Description and usage
	managementRBACEnabled	Specifies whether role-based access control (RBAC) is enabled for the brokers in the deployment. To use Fuse Console, you **must** set the value to **false**, because Fuse Console uses its own role-based access control. **Type**: Boolean **Example**: false **Default value**: true
	affinity	Specifies scheduling constraints for pods. For information about affinity properties, see the properties in the OpenShift Container Platform documentation.
	tolerations	Specifies the pod's tolerations. For information about tolerations properties, see the properties in the OpenShift Container Platform documentation.
	nodeSelector	Specify a label that matches a node's labels for the pod to be scheduled on that node.

Entry	Sub-entry	Description and usage
	storageClassName	Specifies the name of the storage class to use for the Persistent Volume Claim (PVC). Storage classes provide a way for administrators to describe and classify the available storage. For example, a storage class might have specific quality-of-service levels, backup policies, or other administrative policies associated with it. **Type**: string **Example**: gp3 **Default value**: Not specified
	startupProbe	Configure a startup probe to check if the AMQ Broker application within the broker container has started. For information about startup probe properties, see the properties in the OpenShift Container Platform documentation.
	livenessProbe	Configures a periodic health check on a running broker container to check that the broker is running. For information about liveness probe properties, see the properties in the OpenShift Container Platform documentation.

Entry	Sub-entry	Description and usage
	readinessProbe	Configures a periodic health check on a running broker container to check that the broker is accepting network traffic. For information about readiness probe properties, see the properties in the OpenShift Container Platform documentation.
	extraMounts	Mounts a secret or configMAP, that contains configuration information, as a file on a broker Pod. For example, you can mount a secret that contains customized logging configuration for AMQ Broker. **Type**: object **Example** See Section 4.15, "Configuring logging for brokers" **Default value**: Not specified
	labels	Assign labels to a broker pod. **Type**: string **Example**: location: "production" **Default value**: Not specified
	podSecurity.serviceAccountName	Specify a service account name for the broker pod. **Type**: string **Example**: amq-broker-controller-manager **Default value**: default

Entry	Sub-entry	Description and usage
	podSecurityContext	Specify the following pod-level security attributes and common container settings. * fsGroup * fsGroupChangePolicy * runAsGroup * runAsUser * runAsNonRoot * seLinuxOptions * seccompProfile * supplementalGroups * sysctls * windowsOptions For information on **podSecurityContext** properties, see the properties in the OpenShift Container Platform documentation.
console		Configuration of broker management console.
	expose	Specify whether to expose the management console port for each broker in a deployment. **Type**: Boolean **Example**: true **Default value**: false

Entry	Sub-entry	Description and usage
	sslEnabled	Specify whether to use SSL on the management console port. **Type**: Boolean **Example**: true **Default value**: false
	sslSecret	Secret where broker key store, trust store, and their corresponding passwords (all Base64-encoded) are stored. If you do not specify a value for **sslSecret**, the console uses a default secret name. The default secret name is in the form of ***<custom_resource_name>*****-console-secret**. This property applies only when the **sslEnabled** property is set to **true**. **Type**: string **Example**: my-broker-deployment-console-secret **Default value**: Not specified
	useClientAuth	Specify whether the management console requires client authorization. **Type**: Boolean **Example**: true **Default value**: false
acceptors.acceptor		A single acceptor configuration instance.

Entry	Sub-entry	Description and usage
	name*	Name of acceptor. **Type**: string **Example**: my-acceptor **Default value**: Not applicable
	port	Port number to use for the acceptor instance. **Type**: int **Example**: 5672 **Default value**: 61626 for the first acceptor that you define. The default value then increments by 10 for every subsequent acceptor that you define.
	protocols	Messaging protocols to be enabled on the acceptor instance. **Type**: string **Example**: amqp,core **Default value**: all
	sslEnabled	Specify whether SSL is enabled on the acceptor port. If set to **true**, look in the secret name specified in **sslSecret** for the credentials required by TLS/SSL. **Type**: Boolean **Example**: true **Default value**: false

Entry	Sub-entry	Description and usage
	sslSecret	Secret where broker key store, trust store, and their corresponding passwords (all Base64-encoded) are stored. If you do not specify a custom secret name for **sslSecret**, the acceptor assumes a default secret name. The default secret name has a format of ***<custom_resource_name>-<acceptor_name>*-secret**. You must always create this secret yourself, even when the acceptor assumes a default name. **Type**: string **Example**: my-broker-deployment-my-acceptor-secret **Default value**: *<custom_resource_name>*-*<acceptor_name>*-secret

Entry	Sub-entry	Description and usage
	enabledCipherSuites	Comma-separated list of cipher suites to use for TLS communication. Specify the most secure cipher suite(s) supported by your client application. If you specify a comma-separated list of cipher suites that are common to both the broker and the client, or you do not specify any cipher suites, the broker and client mutually negotiate a cipher suite to use. If you do not know which cipher suites to specify, you can first establish a broker-client connection with your client running in debug mode to verify the cipher suites that are common to both the broker and the client. Then, configure **enabledCipherSuites** on the broker. The cipher suites available depend on the TLS protocol versions used by the broker and clients. If the default TLS protocol version changes after you upgrade the broker, you might need to select an earlier TLS protocol version to ensure that the broker and the clients can use a common cipher suite. For more information, see **enabledProtocols**. **Type**: string **Default value**: Not specified

Entry	Sub-entry	Description and usage
	enabledProtocols	Comma-separated list of protocols to use for TLS communication. **Type**: string **Example**: TLSv1,TLSv1.1,TLSv1.2 **Default value**: Not specified If you don't specify a TLS protocol version, the broker uses the JVM's default version. If the broker uses the JVM's default TLS protocol version and that version changes after you upgrade the broker, the TLS protocol versions used by the broker and clients might be incompatible. While it is recommended that you use the later TLS protocol version, you can specify an earlier version in **enabledProtocols** to interoperate with clients that do not support a newer TLS protocol version.
	keyStoreProvider	The name of the provider of the keystore that the broker uses. **Type**: string **Example**: SunJCE **Default value**: Not specified

Entry	Sub-entry	Description and usage
	trustStoreProvider	The name of the provider of the truststore that the broker uses. **Type**: string **Example**: SunJCE **Default value**: Not specified
	trustStoreType	The type of truststore that the broker uses. **Type**: string **Example**: JCEKS **Default value**: JKS
	needClientAuth	Specify whether the broker informs clients that two-way TLS is required on the acceptor. This property overrides **wantClientAuth**. **Type**: Boolean **Example**: true **Default value**: Not specified
	wantClientAuth	Specify whether the broker informs clients that two-way TLS is *requested* on the acceptor, but not required. This property is overridden by **needClientAuth**. **Type**: Boolean **Example**: true **Default value**: Not specified

