Red Hat AMQ 2021.Q3

Deploying AMQ Broker on OpenShift

For Use with AMQ Broker 7.9

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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 7.9 is available as a containerized image for use with OpenShift Container Platform (OCP) 4.6, 4.7, 4.8, 4.9 or 4.10.

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, when pods are scaled down, HA is provided in OpenShift by using the scaledown controller, which enables message migration.

  External Clients that connect to a cluster of brokers, either through the OpenShift proxy or by using bind ports, may need to be configured for HA accordingly. In a clustered scenario, a broker will inform certain clients of the addresses of all the broker's host and port information. Since these are only accessible internally, certain client features either will not work or will need to be disabled.

Client	Configuration
Core JMS Client	Because external Core Protocol JMS clients do not support HA or any type of failover, the connection factories must be configured with **useTopologyForLoadBalancing=false**.
AMQP Clients	AMQP clients do not support failover lists

- Durable subscriptions in a cluster
  When a durable subscription is created, this is represented as a durable queue on the broker to which a client has connected. When a cluster is running within OpenShift the client does not know on which broker the durable subscription queue has been created. If the subscription is durable and the client reconnects there is currently no method for the load balancer to reconnect it to the same node. When this happens, it is possible that the client will connect to a different broker and create a duplicate subscription queue. For this reason, using durable subscriptions with a cluster of brokers is not recommended.

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 The **sudo** Command.

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 failure or 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 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”

2.2. 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** directory, as listed below.

artemis-basic-deployment.yaml

Basic broker deployment.

artemis-persistence-deployment.yaml

Broker deployment with persistent storage.

artemis-cluster-deployment.yaml

Deployment of clustered brokers.

artemis-persistence-cluster-deployment.yaml

Deployment of clustered brokers with persistent storage.

artemis-ssl-deployment.yaml

Broker deployment with SSL security.

artemis-ssl-persistence-deployment.yaml

Broker deployment with SSL security and persistent storage.

artemis-aio-journal.yaml

Use of asynchronous I/O (AIO) with the broker journal.

address-queue-create.yaml

Address and queue creation.

2.3. 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 7.9 version to watch that namespace to avoid potential conflicts.

2.4. HOW THE OPERATOR CHOOSES CONTAINER IMAGES

When you create a Custom Resource (CR) instance for a broker deployment based on *at least* version 7.9.4-opr-3 of the Operator, you **do not** need to explicitly specify broker or Init Container image names in the CR. By default, if you deploy a CR and do not explicitly specify container image values, the Operator automatically chooses the appropriate container images to use.

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 an appropriate built-in Init Container image to use when you deploy the CR.

How the Operator chooses these images is described in this section.

To choose broker and Init Container images, the Operator first determines an AMQ Broker version to which the images should correspond. The Operator determines the version as follows:

- If the **spec.upgrades.enabled** property in the main CR is already set to **true** and the **spec.version** property specifies **7.7.0**, **7.8.0**, **7.8.1**, or **7.8.2**, the Operator uses that specified version.
- If **spec.upgrades.enabled** is **not** set to **true**, or **spec.version** is set to an AMQ Broker version earlier than **7.7.0**, the Operator uses the **latest** version of AMQ Broker (that is, **7.9.4**).

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 sub-sections.

2.4.1. Environment variables for broker container images

The environment variables included in the **operator.yaml** configuration file for broker container images have the following naming convention:

OpenShift Container Platform

RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_*<AMQ_Broker_version_identifier>*

OpenShift Container Platform on IBM Z

RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_*<AMQ_Broker_version_identifier>*_s390x

OpenShift Container Platform on IBM Power Systems

RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_*<AMQ_Broker_version_identifier>*_ppc64le

Environment variable names for each supported container platform and specific AMQ Broker versions are shown in the table.

Container platform	Environment variable names
OpenShift Container Platform	• **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_781** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_782** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_790**
OpenShift Container Platform on IBM Z	• **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_781_s390x** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_782_s390x** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_790_s390x**
OpenShift Container Platform on IBM Power Systems	• **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_781_ppc64le** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_782_ppc64le** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_790_ppc64le**

The value of each environment variable specifies a broker container image that is available from Red Hat. For example:

```
- name: RELATED_IMAGE_ActiveMQ_Artemis_Broker_Kubernetes_790
  #value: registry.redhat.io/amq7/amq-broker-rhel8:7.9
  value: registry.redhat.io/amq7/amq-broker-
rhel8@sha256:71aef8faa1c661212ef8a7ef450656a250d95b51d33d1ce77f12ece27cdb9442
```

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

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.

2.4.2. Environment variables for Init Container images

The environment variables included in the **operator.yaml** configuration file for Init Container images have the following naming convention:

RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_*<AMQ_Broker_version_identifier>*

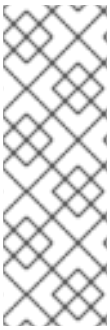
Environment variable names for specific AMQ Broker versions are listed below.

- **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_781**
- **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_782**
- **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_790**

The value of each environment variable specifies an Init Container image that is available from Red Hat. For example:

```
- name: RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_790
  #value: registry.redhat.io/amq7/amq-broker-init-rhel8:0.4-21
  value: registry.redhat.io/amq7/amq-broker-init-
rhel8@sha256:d327d358e6cfccac14becc486bce643e34970ecfc6c4d187a862425867a9ac8a
```

Therefore, based on an AMQ Broker version, the Operator determines the applicable environment variable name. The Operator uses the corresponding image value when starting the Init Container.



NOTE

As shown in the example, 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. Observe that the corresponding container image tag is **not** a floating tag in the form of **0.4-21**. This means that the container image used by the Operator remains fixed. The Operator **does not** automatically pull and use a new *micro* image version (that is, **0.4-21-n**, where *n* is the latest micro version) when it becomes available from Red Hat.

The environment variables included in the **operator.yaml** configuration file for Init Container images have the following naming convention:

OpenShift Container Platform

RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_*<AMQ_Broker_version_identifier>*

OpenShift Container Platform on IBM Z

RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_s390x_*<AMQ_Broker_version_identifier>*

OpenShift Container Platform on IBM Power Systems

RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_ppc64le_*<AMQ_Broker_version_identifier>*

Environment variable names for each supported container platform and specific AMQ Broker versions are shown in the table.

Container platform	Environment variable names

Container platform	Environment variable names
OpenShift Container Platform	• **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_781** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_782** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_790**
OpenShift Container Platform on IBM Z	• **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_s390x_781** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_s390x_782** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_s390x_790**
OpenShift Container Platform on IBM Power Systems	• **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_ppc64le_781** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_ppc64le_782** • **RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_ppc64le_790**

The value of each environment variable specifies an Init Container image that is available from Red Hat. For example:

```
- name: RELATED_IMAGE_ActiveMQ_Artemis_Broker_Init_790
  #value: registry.redhat.io/amq7/amq-broker-init-rhel8:0.4-21-1
  value: registry.redhat.io/amq7/amq-broker-init-
rhel8@sha256:d327d358e6cfccac14becc486bce643e34970ecfc6c4d187a862425867a9ac8a
```

Therefore, based on an AMQ Broker version and your container platform, the Operator determines the applicable environment variable name. The Operator uses the corresponding image value when starting the Init Container.