Entry	Sub-entry	Description and usage
	verifyHost	Specify whether to compare the Common Name (CN) of a client's certificate to its host name, to verify that they match. This option applies only when two-way TLS is used. **Type**: Boolean **Example**: true **Default value**: Not specified
	sslProvider	Specify whether the SSL provider is JDK or OPENSSL. **Type**: string **Example**: OPENSSL **Default value**: JDK
	sniHost	Regular expression to match against the **server_name** extension on incoming connections. If the names don't match, connection to the acceptor is rejected. **Type**: string **Example**: some_regular_expression **Default value**: Not specified

Entry	Sub-entry	Description and usage
	expose	Specify whether to expose the acceptor to clients outside OpenShift Container Platform. When you expose an acceptor to clients outside OpenShift, the Operator automatically creates a dedicated Service and Route for each broker Pod in the deployment. **Type**: Boolean **Example**: true **Default value**: false
	anycastPrefix	Prefix used by a client to specify that the **anycast** routing type should be used. **Type**: string **Example**: jms.queue **Default value**: Not specified
	multicastPrefix	Prefix used by a client to specify that the **multicast** routing type should be used. **Type**: string **Example**: /topic/ **Default value**: Not specified

Entry	Sub-entry	Description and usage
	connectionsAllowed	Number of connections allowed on the acceptor. When this limit is reached, a DEBUG message is issued to the log, and the connection is refused. The type of client in use determines what happens when the connection is refused. **Type**: integer **Example**: 2 **Default value**: 0 (unlimited connections)
	amqpMinLargeMessageSize	Minimum message size, in bytes, required for the broker to handle an AMQP message as a large message. If the size of an AMQP message is equal or greater to this value, the broker stores the message in a large messages directory (**/opt/*<custom_resource_name>*/data/large-messages**, by default) on the persistent volume (PV) used by the broker for message storage. Setting the value to **-1** disables large message handling for AMQP messages. **Type**: integer **Example**: 204800 **Default value**: 102400 (100 KB)

Entry	Sub-entry	Description and usage
	BindToAllInterfaces	If set to true, configures the broker acceptors with a 0.0.0.0 IP address instead of the internal IP address of the pod. When the broker acceptors have a 0.0.0.0 IP address, they bind to all interfaces configured for the pod and clients can direct traffic to the broker by using OpenShift Container Platform port-forwarding. Normally, you use this configuration to debug a service. For more information about port-forwarding, see Using port-forwarding to access applications in a container in the OpenShift Container Platform documentation. **NOTE** If port-forwarding is used incorrectly, it can create a security risk for your environment. Where possible, Red Hat recommends that you do not use port-forwarding in a production environment. **Type**: Boolean **Example**: true **Default value**: false

Entry	Sub-entry	Description and usage
connectors.connector		A single connector configuration instance.
	name*	Name of connector. **Type**: string **Example**: my-connector **Default value**: Not applicable
	type	The type of connector to create; **tcp** or **vm**. **Type**: string **Example**: vm **Default value**: tcp
	host*	Host name or IP address to connect to. **Type**: string **Example**: 192.168.0.58 **Default value**: Not specified
	port*	Port number to be used for the connector instance. **Type**: int **Example**: 22222 **Default value**: Not specified
	sslEnabled	Specify whether SSL is enabled on the connector port. If set to **true**, look in the secret name specified in **sslSecret** for the credentials required by TLS/SSL. **Type**: Boolean **Example**: true **Default value**: false

Entry	Sub-entry	Description and usage
	sslSecret	Secret where broker key store, trust store, and their corresponding passwords (all Base64-encoded) are stored. If you do not specify a custom secret name for **sslSecret**, the connector assumes a default secret name. The default secret name has a format of ***<custom_resource_name>-<connector_name>*-secret**. You must always create this secret yourself, even when the connector assumes a default name. **Type**: string **Example**: my-broker-deployment-my-connector-secret **Default value**: *<custom_resource_name>*-*<connector_name>*-secret
	enabledCipherSuites	Comma-separated list of cipher suites to use for TLS communication. **Type**: string **NOTE**: For a connector, it is recommended that you **do not** specify a list of cipher suites. **Default value**: Not specified

Entry	Sub-entry	Description and usage
	keyStoreProvider	The name of the provider of the keystore that the broker uses. **Type**: string **Example**: SunJCE **Default value**: Not specified
	trustStoreProvider	The name of the provider of the truststore that the broker uses. **Type**: string **Example**: SunJCE **Default value**: Not specified
	trustStoreType	The type of truststore that the broker uses. **Type**: string **Example**: JCEKS **Default value**: JKS
	enabledProtocols	Comma-separated list of protocols to use for TLS communication. **Type**: string **Example**: TLSv1,TLSv1.1,TLSv1.2 **Default value**: Not specified

Entry	Sub-entry	Description and usage
	needClientAuth	Specify whether the broker informs clients that two-way TLS is required on the connector. This property overrides **wantClientAuth**. **Type**: Boolean **Example**: true **Default value**: Not specified
	wantClientAuth	Specify whether the broker informs clients that two-way TLS is *requested* on the connector, but not required. This property is overridden by **needClientAuth**. **Type**: Boolean **Example**: true **Default value**: Not specified
	verifyHost	Specify whether to compare the Common Name (CN) of client’s certificate to its host name, to verify that they match. This option applies only when two-way TLS is used. **Type**: Boolean **Example**: true **Default value**: Not specified

Entry	Sub-entry	Description and usage
	sslProvider	Specify whether the SSL provider is **JDK** or **OPENSSL**. **Type**: string **Example**: OPENSSL **Default value**: JDK
	sniHost	Regular expression to match against the **server_name** extension on outgoing connections. If the names don't match, the connector connection is rejected. **Type**: string **Example**: some_regular_expression **Default value**: Not specified
	expose	Specify whether to expose the connector to clients outside OpenShift Container Platform. **Type**: Boolean **Example**: true **Default value**: false
addressSettings.applyRule		Specifies how the Operator applies the configuration that you add to the CR for each matching address or set of addresses. The values that you can specify are: **merge_all** For address settings specified in both the CR **and** the default configuration that

Entry	Sub-entry	Description and usage
		match the same address or set of addresses: ● Replace any property values specified in the default configuration with those specified in the CR. ● Keep any property values that are specified uniquely in the CR **or** the default configuration. Include each of these in the final, merged configuration. For address settings specified in either the CR **or** the default configuration that uniquely match a particular address or set of addresses, include these in the final, merged configuration. **merge_replace** For address settings specified in both the CR **and** the default configuration that match the same address or set of addresses, include the settings specified in the **CR** in the final, merged configuration. **Do not** include any properties specified in the default configuration, even if these are not specified in the CR. + For address settings specified in either the CR **or** the default configuration that uniquely match a particular address or set of addresses, include these in the final, merged configuration.