NOTE

As shown in the example, 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. Observe that the corresponding container image tag is **not** a floating tag in the form of **0.4-21**. This means that the container image used by the Operator remains fixed. The Operator **does not** automatically pull and use a new *micro* image version (that is, **0.4-21-n**, where *n* is the latest micro version) when it becomes available from Red Hat.

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 4.6, "Specifying a custom Init Container image".

2.5. 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 (OpenShift Container Platform 4.5)
- 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 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

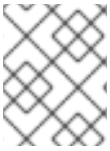
The procedures in the next section show you how to install the Operator and use Custom Resources (CRs) to create broker deployments on OpenShift Container Platform. When you have successfully completed the procedures, you will have the Operator running in an individual Pod. Each broker instance that you create will run as an individual Pod in a StatefulSet in the same project as the Operator. Later, you will 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 2.5, "Operator deployment notes".

3.2. INSTALLING THE OPERATOR USING THE CLI



NOTE

Each Operator release requires that you download the latest **AMQ Broker 7.9.4 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 7.9 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. Getting the Operator code

This procedure shows how to access and prepare the code you need to install the latest version of the Operator for AMQ Broker 7.9.

Procedure

1. In your web browser, navigate to the **Software Downloads** page for AMQ Broker 7.9.4 releases.
2. Ensure that the value of the **Version** drop-down list is set to **7.9.4** and the **Releases** tab is selected.
3. Next to **AMQ Broker 7.9.4 Operator Installation and Example Files** click **Download**. Download of the **amq-broker-operator-7.9.4-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-7.9.4-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-7.9.4-ocp-install-examples.zip
```

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

```
$ cd amq-broker-operator-7.9.4-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. In the **metadata** section, assign a custom name to the service account, or use the default name. The default name is **amq-broker-operator**.

   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. In the **metadata** section, assign a custom name to the role, or use the default name. The default name is **amq-broker-operator**.

    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. 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
subjects:
    kind: ServiceAccount
    name: amq-broker-operator
roleRef:
    kind: Role
    name: amq-broker-operator
```

b. Create the role binding in your project.

```
$ oc create -f deploy/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 7.9 in your OpenShift project.

Prerequisites

- You must have already prepared your OpenShift project for the Operator deployment. See Section 3.2.1, “Getting the Operator code”.
- 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 (OpenShift Container Platform 4.5)

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-7.9.4-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
   ```

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 7.9.4-opr-3 of the Operator, as shown below.

```
spec:
   template:
      spec:
         containers:
            #image: registry.redhat.io/amq7/amq-broker-rhel8-operator:7.9
            image: registry.redhat.io/amq7/amq-broker-rhel8-
operator@sha256:4045170b583f76cdfbe123fd794ed4d175de0c2a76bdb7bf8762b3e35f0eb5b
8
```

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. Determine which namespaces are watched by the Operator by optionally editing the **WATCH_NAMESPACE** section of the **operator.yaml** file.

   - To deploy the Operator to watch the active namespace, do not edit the section:

     ```
     - name: WATCH_NAMESPACE
       valueFrom:
         fieldRef:
           fieldPath: metadata.namespace
     ```

   - To deploy the Operator to watch all namespaces:

     ```
     - name: WATCH_NAMESPACE
       value: '*'
     ```

   - To deploy the Operator to watch multiple namespaces, for example **namespace1** and **namespace2**:

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

   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.

8. 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.

IMPORTANT

Deploying the Operator using OperatorHub requires cluster administrator privileges.

Prerequisites

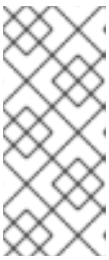
- The **Red Hat Integration - AMQ Broker for RHEL 8 (Multiarch)** Operator must be available in OperatorHub.

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 7.9, the latest minor version tag of this Operator is **7.9.4-opr-3**.

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

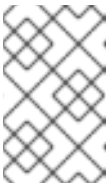
6. On the **Install Operator** page:

   a. Under **Update Channel**, specify the channel used to track and receive updates for the Operator by selecting **7.x** from the following radio buttons:

      - **7.x** - This channel will update to **7.10** when available.
      - **7.8.x** - This is the Long Term Support (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.

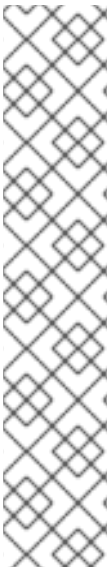
Additional resources

- 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 7.9, 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 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 2.4, “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. This configuration is the default content of the **broker_activemqartemis_cr.yaml** sample CR file.

```
apiVersion: broker.amq.io/v2alpha4
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
spec:
    version: 7.9.4
    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 2.4, "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/v2alpha4
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
```

```
spec:
  version: 7.9.4
  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.

- The value of the **deploymentPlan.size** attribute in your CR overrides any change you make to size of your broker deployment via the **oc scale** command. For example, suppose you use **oc scale** to change the size of a deployment from three brokers to two, but the value of

deploymentPlan.size in your CR is still **3**. In this case, OpenShift initially scales the deployment down to two brokers. However, when the scaledown operation is complete, the Operator restores the deployment to three brokers, as specified in the CR.

- 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 7.9, 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 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.

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

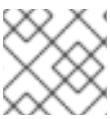
- For an example of using the **applyRule** property in a CR, see Section 4.2.3, "Matching address settings to configured addresses in an Operator-based broker deployment".

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 2.4, "How the Operator chooses container images".
- To learn how to build and specify a custom Init Container image, see Section 4.6, "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 **ActiveMQAretmisAddress** 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 **ActiveMQAretmis** 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 Addresses, Queues, and Topics 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/v2alpha2
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. (Optional) To delete an address and queue previously added to your deployment using a CR instance, use the following command:

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

4.2.3. 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 must be using the latest version of the Operator for AMQ Broker 7.9 (that is, version 7.9.4-opr-3). To learn how to upgrade the Operator to the latest version, see Chapter 6, *Upgrading an Operator-based broker deployment*.
- 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” .
- You should be 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 a 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/v2alpha2
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. Start configuring a Custom Resource (CR) instance for a broker deployment.

a. From a sample CR file:

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

ii. Click the **ActiveMQArtemis** CRD.

iii. Click the **Instances** tab.

iv. 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. This configuration is the default content of the **broker_activemqartemis_cr.yaml** sample CR file.

```
apiVersion: broker.amq.io/v2alpha4
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
spec:
    version: 7.9.4
    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 2.4, "How the Operator chooses container images".

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

```
spec:
    version: 7.9.4
    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:
  version: 7.9.4
  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:
  version: 7.9.4
  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:
  version: 7.9.4
  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 an asterisk 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:
  version: 7.9.4
  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.

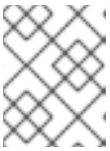
merge_replace

- 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. Deploy the broker CR instance.

    a. Using the OpenShift command-line interface:

        i. Save the CR file.

        ii. Create the CR instance.

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

    b. Using the OpenShift web console:

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

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 Addresses, Queues, and Topics 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.

4.3. CREATING A SECURITY CONFIGURATION FOR AN OPERATOR-BASED BROKER DEPLOYMENT

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

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
- 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

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. Open the sample CR file called **broker_activemqartemissecurity_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 **ActiveMQArtemisSecurity** CRD.

iv. Click the **Instances** tab.

v. Click **Create ActiveMQArtemisSecurity**.
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/v1alpha1
kind: ActiveMQArtemisSecurity
metadata:
  name: ex-prop
spec:
  loginModules:
    propertiesLoginModules:
      - name: "prop-module"
        users:
          - name: "sam"
            password: "samsecret"
            roles:
              - "sender"
          - name: "rob"
            password: "robsecret"
            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"
              ...
```

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/address_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"

4.4. CONFIGURING BROKER STORAGE REQUIREMENTS

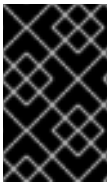
To use persistent storage in an Operator-based broker deployment, you set **persistenceEnabled** to **true** in the Custom Resource (CR) instance used to create the deployment. If you do not have container-native storage in your OpenShift cluster, you need to manually provision Persistent Volumes (PVs) 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. By default, each broker in your deployment requires storage of 2 GiB. However, you can configure the CR for your broker deployment to specify the size of PVC required by each broker.

IMPORTANT

You must add the configuration for broker storage size to the main CR 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.

4.4.1. Configuring broker storage size

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



IMPORTANT

You must add the configuration for broker storage size to the main CR 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.

Prerequisites

- You must be using *at least* the latest version of the Operator for AMQ Broker 7.7 (that is, version 0.17). To learn how to upgrade the Operator to the latest version for AMQ Broker 7.9, see Chapter 6, *Upgrading an Operator-based broker deployment*.
- 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 (OpenShift Container Platform 4.5)

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. This configuration is the default content of the **broker_activemqartemis_cr.yaml** sample CR file.

```
apiVersion: broker.amq.io/v2alpha4
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
spec:
    version: 7.9.4
    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 2.4, "How the Operator chooses container images".

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

```
spec:
    version: 7.9.4
    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. Supports byte notation (for example, K, M, G), or the binary equivalents (Ki, Mi, Gi).

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**.

4.5. 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

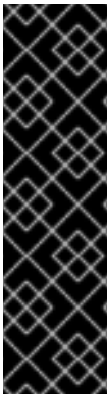
For each broker container running in a Pod, this value is the amount of host-node memory that the container requests. The OpenShift scheduler considers the memory request value during Pod placement, to bind the broker Pod to a node with sufficient compute resources.
The memory request value is the *minimum* 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. This configuration is the default content of the **broker_activemqartemis_cr.yaml** sample CR file.

```
apiVersion: broker.amq.io/v2alpha4
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
spec:
    version: 7.9.4
    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 2.4, "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:
    version: 7.9.4
    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. 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. The **only** items that you can specify in the CR are those that are exposed in the main broker Custom Resource Definition (CRD).

However, there might a case where you need to include configuration that is **not** exposed in the CRD. In this case, in your main CR instance, you can specify a *custom* Init Container. The custom Init Container can modify or add to the configuration that has already been created by the Operator. For example, you might use a custom Init Container to modify the broker logging settings. Or, you might use a custom Init Container to include extra runtime dependencies (that is, **.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@sha256:d327d358e6cfccac14becc486bce643e34970ecfc6c4d187a862425867a9ac8a
```

- 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 be using *at least* version 7.9.4-opr-3 of the Operator. To learn how to upgrade to the latest Operator version, see Chapter 6, *Upgrading an Operator-based broker deployment*.

- 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. 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. This configuration is the default content of the **broker_activemqartemis_cr.yaml** sample CR file.

```
apiVersion: broker.amq.io/v2alpha4
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
spec:
    version: 7.9.4
    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 2.4, “How the Operator chooses container images”.

2. In the **deploymentPlan** section of the CR, add the **initImage** property.

```
apiVersion: broker.amq.io/v2alpha4
kind: ActiveMQArtemis
metadata:
  name: ex-aao
```

```
  application: ex-aao-app
spec:
  version: 7.9.4
  deploymentPlan:
    size: 1
    image: placeholder
    initImage:
    requireLogin: false
    persistenceEnabled: true
    journalType: nio
    messageMigration: true
```

3. Set the value of the **initImage** property to the URL of your custom Init Container image.

```
apiVersion: broker.amq.io/v2alpha4
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
spec:
  version: 7.9.4
  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 you must have added to repository in a container registry.

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**.

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 .

4.7. CONFIGURING OPERATOR-BASED BROKER DEPLOYMENTS FOR CLIENT CONNECTIONS

4.7.1. 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.

Prerequisites

- To configure acceptors, your broker deployment must be based on version 0.9 or greater of the AMQ Broker Operator. For more information about installing the latest version of the Operator, see Section 3.2, “Installing the Operator using the CLI” .

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**

Protocol	Value
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 4.7.2, "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 4.7.2, "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".

4.7.2. 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.

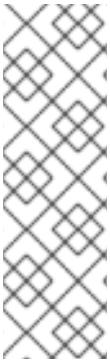
Two-way TLS

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

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.

4.7.2.1. 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,..."
```

4.7.2.2. 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 4.7.2.1, “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:

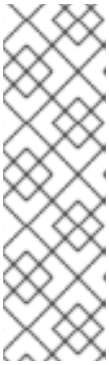
```
$ oc login -u system:admin
```

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=~/broker.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
...
```

4.7.2.3. 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 4.7.2.1, “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
...
```

4.7.3. 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 ports 8161 and 61616 on each broker Pod. Port 8161 is used by the broker management console, and port 61616 is used for broker clustering. You can also use the headless Service to connect to a broker Pod from an internal client (that is, a client inside the same OpenShift cluster as the broker deployment).

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.

Additional resources

- To learn about using the headless Service to connect to a broker Pod from an internal client, see Section 4.7.4.1, “Connecting to the broker from internal clients” .

4.7.4. 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).

4.7.4.1. Connecting to the broker from internal clients

An internal client can connect to the broker Pod using the *headless* Service that is running for the broker deployment.