Entry	Sub-entry	Description and usage
		replace_all Replace **all** address settings specified in the default configuration with those specified in the CR. The final, megred configuration corresponds exactly to that specified in the CR. **Type**: string **Example**: replace_all **Default value**: merge_all
addressSettings.addressSetting		Address settings for a matching address or *set* of addresses.

Entry	Sub-entry	Description and usage
	addressFullPolicy	Specify what happens when an address configured with **maxSizeBytes** becomes full. The available policies are: **PAGE** Messages sent to a full address are paged to disk. **DROP** Messages sent to a full address are silently dropped. **FAIL** Messages sent to a full address are dropped and the message producers receive an exception. **BLOCK** Message producers will block when they try to send any further messages. The BLOCK policy works only for AMQP, OpenWire, and Core Protocol, because those protocols support flow control. **Type**: string **Example**: DROP **Default value**: PAGE
	autoCreateAddresses	Specify whether the broker automatically creates an address when a client sends a message to, or attempts to consume a message from, a queue that is bound to an address that does not exist. **Type**: Boolean **Example**: false **Default value**: true

Entry	Sub-entry	Description and usage
	autoCreateDeadLetterResources	Specify whether the broker automatically creates a dead letter address and queue to receive undelivered messages. If the parameter is set to **true**, the broker automatically creates a dead letter address and an associated dead letter queue. The name of the automatically-created address matches the value that you specify for **deadLetterAddress**. **Type**: Boolean **Example**: true **Default value**: false
	autoCreateExpiryResources	Specify whether the broker automatically creates an address and queue to receive expired messages. If the parameter is set to **true**, the broker automatically creates an expiry address and an associated expiry queue. The name of the automatically-created address matches the value that you specify for **expiryAddress**. **Type**: Boolean **Example**: true **Default value**: false
	autoCreateJmsQueues	This property is deprecated. Use **autoCreateQueues** instead.

Entry	Sub-entry	Description and usage
	autoCreateJmsTopics	This property is deprecated. Use **autoCreateQueues** instead.
	autoCreateQueues	Specify whether the broker automatically creates a queue when a client sends a message to, or attempts to consume a message from, a queue that does not yet exist. **Type**: Boolean **Example**: false **Default value**: true
	autoDeleteAddresses	Specify whether the broker automatically deletes automatically-created addresses when the broker no longer has any queues. **Type**: Boolean **Example**: false **Default value**: true
	autoDeleteAddressDelay	Time, in milliseconds, that the broker waits before automatically deleting an automatically-created address when the address has no queues. **Type**: integer **Example**: 100 **Default value**: 0
	autoDeleteJmsQueues	This property is deprecated. Use **autoDeleteQueues** instead.
	autoDeleteJmsTopics	This property is deprecated. Use **autoDeleteQueues** instead.

Entry	Sub-entry	Description and usage
	autoDeleteQueues	Specify whether the broker automatically deletes an automatically-created queue when the queue has no consumers and no messages. **Type**: Boolean **Example**: false **Default value**: true
	autoDeleteCreatedQueues	Specify whether the broker automatically deletes a manually-created queue when the queue has no consumers and no messages. **Type**: Boolean **Example**: true **Default value**: false
	autoDeleteQueuesDelay	Time, in milliseconds, that the broker waits before automatically deleting an automatically-created queue when the queue has no consumers. **Type**: integer **Example**: 10 **Default value**: 0
	autoDeleteQueuesMessageCount	Maximum number of messages that can be in a queue before the broker evaluates whether the queue can be automatically deleted. **Type**: integer **Example**: 5 **Default value**: 0

Entry	Sub-entry	Description and usage
	configDeleteAddresses	When the configuration file is reloaded, this parameter specifies how to handle an address (and its queues) that has been deleted from the configuration file. You can specify the following values: **OFF** The broker does not delete the address when the configuration file is reloaded. **FORCE** The broker deletes the address and its queues when the configuration file is reloaded. If there are any messages in the queues, they are removed also. **Type**: string **Example**: FORCE **Default value**: OFF

Entry	Sub-entry	Description and usage
	configDeleteQueues	When the configuration file is reloaded, this setting specifies how the broker handles queues that have been deleted from the configuration file. You can specify the following values: **OFF** The broker does not delete the queue when the configuration file is reloaded. **FORCE** The broker deletes the queue when the configuration file is reloaded. If there are any messages in the queue, they are removed also. **Type**: string **Example**: FORCE **Default value**: OFF
	deadLetterAddress	The address to which the broker sends dead (that is, *undelivered*) messages. **Type**: string **Example**: DLA **Default value**: None
	deadLetterQueuePrefix	Prefix that the broker applies to the name of an automatically-created dead letter queue. **Type**: string **Example**: myDLQ. **Default value**: DLQ.

Entry	Sub-entry	Description and usage
	deadLetterQueueSuffix	Suffix that the broker applies to an automatically-created dead letter queue. **Type**: string **Example**: .DLQ **Default value**: None
	defaultAddressRoutingType	Routing type used on automatically-created addresses. **Type**: string **Example**: ANYCAST **Default value**: MULTICAST
	defaultConsumersBeforeDispatch	Number of consumers needed before message dispatch can begin for queues on an address. **Type**: integer **Example**: 5 **Default value**: 0
	defaultConsumerWindowSize	Default window size, in bytes, for a consumer. **Type**: integer **Example**: 300000 **Default value**: 1048576 (1024*1024)

Entry	Sub-entry	Description and usage
	defaultDelayBeforeDispatch	Default time, in milliseconds, that the broker waits before dispatching messages if the value specified for **defaultConsumersBeforeDispatch** has not been reached. **Type**: integer **Example**: 5 **Default value**: -1 (no delay)
	defaultExclusiveQueue	Specifies whether all queues on an address are exclusive queues by default. **Type**: Boolean **Example**: true **Default value**: false
	defaultGroupBuckets	Number of buckets to use for message grouping. **Type**: integer **Example**: 0 (message grouping disabled) **Default value**: -1 (no limit)
	defaultGroupFirstKey	Key used to indicate to a consumer which message in a group is first. **Type**: string **Example**: firstMessageKey **Default value**: None

Entry	Sub-entry	Description and usage
	defaultGroupRebalance	Specifies whether to rebalance groups when a new consumer connects to the broker. **Type**: Boolean **Example**: true **Default value**: false
	defaultGroupRebalancePauseDispatch	Specifies whether to pause message dispatch while the broker is rebalancing groups. **Type**: Boolean **Example**: true **Default value**: false
	defaultLastValueQueue	Specifies whether all queues on an address are last value queues by default. **Type**: Boolean **Example**: true **Default value**: false
	defaultLastValueKey	Default key to use for a last value queue. **Type**: string **Example**: stock_ticker **Default value**: None
	defaultMaxConsumers	Maximum number of consumers allowed on a queue at any time. **Type**: integer **Example**: 100 **Default value**: -1 (no limit)