To connect to a broker Pod using the headless Service, specify an address in the format **<Protocol>://<PodName>.<HeadlessServiceName>.<ProjectName>.svc.cluster.local**. For example:

```
$ tcp://my-broker-deployment-0.my-broker-deployment-hdls-svc.my-openshift-project.svc.cluster.local
```

OpenShift DNS successfully resolves addresses in this format because the StatefulSets created by Operator-based broker deployments provide stable Pod names.

Additional resources

- For more information about the headless Service that runs by a default in a broker deployment, see Section 4.7.3, "Networking Services in your broker deployments" .

4.7.4.2. 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. To see the Routes configured on a given broker Pod, select the Pod in the OpenShift Container Platform web console and click the **Routes** tab.

An external client can connect to the broker by specifying the full host name of the Route created for the 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 for the Route must resolve to the node that's 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 non-secured (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**).

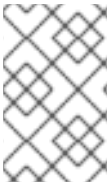
For non-HTTP connections:

- 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 protcols, 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>
```

4.7.4.3. 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-specifc 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>***.

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 (OpenShift Container Platform 4.5)

4.8. 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.

IMPORTANT

For Operator-based broker deployments in AMQ Broker 7.9, large message handling is available only for the AMQP protocol.

4.8.1. 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 4.7.1, "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 2.5, "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.

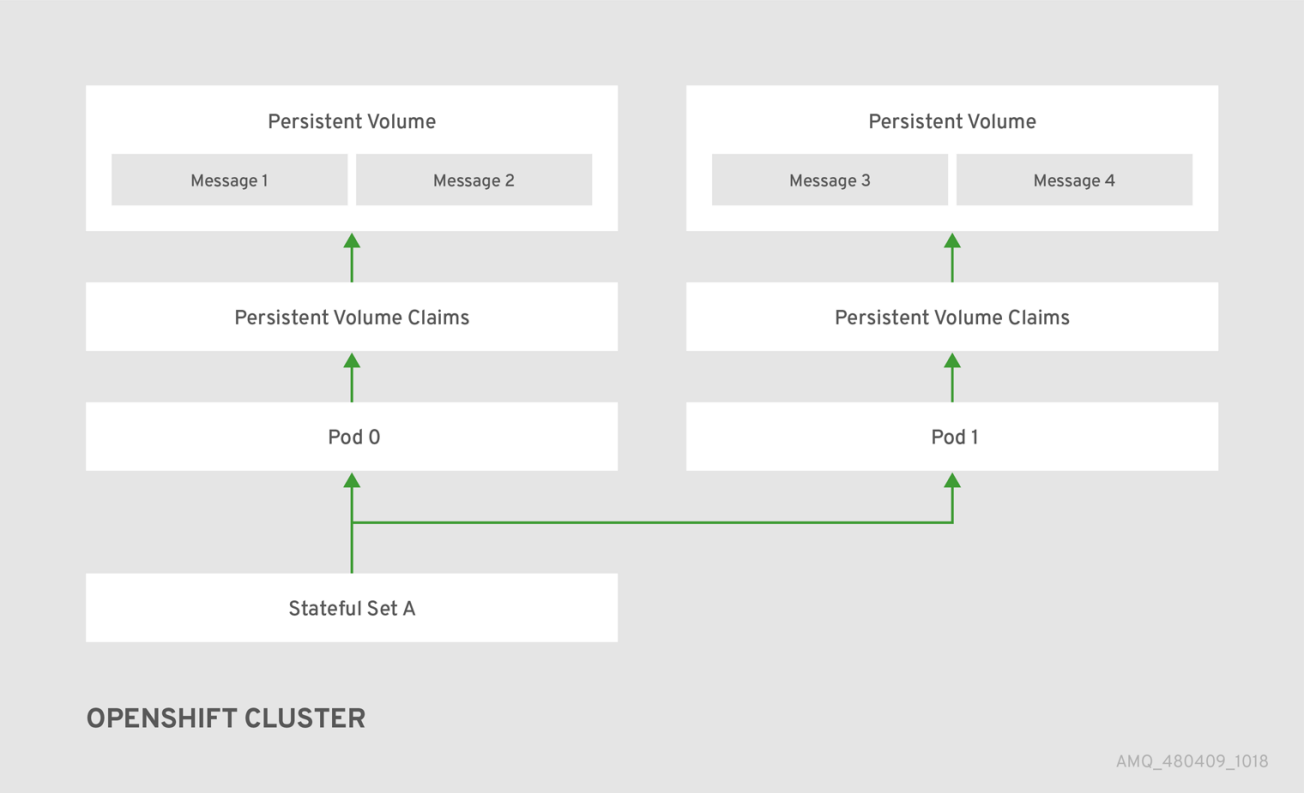
4.9. HIGH AVAILABILITY AND MESSAGE MIGRATION

4.9.1. High availability

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, or shuts down due to intentional scaledown of your deployment.

To allow high availability for AMQ Broker on OpenShift Container Platform, you run multiple broker Pods in a broker cluster. Each broker Pod writes its message data to an available Persistent Volume (PV) that you have claimed for use with a Persistent Volume Claim (PVC). If a broker Pod fails or is shut down, the message data stored in the PV is migrated to another available broker Pod in the broker cluster. The other broker Pod stores the message data in its own PV.

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



When a broker Pod shuts down, the AMQ Broker Operator automatically starts a *scaledown controller* that performs the migration of messages to an another broker Pod that is still running in the broker cluster. This message migration process is also known as *Pod draining*. The section that follows describes message migration.

4.9.2. Message migration

Message migration is how you ensure the integrity of messaging data when a broker in a clustered deployment shuts down due to failure or intentional scaledown of the deployment. Also known as *Pod draining*, this process refers to removal and redistribution of messages from a broker Pod that has shut down.

NOTE

- The scaledown controller that performs message migration can operate only within a single OpenShift project. The controller cannot migrate messages between brokers in separate projects.
- To use message migration, you must have a minimum of two brokers in your deployment. A broker with two or more brokers is clustered by default.

For an Operator-based broker deployment, you enable message migration by setting **messageMigration** to **true** in the main broker Custom Resource for your deployment.

The message migration process follows these steps:

1. When a broker Pod in the deployment shuts down due to failure or intentional scaledown of the deployment, the Operator automatically starts a scaledown controller to prepare for message migration. The scaledown controller runs in the same OpenShift project name as the broker cluster.

2. The scaledown controller registers itself and listens for Kubernetes events that are related to Persistent Volume Claims (PVCs) in the project.

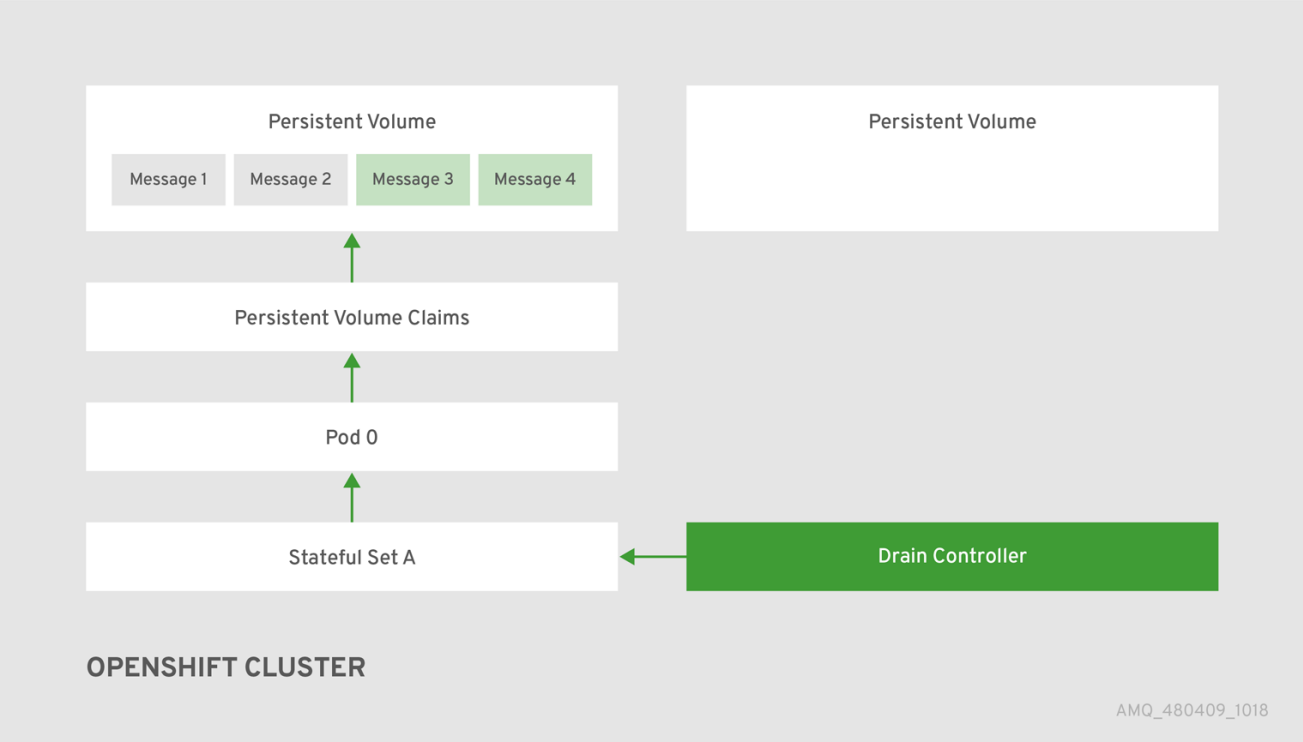
3. To check for Persistent Volumes (PVs) that have been orphaned, the scaledown controller looks at the ordinal on the volume claim. The controller compares the ordinal on the volume claim to that of the broker Pods that are still running in the StatefulSet (that is, the broker cluster) in the project.
   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.

4. The scaledown controller starts a drainer Pod. The drainer Pod runs the broker and executes the message migration. Then, the drainer Pod identifies an alternative broker Pod to which the orphaned messages can be migrated.

NOTE

There must be at least one broker Pod still running in your deployment for message migration to occur.

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 successfully migrated 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 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.

Additional resources

- For an example of message migration when you scale down a broker deployment, see Migrating messages upon scaledown.

4.9.3. Migrating messages upon scaledown

To migrate messages upon scaledown of your broker deployment, use the main broker Custom Resource (CR) to enable message migration. The AMQ Broker Operator automatically runs a dedicated scaledown controller to execute message migration when you scale down a clustered broker deployment.

With message migration enabled, the scaledown controller within the Operator detects shutdown of a broker Pod and starts a drainer Pod to execute message migration. The drainer Pod connects to one of the other live broker Pods in the cluster and migrates messages to that live broker Pod. After migration is complete, the scaledown controller shuts down.

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 the messaging data can be migrated. However, if you scale a deployment down to zero brokers and then back up to only some of the brokers that were in the original deployment, drainer Pods are started for the brokers that remain shut down.

The following example procedure shows the behavior of the scaledown controller.

Prerequisites

- You already have a basic broker deployment. See Section 3.4.1, "Deploying a basic broker instance".
- You should understand how message migration works. For more information, see Section 4.9.2, "Message migration".

Procedure

1. In the **deploy/crs** directory of the Operator repository that you originally downloaded and extracted, open the main broker CR, **broker_activemqartemis_cr.yaml**.
2. In the main broker CR set **messageMigration** and **persistenceEnabled** to **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. 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.
4. Log into each Pod and send some messages to each broker.
   a. Supposing that Pod **ex-aao-ss-0** has a cluster IP address of **172.17.0.6**, run the following command:

      ```
      $ /opt/amq-broker/bin/artemis producer --url tcp://172.17.0.6:61616 --user admin --password admin
      ```

   b. Supposing that Pod **ex-aao-ss-1** has a cluster IP address of **172.17.0.7**, run the following command:

```
$ /opt/amq-broker/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.

5. Scale the cluster down from two brokers to one.

   a. Open the main broker CR, **broker_activemqartemis_cr.yaml**.

   b. In the CR, set **deploymentPlan.size** to **1**.

   c. 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**.

6. 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.

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. To provide access to the console for each broker, you can configure the Custom Resource (CR) instance for the broker deployment to instruct the Operator to automatically create a dedicated Service and Route for each broker Pod.

The following procedures describe how to connect to AMQ Management Console for a deployed broker.

Prerequisites

- You must have 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".
- To instruct the Operator to automatically create a Service and Route for each broker Pod in a deployment for console access, you must set the value of the **console.expose** property to **true** in the Custom Resource (CR) instance used to create the deployment. The default value of this property is **false**. For a complete Custom Resource configuration reference, including configuration of the **console** section of the CR, see Section 8.1, "Custom Resource configuration reference".

5.1. CONNECTING TO AMQ MANAGEMENT CONSOLE

When you set the value of the **console.expose** property to **true** in the Custom Resource (CR) instance used to create a 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

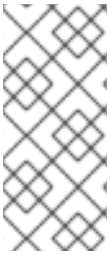
1. In the OpenShift Container Platform web console, click **Networking → Routes**.
   On the **Routes** page, identify the **wconsj** Route for the given broker Pod. For example, **my-broker-deployment-wconsj-0-svc-rte**.
2. Under **Location**, click the link that corresponds to the Route.
   A new tab opens in your web browser.
3. Click the **Management Console** link.
   The AMQ Management Console login page opens.
4. To log in to the console, enter the values specified for the **adminUser** and **adminPassword** properties in the Custom Resource (CR) instance used to create your broker deployment.
   If there are no values explicitly specified for **adminUser** and **adminPassword** in the CR, follow the instructions in Section 5.2, "Accessing AMQ Management Console login credentials" to retrieve the credentials required to log in to the console.