Entry	Sub-entry	Description and usage
	defaultNonDestructive	Specifies whether all queues on an address are non-destructive by default. **Type**: Boolean **Example**: true **Default value**: false
	defaultPurgeOnNoConsumers	Specifies whether the broker purges the contents of a queue once there are no consumers. **Type**: Boolean **Example**: true **Default value**: false
	defaultQueueRoutingType	Routing type used on automatically-created queues. The default value is **MULTICAST**. **Type**: string **Example**: ANYCAST **Default value**: MULTICAST
	defaultRingSize	Default ring size for a matching queue that does not have a ring size explicitly set. **Type**: integer **Example**: 3 **Default value**: -1 (no size limit)

Entry	Sub-entry	Description and usage
	enableMetrics	Specifies whether a configured metrics plugin such as the Prometheus plugin collects metrics for a matching address or set of addresses. **Type**: Boolean **Example**: false **Default value**: true
	expiryAddress	Address that receives expired messages. **Type**: string **Example**: myExpiryAddress **Default value**: None
	expiryDelay	Expiration time, in milliseconds, applied to messages that are using the default expiration time. **Type**: integer **Example**: 100 **Default value**: -1 (no expiration time applied)
	expiryQueuePrefix	Prefix that the broker applies to the name of an automatically-created expiry queue. **Type**: string **Example**: myExp. **Default value**: EXP.

Entry	Sub-entry	Description and usage
	expiryQueueSuffix	Suffix that the broker applies to the name of an automatically-created expiry queue. **Type**: string **Example**: .EXP **Default value**: None
	lastValueQueue	Specify whether a queue uses only last values or not. **Type**: Boolean **Example**: true **Default value**: false
	managementBrowsePageSize	Specify how many messages a management resource can browse. **Type**: integer **Example**: 100 **Default value**: 200

Entry	Sub-entry	Description and usage
	match*	String that matches address settings to addresses configured on the broker. You can specify an exact address name or use a wildcard expression to match the address settings to a *set* of addresses. If you use a wildcard expression as a value for the **match** property, you must enclose the value in single quotation marks, for example, **'myAddresses*'**. **Type**: string **Example**: 'myAddresses*' **Default value**: None
	maxDeliveryAttempts	Specifies how many times the broker attempts to deliver a message before sending the message to the configured dead letter address. **Type**: integer **Example**: 20 **Default value**: 10
	maxExpiryDelay	Expiration time, in milliseconds, applied to messages that are using an expiration time greater than this value. **Type**: integer **Example**: 20 **Default value**: -1 (no maximum expiration time applied)

Entry	Sub-entry	Description and usage
	maxRedeliveryDelay	Maximum value, in milliseconds, between message redelivery attempts made by the broker. **Type**: integer **Example**: 100 **Default value**: The default value is ten times the value of **redeliveryDelay**, which has a default value of **0**.
	maxSizeBytes	Maximum memory size, in bytes, for an address. Used when **addressFullPolicy** is set to **PAGING**, **BLOCK**, or **FAIL**. Also supports byte notation such as "K", "Mb", and "GB". **Type**: string **Example**: 10Mb **Default value**: -1 (no limit)
	maxSizeBytesRejectThreshold	Maximum size, in bytes, that an address can reach before the broker begins to reject messages. Used when the **address-full-policy** is set to **BLOCK**. Works in combination with **maxSizeBytes** for the AMQP protocol only. **Type**: integer **Example**: 500 **Default value**: -1 (no maximum size)

Entry	Sub-entry	Description and usage
	messageCounterHistoryDayLimit	Number of days for which a broker keeps a message counter history for an address. **Type**: integer **Example**: 5 **Default value**: 0
	minExpiryDelay	Expiration time, in milliseconds, applied to messages that are using an expiration time lower than this value. **Type**: integer **Example**: 20 **Default value**: -1 (no minimum expiration time applied)
	pageMaxCacheSize	Number of page files to keep in memory to optimize I/O during paging navigation. **Type**: integer **Example**: 10 **Default value**: 5
	pageSizeBytes	Paging size in bytes. Also supports byte notation such as **K**, **Mb**, and **GB**. **Type**: string **Example**: 20971520 **Default value**: 10485760 (approximately 10.5 MB)

Entry	Sub-entry	Description and usage
	redeliveryDelay	Time, in milliseconds, that the broker waits before redelivering a cancelled message. **Type**: integer **Example**: 100 **Default value**: 0
	redistributionDelay	Time, in milliseconds, that the broker waits after the last consumer is closed on a queue before redistributing any remaining messages. **Type**: integer **Example**: 100 **Default value**: -1 (not set)
	retroactiveMessageCount	Number of messages to keep for future queues created on an address. **Type**: integer **Example**: 100 **Default value**: 0
	sendToDlaOnNoRoute	Specify whether a message will be sent to the configured dead letter address if it cannot be routed to any queues. **Type**: Boolean **Example**: true **Default value**: false

Entry	Sub-entry	Description and usage
	slowConsumerCheckPeriod	How often, in **seconds**, that the broker checks for slow consumers. **Type**: integer **Example**: 15 **Default value**: 5
	slowConsumerPolicy	Specifies what happens when a slow consumer is identified. Valid options are **KILL** or **NOTIFY**. **KILL** kills the consumer's connection, which impacts any client threads using that same connection. **NOTIFY** sends a **CONSUMER_SLOW** management notification to the client. **Type**: string **Example**: KILL **Default value**: NOTIFY
	slowConsumerThreshold	Minimum rate of message consumption, in messages per second, before a consumer is considered slow. **Type**: integer **Example**: 100 **Default value**: -1 (not set)
env		Set environment variables for the broker.
	<property name>=<value>	A list of property names and values to configure for the broker. **Type**: array

Entry	Sub-entry	Description and usage
`name:<*variable name*> value:<*variable value*>	A list of environment variable names and values to configure for the broker. **Type**: array **Example**: name: TZ value: Europe/Vienna **Default value**: Not applicable	**brokerProperties**
	Configure broker properties that are not exposed in the broker's Custom Resource Definitions (CRDs) and are, otherwise, not configurable in a Custom Resource(CR).	
<property name>=<value>	A list of property names and values to configure for the broker. One property, **globalMaxSize**, is currently configurable in the **brokerProperties** section. Setting the **globalMaxSize** property overrides the default amount of memory assigned to the broker. By default, a broker is assigned half of the maximum memory available to the broker's Java Virtual Machine. The default unit for the **globalMaxSize** property is bytes. To change the default unit, add a suffix of m (for MB) or g (for GB) to the value. **Type**: string **Example**: globalMaxSize=512m **Default value**: Not applicable	**version**

8.1.2. Address Custom Resource configuration reference

A CR instance based on the address CRD enables you to define addresses and queues for the brokers in your deployment. The following table details the items that you can configure.