NOTE

Values for **adminUser** and **adminPassword** are required to log in to the 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** the console. 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.

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.

- To upgrade an Operator-based broker deployment running on OpenShift Container Platform 3.11 to run on OpenShift Container Platform 4.5 or later, you must first upgrade your OpenShift Container Platform installation. Then, you must create a new Operator-based broker deployment that matches your existing deployment. To learn how to create a new Operator-based broker deployment, see Chapter 3, *Deploying AMQ Broker on OpenShift Container Platform using the AMQ Broker Operator*.
- 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 6.3.3, “Upgrading the Operator using OperatorHub”
- If you want to deploy the Operator to watch many namespaces, for example to watch all namespaces, you must:
  1. Make sure you have backed up all the CRs relating to broker deployments in your cluster.
  2. Uninstall the existing Operator.
  3. Deploy the 7.9 Operator to watch the namespaces you require.
  4. Check all your deployments and recreate if necessary.

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 7.9.

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 version 7.8.x of the Operator

This procedure shows to how to use the OpenShift command-line interface (CLI) to upgrade version 7.8.x of the Operator to the latest version for AMQ Broker 7.9.

Procedure

1. In your web browser, navigate to the **Software Downloads** page for AMQ Broker 7.9.4 patches.
2. Ensure that the value of the **Version** drop-down list is set to **7.9.4** and the **Patches** tab is selected.
3. Next to **AMQ Broker 7.9.4 Operator Installation and Example Files**, click **Download**. Download of the **amq-broker-operator-7.9.4-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-7.9.4-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-7.9.4-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. If you have made any updates to the **new operator.yaml** file, save the file.

11. Apply the updated Operator configuration.

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

OpenShift updates your project to use the latest Operator version.

12. To recreate your previous broker deployment, create a new CR yaml file to match the purpose of your original CR and apply it. Section 3.4.1, "Deploying a basic broker instance" . describes how to apply the **deploy/crs/broker_activemqartemis_cr.yaml** file in the Operator installation archive, you can use that file as a basis for your new CR yaml file.

6.3. UPGRADING THE OPERATOR USING OPERATORHUB

This section describes how to use OperatorHub to upgrade different versions of the Operator to the latest version available for AMQ Broker 7.9.

6.3.1. Prerequisites

- You should 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.

- 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.

6.3.3. Upgrading the Operator using OperatorHub

This procedure shows how to use OperatorHub to upgrade an instance of the AMQ Broker Operator.

Procedure

1. Log in to the OpenShift Container Platform web console as a cluster administrator.
2. Delete the main Custom Resource (CR) instance for the broker deployment in your project. This action deletes the broker deployment.
    a. In the left navigation menu, click **Administration → Custom Resource Definitions**.
    b. On the **Custom Resource Definitions** page, click the **ActiveMQArtemis** CRD.
    c. Click the **Instances** tab.
    d. Locate the CR instance that corresponds to your project namespace.
    e. For your CR instance, click the **More Options** icon (three vertical dots) on the right-hand side. Select **Delete ActiveMQArtemis**.
3. 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**.
4. Use OperatorHub to install the latest version of the Operator for AMQ Broker 7.9. For more information, see Section 3.3.2, "Deploying the Operator from OperatorHub".
5. To recreate your previous broker deployment, create a new CR yaml file to match the purpose of your original CR and apply it. Section 3.4.1, "Deploying a basic broker instance". describes how to apply the **deploy/crs/broker_activemqartemis_cr.yaml** file in the Operator installation archive, you can use that file as a basis for your new CR yaml file.

6.4. UPGRADING THE BROKER CONTAINER IMAGE BY SPECIFYING AN AMQ BROKER VERSION

The following procedure shows how to upgrade the broker container image for an Operator-based broker deployment by specifying an AMQ Broker version. You might do this, for example, if you upgrade the Operator to the latest version for AMQ Broker 7.9.4 but the **spec.upgrades.enabled** property in your CR is already set to **true** and the **spec.version** property specifies **7.8.0**. To *upgrade* the broker container image, you need to manually specify a new AMQ Broker version (for example, **7.9.4**). When you specify a new version of AMQ Broker, the Operator automatically chooses the broker container image that corresponds to this version.

Prerequisites

- You must be using the latest version of the Operator for 7.9.4. To learn how to upgrade the Operator to the latest version, see:
    - Section 6.2, "Upgrading the Operator using the CLI"

- Section 6.3.3, “Upgrading the Operator using OperatorHub”.

- As described in Section 2.4, “How the Operator chooses container images”, if you deploy a CR and do not explicitly specify a broker container image, the Operator automatically chooses the appropriate container image to use. To use the upgrade process described in this section, you **must** use this default behavior. If you override the default behavior by directly specifying a broker container image in your CR, the Operator **cannot** automatically upgrade the broker container image to correspond to an AMQ Broker version as described below.

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. In a text editor, open the CR file that you used for your broker deployment. For example, this might be the **broker_activemqartemis_cr.yaml** file that was included in the **deploy/crs** directory of the Operator installation archive that you previously downloaded and extracted.

   b. Using the OpenShift Container Platform web console:
      i. Log in to the console as a user that has privileges to edit and 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. Locate the CR instance that corresponds to your project namespace.
      vi. For your CR instance, click the **More Options** icon (three vertical dots) on the right-hand side. Select **Edit ActiveMQArtemis**.
      Within the console, a YAML editor opens, enabling you to edit the CR instance.

2. To specify a version of AMQ Broker to which to upgrade the broker container image, set a value for the **spec.version** property of the CR. For example:

```
spec:
  version: 7.9.4
  ...
```

3. In the **spec** section of the CR, locate the **upgrades** section. If this section is not already included in the CR, add it.

```
spec:
  version: 7.9.4
  ...
  upgrades:
```

4. Ensure that the **upgrades** section includes the **enabled** and **minor** properties.

```
spec:
  version: 7.9.4
  ...
  upgrades:
    enabled:
    minor:
```

5. To enable an upgrade of the broker container image based on a specified version of AMQ Broker, set the value of the **enabled** property to **true**.

```
spec:
  version: 7.9.4
  ...
  upgrades:
    enabled: true
    minor:
```

6. To define the upgrade behavior of the broker, set a value for the **minor** property.

   a. To allow upgrades between **minor** AMQ Broker versions, set the value of **minor** to **true**.

```
spec:
  version: 7.9.0
  ...
  upgrades:
    enabled: true
    minor: true
```

   For example, suppose that the current broker container image corresponds to **7.8.0**, and a new image, corresponding to the **7.9.0** version specified for **spec.version**, is available. In this case, the Operator determines that there is an available upgrade between the **7.8** and **7.9** minor versions. Based on the preceding settings, which allow upgrades between minor versions, the Operator upgrades the broker container image.

   By contrast, suppose that the current broker container image corresponds to **7.9.0**, and you specify a **new** value of **7.9.1** for **spec.version**. If an image corresponding to **7.9.1** exists, the Operator determines that there is an available upgrade between **7.9.0** and **7.9.1** micro versions. Based on the preceding settings, which allow upgrades only between minor versions, the Operator **does not** upgrade the broker container image.

   b. To allow upgrades between **micro** AMQ Broker versions, set the value of **minor** to **false**.

```
spec:
  version: 7.9.0
  ...
  upgrades:
    enabled: true
    minor: false
```

   For example, suppose that the current broker container image corresponds to **7.8.0**, and a new image, corresponding to the **7.9.0** version specified for **spec.version**, is available. In this case, the Operator determines that there is an available upgrade between the **7.8** and

7.9 minor versions. Based on the preceding settings, which do not allow upgrades between minor versions (that is, only between micro versions), the Operator **does not** upgrade the broker container image.

By contrast, suppose that the current broker container image corresponds to **7.9.0**, and you specify a **new** value of **7.9.1** for **spec.version**. If an image corresponding to **7.9.1** exists, the Operator determines that there is an available upgrade between **7.9.0** and **7.9.1** micro versions. Based on the preceding settings, which allow upgrades between micro versions, the Operator upgrades the broker container image.

7. 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 have finished editing the CR, click **Save**.

   When you apply the CR change, the Operator first validates that an upgrade to the AMQ Broker version specified for **spec.version** is available for your existing deployment. If you have 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, and the values specified for **upgrades.enabled** and **upgrades.minor** allow the upgrade, then the Operator upgrades each broker in the deployment to use the broker container image that corresponds 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_791** corresponds to AMQ Broker 7.9.1.

   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 2.4, “How the Operator chooses container images”.

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.

IMPORTANT

Viewing brokers from Fuse Console is a Technology Preview feature only. Technology Preview features are not supported with Red Hat production service level agreements (SLAs) and might not be functionally complete. Red Hat does not recommend using them in production. These features provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process. For more information about the support scope of Red Hat Technology Preview features, see Technology Preview Features Support Scope .

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/v2alpha4
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
spec:
    version: 7.9.4
    deploymentPlan:
        size: 4
        image: registry.redhat.io/amq7/amq-broker-rhel8:7.9
        ...
```

2. In the **deploymentPlan** section, add the **jolokiaAgentEnabled** and **managementRBACEnabled** properties and specify values, as shown below.

```
apiVersion: broker.amq.io/v2alpha4
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
spec:
    version: 7.9.4
    deploymentPlan:
        size: 4
        image: registry.redhat.io/amq7/amq-broker-rhel8:7.9
        ...
        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**.

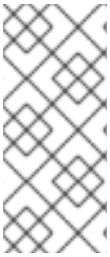
Additional resources

- 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/v2alpha5
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
spec:
    version: 7.9.4
    deploymentPlan:
        size: 4
        image: registry.redhat.io/amq7/amq-broker-rhel8:7.9
        ...
```

2. In the **deploymentPlan** section, add the **enableMetricsPlugin** property and set the value to **true**, as shown below.