IMPORTANT

Configuration items marked with an asterisk (*) are required in any corresponding Custom Resource (CR) that you deploy. If you do not explicitly specify a value for a non-required item, the configuration uses the default value.

Entry	Description and usage
addressName*	Address name to be created on broker. **Type**: string **Example**: address0 **Default value**: Not specified
queueName	Queue name to be created on broker. If **queueName** is not specified, the CR creates only the address. **Type**: string **Example**: queue0 **Default value**: Not specified
removeFromBrokerOnDelete*	Specify whether the Operator removes existing addresses for all brokers in a deployment when you remove the address CR instance for that deployment. The default value is **false**, which means the Operator does not delete existing addresses when you remove the CR. **Type**: Boolean **Example**: true **Default value**: false
routingType*	Routing type to be used; **anycast** or **multicast**. **Type**: string **Example**: anycast **Default value**: multicast

8.1.3. Security Custom Resource configuration reference

A CR instance based on the security CRD enables you to define the security configuration for the brokers in your deployment, including:

- users and roles
- login modules, including **propertiesLoginModule**, **guestLoginModule** and **keycloakLoginModule**
- role based access control
- console access control

NOTE

Many of the options require you understand the broker security concepts described in Securing brokers

The following table details the items that you can configure.

IMPORTANT

Configuration items marked with an asterisk (*) are required in any corresponding Custom Resource (CR) that you deploy. If you do not explicitly specify a value for a non-required item, the configuration uses the default value.

Entry	Sub-entry	Description and usage
loginModules		One or more login module configurations. A login module can be one of the following types: ● **propertiesLoginModule** - allows you define broker users directly. ● **guestLoginModule** - for a user who does not have login credentials, or whose credentials fail authentication, you can grant limited access to the broker using a guest account. ● **keycloakLoginModule**. - allows you secure brokers using Red Hat Single Sign-On.
propertiesLoginModule	name*	Name of login module. **Type**: string **Example**: my-login **Default value**: Not applicable
	users.name*	Name of user. **Type**: string **Example**: jdoe **Default value**: Not applicable

Entry	Sub-entry	Description and usage
	users.password*	password of user. **Type**: string **Example**: password **Default value**: Not applicable
	users.roles	Names of roles. **Type**: string **Example**: viewer **Default value**: Not applicable
guestLoginModule	name*	Name of guest login module. **Type**: string **Example**: guest-login **Default value**: Not applicable
	guestUser	Name of guest user. **Type**: string **Example**: myguest **Default value**: Not applicable
	guestRole	Name of role for guest user. **Type**: string **Example**: guest **Default value**: Not applicable
keycloakLoginModule	name	Name for KeycloakLoginModule **Type**: string **Example**: sso **Default value**: Not applicable

Entry	Sub-entry	Description and usage
	moduleType	Type of KeycloakLoginModule (directAccess or bearerToken) **Type**: string **Example**: bearerToken **Default value**: Not applicable
	configuration	The following configuration items are related to Red Hat Single Sign-On and detailed information is available from the OpenID Connect documentation.
	configuration.realm*	Realm for KeycloakLoginModule **Type**: string **Example**: myrealm **Default value**: Not applicable
	configuration.realmPublicKey	Public key for the realm **Type**: string **Default value**: Not applicable
	configuration.authServerUrl*	URL of the keycloak authentication server **Type**: string **Default value**: Not applicable
	configuration.sslRequired	Specify whether SSL is required **Type**: string Valid values are 'all', 'external' and 'none'.
	configuration.resource*	Resource Name The client-id of the application. Each application has a client-id that is used to identify the application.

Entry	Sub-entry	Description and usage
	configuration.publicClient	Specify whether it is public client. **Type**: Boolean **Default value**: false **Example**: false
	configuration.credentials.key	Specify the credentials key. **Type**: string **Default value**: Not applicable **Type**: string **Default value**: Not applicable
	configuration.credentials.value	Specify the credentials value **Type**: string **Default value**: Not applicable
	configuration.useResourceRoleMappings	Specify whether to use resource role mappings **Type**: Boolean **Example**: false
	configuration.enableCors	Specify whether to enable Cross-Origin Resource Sharing (CORS) It will handle CORS preflight requests. It will also look into the access token to determine valid origins. **Type**: Boolean **Default value**: false
	configuration.corsMaxAge	CORS max age If CORS is enabled, this sets the value of the Access-Control-Max-Age header.
	configuration.corsAllowedMethods	CORS allowed methods If CORS is enabled, this sets the value of the Access-Control-Allow-Methods header. This should be a comma-separated string.

Entry	Sub-entry	Description and usage
	configuration.corsAllowedHeaders	CORS allowed headers If CORS is enabled, this sets the value of the Access-Control-Allow-Headers header. This should be a comma-separated string.
	configuration.corsExposedHeaders	CORS exposed headers If CORS is enabled, this sets the value of the Access-Control-Expose-Headers header. This should be a comma-separated string.
	configuration.exposeToken	Specify whether to expose access token **Type**: Boolean **Default value**: false
	configuration.bearerOnly	Specify whether to verify bearer token **Type**: Boolean **Default value**: false
	configuration.autoDetectBearerOnly	Specify whether to only auto-detect bearer token **Type**: Boolean **Default value**: false
	configuration.connectionPoolSize	Size of the connection pool **Type**: Integer **Default value**: 20
	configuration.allowAnyHostName	Specify whether to allow any host name **Type**: Boolean **Default value**: false
	configuration.disableTrustManager	Specify whether to disable trust manager **Type**: Boolean **Default value**: false

Entry	Sub-entry	Description and usage
	configuration.trustStore*	Path of a trust store This is REQUIRED unless ssl-required is none or disable-trust-manager is true.
	configuration.trustStorePassword*	Truststore password This is REQUIRED if truststore is set and the truststore requires a password.
	configuration.clientKeyStore	Path of a client keystore **Type**: string **Default value**: Not applicable
	configuration.clientKeyStorePassword	Client keystore password **Type**: string **Default value**: Not applicable
	configuration.clientKeyPassword	Client key password **Type**: string **Default value**: Not applicable
	configuration.alwaysRefreshToken	Specify whether to always refresh token **Type**: Boolean **Example**: false
	configuration.registerNodeAtStartup	Specify whether to register node at startup **Type**: Boolean **Example**: false
	configuration.registerNodePeriod	Period for re-registering node **Type**: string **Default value**: Not applicable
	configuration.tokenStore	Type of token store (session or cookie) **Type**: string **Default value**: Not applicable