```
apiVersion: broker.amq.io/v2alpha5
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
spec:
    version: 7.9.4
    deploymentPlan:
        size: 4
        image: registry.redhat.io/amq7/amq-broker-rhel8:7.9
        ...
        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=%22broker
%22,component=addresses,address=%22TESTQUEUE%22,subcomponent=queues,routing-
type=%22anycast%22,queue=%22TESTQUEUE%22/MaxConsumers
```

{"request":
{"mbean":"org.apache.activemq.artemis:address=\"TESTQUEUE\",broker=\"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 2.4, "How the Operator chooses container images". **Type**: string **Example**: registry.redhat.io/amq7/amq-broker-rhel8@sha256:71aef8faa1c661212ef8a7ef450656a250d95b51d33d1ce77f12ece27cdb9442 **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**: 2

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 2.4, "How the Operator chooses container images". To learn how to specify a *custom* Init Container image, see Section 4.6, "Specifying a custom Init Container image". **Type**: string **Example**: registry.redhat.io/amq7/amq-broker-init-rhel8@sha256:d327d358e6cfccac14becc486bce643e34970ecfc6c4d187a862425867a9ac8a **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 a failure or 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
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
	sslEnabled	Specify whether to use SSL on the management console port. **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 value for **sslSecret**, the console uses a default secret name. The default secret name is in the form of ***<custom_resource_name>*-console-secret**. **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.
	name*	Name of acceptor. **Type**: string **Example**: my-acceptor **Default value**: Not applicable

Entry	Sub-entry	Description and usage
	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/SSL communication. Specify the most secure cipher suite(s) supported by your client application. If you use a comma-separated list to specify a set of cipher suites that is 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, it is recommended that you 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. **Type**: string **Default value**: Not specified
	enabledProtocols	Comma-separated list of protocols to use for TLS/SSL 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 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
	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

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 incoming connections. If the names don't match, connection to the acceptor is rejected. **Type**: string **Example**: some_regular_expression **Default value**: Not specified
	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

Entry	Sub-entry	Description and usage
	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
	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)

Entry	Sub-entry	Description and usage
	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)
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

Entry	Sub-entry	Description and usage
	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/SSL 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
	enabledProtocols	Comma-separated list of protocols to use for TLS/SSL communication. **Type**: string **Example**: TLSv1,TLSv1.1,TLSv1.2 **Default value**: Not specified
	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

Entry	Sub-entry	Description and usage
	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
	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 Entry	Sub-entry	Description and usage
		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.

Entry	Sub-entry	Description and usage
		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, 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

Entry	Sub-entry	Description and usage
	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
	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

Entry	Sub-entry	Description and usage
	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.
	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

Entry	Sub-entry	Description and usage
	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.
	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

Entry	Sub-entry	Description and usage
	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
	redeliveryDelayMultiplier	Multiplying factor to apply to the value of **redeliveryDelay**. **Type**: number **Example**: 5 **Default value**: 1
	redeliveryCollisionAvoidanceFactor	Multiplying factor to apply to the value of **redeliveryDelay** to avoid collisions. **Type**: number **Example**: 1.1 **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)

Entry	Sub-entry	Description and usage
	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
	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

Entry	Sub-entry	Description and usage
	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)
upgrades		
	enabled	When you update the value of **version** to specify a new target version of AMQ Broker, specify whether to allow the Operator to automatically update the **deploymentPlan.image** value to a broker container image that corresponds to that version of AMQ Broker. **Type**: Boolean **Example**: true **Default value**: false
	minor	Specify whether to allow the Operator to automatically update the **deploymentPlan.image** value when you update the value of **version** from one *minor* version of AMQ Broker to another, for example, from **7.8.0** to **7.9.4**. **Type**: Boolean **Example**: true **Default value**: false

Entry	Sub-entry	Description and usage
version		Specify a target *minor* version of AMQ Broker for which you want the Operator to automatically update the CR to use a corresponding broker container image. For example, if you change the value of **version** from **7.6.0** to **7.7.0** (and **upgrades.enabled** and **upgrades.minor** are both set to **true**), then the Operator updates **deploymentPlan.image** to a broker image of the form **registry.redhat.io/amq7/amq-broker-rhel8:7.8-x**. **Type**: string **Example**: 7.7.0 **Default value**: Current version of AMQ Broker

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

Entry	Description and usage
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

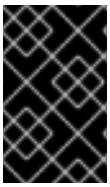
A CR instance based on the security CRD enables you to define the security configuration for the brokers in your deployment, including:

- 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
	users.password*	password of user. **Type**: string **Example**: password **Default value**: Not applicable

Entry	Sub-entry	Description and usage
	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
	moduleType	Type of KeycloakLoginModule (directAccess or bearerToken) **Type**: string **Example**: bearerToken **Default value**: Not applicable

Entry	Sub-entry	Description and usage
	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.
	configuration.publicClient	Specify whether it is public client. **Type**: Boolean **Default value**: false **Example**: false

Entry	Sub-entry	Description and usage
	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.
	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.

Entry	Sub-entry	Description and usage
	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
	configuration.trustStore*	Path of a trust store This is REQUIRED unless ssl-required is none or disable-trust-manager is true.

Entry	Sub-entry	Description and usage
	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. APPLICATION TEMPLATE PARAMETERS

Configuration of the AMQ Broker on OpenShift Container Platform image is performed by specifying values of application template parameters. You can configure the following parameters:

Table 8.1. Application template parameters

Parameter	Description
AMQ_ADDRESSES	Specifies the addresses available by default on the broker on its startup, in a comma-separated list.
AMQ_ANYCAST_PREFIX	Specifies the anycast prefix applied to the multiplexed protocol ports 61616 and 61617.
AMQ_CLUSTERED	Enables clustering.

Parameter	Description
AMQ_CLUSTER_PASSWORD	Specifies the password to use for clustering. The AMQ Broker application templates use the value of this parameter stored in the secret named in AMQ_CREDENTIAL_SECRET.
AMQ_CLUSTER_USER	Specifies the cluster user to use for clustering. The AMQ Broker application templates use the value of this parameter stored in the secret named in AMQ_CREDENTIAL_SECRET.
AMQ_CREDENTIAL_SECRET	Specifies the secret in which sensitive credentials such as broker user name/password, cluster user name/password, and truststore and keystore passwords are stored.
AMQ_DATA_DIR	Specifies the directory for the data. Used in StatefulSets.
AMQ_DATA_DIR_LOGGING	Specifies the directory for the data directory logging.
AMQ_EXTRA_ARGS	Specifies additional arguments to pass to **artemis create**.
GLOBAL_MAX_SIZE	Specifies the maximum amount of memory that message data can consume. If no value is specified, half of the system's memory is allocated.
AMQ_KEYSTORE	Specifies the SSL keystore file name. If no value is specified, a random password is generated but SSL will not be configured.
AMQ_KEYSTORE_PASSWORD	(Optional) Specifies the password used to decrypt the SSL keystore. The AMQ Broker application templates use the value of this parameter stored in the secret named in AMQ_CREDENTIAL_SECRET.
AMQ_KEYSTORE_TRUSTSTORE_DIR	Specifies the directory where the secrets are mounted. The default value is **/etc/amq-secret-volume**.
AMQ_MAX_CONNECTIONS	For SSL only, specifies the maximum number of connections that an acceptor will accept.
AMQ_MULTICAST_PREFIX	Specifies the multicast prefix applied to the multiplexed protocol ports 61616 and 61617.
AMQ_NAME	Specifies the name of the broker instance. The default value is **amq-broker**.

Parameter	Description
AMQ_PASSWORD	Specifies the password used for authentication to the broker. The AMQ Broker application templates use the value of this parameter stored in the secret named in AMQ_CREDENTIAL_SECRET.
AMQ_PROTOCOL	Specifies the messaging protocols used by the broker in a comma-separated list. Available options are **amqp**, **mqtt**, **openwire**, **stomp**, and **hornetq**. If none are specified, all protocols are available. Note that for integration of the image with Red Hat JBoss Enterprise Application Platform, the OpenWire protocol must be specified, while other protocols can be optionally specified as well.
AMQ_QUEUES	Specifies the queues available by default on the broker on its startup, in a comma-separated list.
AMQ_REQUIRE_LOGIN	If set to **true**, login is required. If not specified, or set to **false**, anonymous access is permitted. By default, the value of this parameter is not specified.
AMQ_ROLE	Specifies the name for the role created. The default value is **amq**.
AMQ_TRUSTSTORE	Specifies the SSL truststore file name. If no value is specified, a random password is generated but SSL will not be configured.
AMQ_TRUSTSTORE_PASSWORD	(Optional) Specifies the password used to decrypt the SSL truststore. The AMQ Broker application templates use the value of this parameter stored in the secret named in AMQ_CREDENTIAL_SECRET.
AMQ_USER	Specifies the user name used for authentication to the broker. The AMQ Broker application templates use the value of this parameter stored in the secret named in AMQ_CREDENTIAL_SECRET.
APPLICATION_NAME	Specifies the name of the application used internally within OpenShift. It is used in names of services, pods, and other objects within the application.
IMAGE	Specifies the image. Used in the **persistence**, **persistent-ssl**, and **statefulset-clustered** templates.

Parameter	Description
IMAGE_STREAM_NAMESPACE	Specifies the image stream name space. Used in the **ssl** and **basic** templates.
OPENSHIFT_DNS_PING_SERVICE_PORT	Specifies the port number for the OpenShift DNS ping service.
PING_SVC_NAME	Specifies the name of the OpenShift DNS ping service. The default value is **$APPLICATION_NAME-ping** if you have specified a value for **APPLICATION_NAME**. Otherwise, the default value is **ping**. If you specify a custom value for **PING_SVC_NAME**, this value overrides the default value. If you want to use templates to deploy multiple broker clusters in the same OpenShift project namespace, you must ensure that **PING_SVC_NAME** has a unique value for each deployment.
VOLUME_CAPACITY	Specifies the size of the persistent storage for database volumes.

NOTE

If you use **broker.xml** for a custom configuration, any values specified in that file for the following parameters will override values specified for the same parameters in the your application templates.

- AMQ_NAME
- AMQ_ROLE
- AMQ_CLUSTER_USER
- AMQ_CLUSTER_PASSWORD

8.3. 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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