Entry	Sub-entry	Description and usage
	configuration.tokenCookiePath	Cookie path for a cookie store **Type**: string **Default value**: Not applicable
	configuration.principalAttribute	OpenID Connect ID Token attribute to populate the UserPrincipal name with OpenID Connect ID Token attribute to populate the UserPrincipal name with. If token attribute is null, defaults to sub. Possible values are sub, preferred_username, email, name, nickname, given_name, family_name.
	configuration.proxyUrl	The proxy URL
	configuration.turnOffChangeSessionIdOnLogin	Specify whether to change session id on a successful login **Type**: Boolean **Example**: false
	configuration.tokenMinimumTimeToLive	Minimum time to refresh an active access token **Type**: Integer **Default value**: 0
	configuration.minTimeBetweenJwksRequests	Minimum interval between two requests to Keycloak to retrieve new public keys **Type**: Integer **Default value**: 10
	configuration.publicKeyCacheTtl	Maximum interval between two requests to Keycloak to retrieve new public keys **Type**: Integer **Default value**: 86400

Entry	Sub-entry	Description and usage
	configuration.ignoreOauthQueryParameter	Whether to turn off processing of the access_token query parameter for bearer token processing **Type**: Boolean **Example**: false
	configuration.verifyTokenAudience	Verify whether the token contains this client name (resource) as an audience **Type**: Boolean **Example**: false
	configuration.enableBasicAuth	Whether to support basic authentication **Type**: Boolean **Default value**: false
	configuration.confidentialPort	The confidential port used by the Keycloak server for secure connections over SSL/TLS **Type**: Integer **Example**: 8443
	configuration.redirectRewriteRules.key	The regular expression used to match the Redirect URI. **Type**: string **Default value**: Not applicable
	configuration.redirectRewriteRules.value	The replacement String **Type**: string **Default value**: Not applicable
	configuration.scope	The OAuth2 scope parameter for DirectAccessGrantsLoginModule **Type**: string **Default value**: Not applicable
securityDomains		Broker security domains

Entry	Sub-entry	Description and usage
	brokerDomain.name	Broker domain name **Type**: string **Example**: activemq **Default value**: Not applicable
	brokerDomain.loginModules	One or more login modules. Each entry must be previously defined in the **loginModules** section above.
	brokerDomain.loginModules.name	Name of login module **Type**: string **Example**: prop-module **Default value**: Not applicable
	brokerDomain.loginModules.flag	Same as propertiesLoginModule, **required**, **requisite**, **sufficient** and **optional** are valid values. **Type**: string **Example**: sufficient **Default value**: Not applicable
	brokerDomain.loginModules.debug	Debug
	brokerDomain.loginModules.reload	Reload
	consoleDomain.name	Broker domain name **Type**: string **Example**: activemq **Default value**: Not applicable
	consoleDomain.loginModules	A single login module configuration.

Entry	Sub-entry	Description and usage
	consoleDomain.loginModules.name	Name of login module **Type**: string **Example**: prop-module **Default value**: Not applicable
	consoleDomain.loginModules.flag	Same as propertiesLoginModule, **required**, **requisite**, **sufficient** and **optional** are valid values. **Type**: string **Example**: sufficient **Default value**: Not applicable
	consoleDomain.loginModules.debug	Debug **Type**: Boolean **Example**: false
	consoleDomain.loginModules.reload	Reload **Type**: Boolean **Example**: true **Default**: false
securitySettings		Additional security settings to add to **broker.xml** or **management.xml**
	broker.match	The address match pattern for a security setting section. See AMQ Broker wildcard syntax for details about the match pattern syntax.
	broker.permissions.operationType	The operation type of a security setting, as described in Setting permissions. **Type**: string **Example**: createAddress **Default value**: Not applicable

Entry	Sub-entry	Description and usage
	broker.permissions.roles	The security settings are applied to these roles, as described in Setting permissions. **Type**: string **Example**: root **Default value**: Not applicable
securitySettings.management		Options to configure **management.xml**.
	hawtioRoles	The roles allowed to log into the Broker console. **Type**: string **Example**: root **Default value**: Not applicable
	connector.host	The connector host for connecting to the management API. **Type**: string **Example**: myhost **Default value**: localhost
	connector.port	The connector port for connecting to the management API. **Type**: integer **Example**: 1099 **Default value**: 1099
	connector.jmxRealm	The JMX realm of the management API. **Type**: string **Example**: activemq **Default value**: activemq

Entry	Sub-entry	Description and usage
	connector.objectName	The JMX object name of the management API. **Type**: String **Example**: connector:name=rmi **Default**: connector:name=rmi
	connector.authenticatorType	The management API authentication type. **Type**: String **Example**: password **Default**: password
	connector.secured	Whether the management API connection is secured. **Type**: Boolean **Example**: true **Default value**: false
	connector.keyStoreProvider	The keystore provider for the management connector. Required if you have set connector.secured="true". The default value is JKS.
	connector.keyStorePath	Location of the keystore. Required if you have set connector.secured="true".
	connector.keyStorePassword	The keystore password for the management connector. Required if you have set connector.secured="true".
	connector.trustStoreProvider	The truststore provider for the management connector Required if you have set connector.secured="true". **Type**: String **Example**: JKS **Default**: JKS

Entry	Sub-entry	Description and usage
	connector.trustStorePath	Location of the truststore for the management connector. Required if you have set connector.secured="true". **Type**: string **Default value**: Not applicable
	connector.trustStorePassword	The truststore password for the management connector. Required if you have set connector.secured="true". **Type**: string **Default value**: Not applicable
	connector.passwordCodec	The password codec for management connector The fully qualified class name of the password codec to use as described in Encrypting a password in a configuration file.
	authorisation.allowedList.domain	The domain of allowedList **Type**: string **Default value**: Not applicable
	authorisation.allowedList.key	The key of allowedList **Type**: string **Default value**: Not applicable
	authorisation.defaultAccess.method	The method of defaultAccess List **Type**: string **Default value**: Not applicable
	authorisation.defaultAccess.roles	The roles of defaultAccess List **Type**: string **Default value**: Not applicable
	authorisation.roleAccess.domain	The domain of roleAccess List **Type**: string **Default value**: Not applicable

Entry	Sub-entry	Description and usage
	authorisation.roleAccess.key	The key of roleAccess List **Type**: string **Default value**: Not applicable
	authorisation.roleAccess.accessList.method	The method of roleAccess List **Type**: string **Default value**: Not applicable
	authorisation.roleAccess.accessList.roles	The roles of roleAccess List **Type**: string **Default value**: Not applicable
	applyToCrNames	Apply this security config to the brokers defined by the named CRs in the current namespace. A value of * or empty string means applying to all brokers. **Type**: string **Example**: my-broker **Default value**: All brokers defined by CRs in the current namespace.

8.2. EXAMPLE JAAS LOGIN MODULE CONFIGURATIONS

The following example shows a JAAS login module configuration that has both a properties login module and an LDAP login module configured. The properties login module references the default login module that contains the credentials used by the Operator to authenticate with the broker.

```
activemq {
  org.apache.activemq.artemis.spi.core.security.jaas.LDAPLoginModule required
    debug=true
   initialContextFactory=com.sun.jndi.ldap.LdapCtxFactory
   connectionURL="LDAP://localhost:389"
   connectionUsername="CN=Administrator,CN=Users,OU=System,DC=example,DC=com"
   connectionPassword=redhat.123
   connectionProtocol=s
   connectionTimeout="5000"
   authentication=simple
    userBase="dc=example,dc=com"
   userSearchMatching="(CN={0})"
   userSearchSubtree=true
   readTimeout="5000"
```

```
       roleBase="dc=example,dc=com"
       roleName=cn
       roleSearchMatching="(member={0})"
       roleSearchSubtree=true;

  org.apache.activemq.artemis.spi.core.security.jaas.PropertiesLoginModule
   reload=true
   org.apache.activemq.jaas.properties.user="artemis-users.properties"
   org.apache.activemq.jaas.properties.role="artemis-roles.properties"
   baseDir="/home/jboss/amq-broker/etc";
};
```

The following example shows a JAAS login module configuration that has two properties login modules in separate realms.

- The default properties login module is in a realm named **console** and has the properties files that are used by the Operator and AMQ Management Console to authenticate with the broker.
- The login module in the **activemq** realm has new properties files, which, for example, could contain the credentials to authenticate users for messaging.

You might want to create separate realms to, for example, apply specific security controls to the realm that contains the login module used by the Operator to authenticate with the broker.

```
activemq {
  org.apache.activemq.artemis.spi.core.security.jaas.PropertiesLoginModule
   reload=true
  org.apache.activemq.jaas.properties.user="new-users.properties"
  org.apache.activemq.jaas.properties.role="new-roles.properties"
};

console {
org.apache.activemq.artemis.spi.core.security.jaas.PropertiesLoginModule
  reload=true
   org.apache.activemq.jaas.properties.user="artemis-users.properties"
  org.apache.activemq.jaas.properties.role="artemis-roles.properties"
  baseDir="/home/jboss/amq-broker/etc";
};
```

NOTE

By default, AMQ Management Console uses the default properties login module in the **activemq** realm for authentication. If the default properties login module is configured in another realm, as in the example, you must set an environment variable in the broker CR to configure AMQ Management Console to use that realm. For example:

```
spec:
  ...
  env:
  - name: JAVA_ARGS_APPEND
    value: --Hawtio.realm=console
  ...
```

For more information about setting environment variables in a CR, see Section 4.7, “Setting environment variables for the broker containers”.

8.3. EXAMPLE: CONFIGURING AMQ BROKER TO USE RED HAT SINGLE SIGN-ON

This example shows how to configure AMQ Broker to use Red Hat Single Sign-On for authentication and authorization by using JAAS login modules.

Prerequisites

- A Red Hat Single Sign-On instance integrated with an LDAP directory.
  - The LDAP directory is populated with users and role information for AMQ Broker.
  - Red Hat Single Sign-On is configured to federate users from the LDAP server.
  - Red Hat Single Sign-On is configured to use the role-ldap-mapper to map role information from LDAP to Red Hat Single Sign-On.
- A Red Hat Single Sign-On realm that has:
  - A client configured with the following settings for applications, such as AMQ Management Console, that can use the oAuth protocol to obtain a token:
    Authentication flow: Standard flow

    Valid Redirect URIs: An OpenShift Container Platform route for AMQ Management Console. For example, http://artemis-wconsj-0-svc-rte-kc-ldap-tests-0eae49.apps.redhat-412t.broker.app-services-dev.net/console/*
  - A separate client configured with the following settings if you have messaging client applications that cannot use the oAuth protocol to obtain a token:
    Authentication flow: Direct Access Grants

    Valid Redirect URIs: *

> **NOTE**
>
> Each realm in Red Hat Single Sign-On includes a client named **Broker**. This client is not related to AMQ Broker.

Procedure

1. Create a text file named **login.config** and add the JAAS login module configuration to connect AMQ Broker with Red Hat Single Sign-On. For example:

```
console {
   // ensure the operator can connect to the broker by referencing the existing properties
config
   org.apache.activemq.artemis.spi.core.security.jaas.PropertiesLoginModule sufficient
      org.apache.activemq.jaas.properties.user="artemis-users.properties"
      org.apache.activemq.jaas.properties.role="artemis-roles.properties"
      baseDir="/home/jboss/amq-broker/etc";

  org.keycloak.adapters.jaas.BearerTokenLoginModule sufficient
```

```
        keycloak-config-file="/amq/extra/secrets/sso-jaas-config/_keycloak-bearer-token.json"
        role-principal-class=org.apache.activemq.artemis.spi.core.security.jaas.RolePrincipal;
};
activemq {
    org.keycloak.adapters.jaas.BearerTokenLoginModule sufficient
        keycloak-config-file="/amq/extra/secrets/sso-jaas-config/_keycloak-bearer-token.json"
        role-principal-class=org.apache.activemq.artemis.spi.core.security.jaas.RolePrincipal;

    org.keycloak.adapters.jaas.DirectAccessGrantsLoginModule sufficient
        keycloak-config-file="/amq/extra/secrets/sso-jaas-config/_keycloak-direct-access.json"
        role-principal-class=org.apache.activemq.artemis.spi.core.security.jaas.RolePrincipal;

    org.apache.activemq.artemis.spi.core.security.jaas.PrincipalConversionLoginModule
required
       principalClassList=org.keycloak.KeycloakPrincipal;
};
```

NOTE

- The path to the **.json** configuration files must be in the format **/amq/extra/secrets/*name*-jaas-config**. For *name*, specify a string value. You must use the same string value and a **-jaas-config** suffix to name the secret that you create later in this procedure.

- In the example **login.config** file, a realm named **console** is used to authenticate AMQ Management Console users and a realm named **activemq** to authenticate messaging clients.

The following login modules are configured in the example **login.config** file.

Login module	Description and usage
org.apache.activemq.artemis.spi.core.security.jaas.PropertiesLoginModule	This is the default login module and contains the **artemis-users.properties** file, which contains a default user that is required by the Operator to authenticate with the broker.
org.keycloak.adapters.jaas.BearerTokenLoginModule	This login module is for applications, for example, AMQ Management Console, that can use the oAuth protocol to obtain a token. When a user opens AMQ Management Console in a browser window, they are redirected to the Red Hat Single Sign-On console to log in to obtain a bearer token.

Login module	Description and usage
org.keycloak.adapters.jaas.DirectAccessGrantsLoginModule	This login module is required for non-HTTP applications, such as messaging clients, which cannot use the oAuth protocol. Using this login module, the broker first authenticates the client using a secret that is configured in Red Hat Single Sign-On and then obtains a token on behalf of the client.
org.apache.activemq.artemis.spi.core.security.jaas.PrincipalConversionLoginModule	This login module is required to convert the Keycloak principal received into a JAAS principal that can be used by AMQ Broker.

NOTE

In the **login.config** file example, each **.json** properties file name has an underscore prefix. The Operator ignores files prefixed with an underscore when it reports the status of the **JaasPropertiesApplied** condition. If the file names do not have an underscore prefix, the status of the **JaasPropertiesApplied** condition shows **OutofSync** permanently because the broker does not recognize properties files used by third party login modules. For more information about status reporting, see Section 4.3.2.1, “Configuring the default JAAS login module using the Security Custom Resource (CR)”.

1. Create text files for each of the **.json** properties files that are referenced in the login modules and configure the details required to connect AMQ Broker to Red Hat Single Sign-On. For example:

   _keycloak-bearer-token.json

   ```
   {
      "realm": "amq-broker-ldap",
      "resource": "amq-console",
      "auth-server-url": "https://keycloak-svc-rte-kc-ldap-tests-0eae49.apps.412t.broker.app-
   services-dev.net",
      "principal-attribute": "preferred_username",
      "use-resource-role-mappings": false,
      "ssl-required": "external",
      "confidential-port": 0
   }
   ```

   _keycloak-direct-access.json

   ```
   {
      "realm": "amq-broker-ldap",
      "resource": "amq-broker",
      "auth-server-url": "https://keycloak-svc-rte-kc-ldap-tests-0eae49.apps.412t.broker.app-
   services-dev.net",
      "principal-attribute": "preferred_username",
   ```

```
    "use-resource-role-mappings": false,
    "ssl-required": "external",
    "credentials": {
        "secret": "Lfk6g1ZKlGzNT6eRkz0d1scM4M29Ohmn"
    }
}
```

realm

The realm configured to authenticate the AMQ Broker applications and services in Red Hat Single Sign-On.

resource

The client ID of a client that is configured in Red Red Hat Single Sign-On.

auth-server-url

The base URL of the Red Hat Single Sign-On server.

principal-attribute

The token attribute with which to populate the UserPrincipal name.

use-resource-role-mappings

If set to true, Red Hat Single Sign-On looks inside the token for application level role mappings for the user. If false, it looks at the realm level for user role mappings. The default value is false.

ssl-required

Ensures that all communication to and from the Red Hat Single Sign-On server is over HTTPS. The default value is **external**, which means that HTTPS is required by default for external requests.

credentials

A secret configured in Red Hat Single Sign-On which the broker uses to log in to Red Hat Single Sign-On and obtain a token on behalf of the client.

2. Create a text file named **_keycloak-js-client.json** and add the configuration required for AMQ Management Console to redirect users to the URL of the Red Hat Single Sign-On Admin Console, where they enter their credentials. For example:

```
{
  "realm": "amq-broker-ldap",
  "clientId": "amq-console",
  "url": "https://keycloak-svc-rte-kc-ldap-tests-0eae49.apps.412t.broker.app-services-dev.net"
}
```

3. Use the **oc create secret** command to create a secret that contains the files that are referenced in the login module configuration. For example:

```
oc create secret generic sso-jaas-config --from-file=login.config --from-file=artemis-users.properties --from-file=artemis-roles.properties --from-file=_keycloak-bearer-token.json --from-file=_keycloak-direct-access.json --from-file=_keycloak-js-client.json
```

NOTE

- The secret name must have a suffix of **-jaas-config** so the Operator can recognize that the secret contains login module configuration and propagate any updates to each broker Pod.
- The secret name must match the last directory name in the path to the **.json** configuration files, which you specified in the **login.config** file. For example, if the path to the configuration files is **/amq/extra/secrets/sso-jaas-config**, you must specify a secret name of **sso-jaas-config**.

For more information about how to create secrets, see Secrets in the Kubernetes documentation.

4. Add the secret you created to the ActiveMQArtemis Custom Resource (CR) instance for your broker deployment.
   a. Using the OpenShift command-line interface:
      i. Log in to OpenShift as a user that has privileges to deploy CRs in the project for the broker deployment.
      ii. Edit the CR for your deployment.

```
oc edit ActiveMQArtemis <CR instance name> -n <namespace>
```

   b. Using the OpenShift Container Platform web console:
      i. Log in to the console as a user that has privileges to deploy CRs in the project for the broker deployment.
      ii. In the left pane, click **Operators → Installed Operator**.
      iii. Click the **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)**operator.
      iv. Click the **AMQ Broker** tab.
      v. Click the name of the ActiveMQArtemis instance name.
      vi. Click the **YAML** tab.
      Within the console, a YAML editor opens, enabling you to configure a CR instance.

5. Create an **extraMounts** attribute and a **secrets** attribute and add the name of the secret. The following example adds a secret named **custom-jaas-config** to the CR.

```
deploymentPlan:
  ...
  extraMounts:
    secrets:
    - "sso-jaas-config"
  ...
```

6. In the **ActiveMQArtemis** CR, create an environment variable that contains the hawtio settings required by AMQ Management Console to use Red Hat Single Sign-On for authentication. The contents of the environment variable are passed as arguments to the Java application launcher when the JVM that hosts a broker is started. For example:

```
env:
- name: JAVA_ARGS_APPEND
  value: -
Dhawtio.rolePrincipalClasses=org.apache.activemq.artemis.spi.core.security.jaas.RolePrincipal

      -Dhawtio.keycloakEnabled=true -Dhawtio.keycloakClientConfig=/amq/extra/secrets/sso-
jaas-config/_keycloak-js-client.json
      -Dhawtio.authenticationEnabled=true -Dhawtio.realm=console
```

For more information on hawtio settings, see the hawtio documentation.

7. In the **spec** section of the **ActiveMQArtemis** CR, add a **brokerProperties** attribute and add permissions for the roles configured in the LDAP directory. You can grant a role permissions to a single address. Or, you can specify a wildcard match using the **#** sign to grant a role permissions to all addresses. For example:

```
spec:
  ...
  brokerProperties:
  - securityRoles.#.producers.send=true
  - securityRoles.#.consumers.consume=true
  ...
```

8. Save the CR.
   The Operator mounts the files in the secret in a **/amq/extra/secrets/*secret name*** directory on each Pod and configures the broker JVM to read the mounted **login.config** file, which contains the SSO configuration, instead of the default **login.config** file.

8.4. LOGGING

In addition to viewing the OpenShift logs, you can troubleshoot a running AMQ Broker on OpenShift Container Platform image by viewing the AMQ logs that are output to the container's console.

Procedure

- At the command line, run the following command:

```
$ oc logs -f <pass:quotes[<pod-name>]> <pass:quotes[<container-name>]>
```

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