Red Hat AMQ 7.5

Deploying AMQ Broker on OpenShift

For Use with AMQ Broker 7.5

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Legal Notice

Abstract

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

Table of Contents

CHAPTER 1. INTRODUCTION

Red Hat AMQ Broker 7.5 is available as a containerized image that is provided for use with OpenShift Container Platform (OCP) 3.11 and later.

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.

AMQ Broker on OCP provides similar functionality to Red Hat AMQ Broker, but some aspects of the functionality need to be configured specifically for use with OpenShift Container Platform.

1.1. VERSION COMPATIBILITY AND SUPPORT

For details about OpenShift Container Platform 4.1 image version compatibility, see the OpenShift and Atomic Platform Tested Integrations page.

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.

CHAPTER 2. DEPLOYING AMQ BROKER ON OPENSHIFT CONTAINER PLATFORM USING AN OPERATOR

2.1. OVERVIEW OF THE AMQ BROKER OPERATOR

Kubernetes - and, by extension, OpenShift Container Platform - includes features such as secret handling, load balancing, service discovery, and autoscaling that enable you to build complex distributed systems. Operators are programs that enable you to package, deploy, and manage Kubernetes 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 use Kubernetes extension mechanisms called *Custom Resource Definitions* and corresponding *Custom Resources* to ensure that your custom objects look and act just like native, built-in Kubernetes objects. Custom Resource Definitions and Custom Resources are how you specify the configuration of the OpenShift objects that you plan to deploy.

Previously, you could use only application templates to deploy AMQ Broker on OpenShift Container Platform. While templates are effective for creating an initial deployment, they do not provide a mechanism for updating the deployment. Operators enable you to make changes while your broker instances are running, because they are always listening for changes to your Custom Resources, where you specify your configuration. When you make changes to a Custom Resource, the Operator reconciles the changes with the existing broker installation in your project, and makes it reflect the changes you have made.

2.2. OVERVIEW OF 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. An accompanying Custom Resource (CR) file enables you to 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. The Operator also interacts with Kubernetes via the **kubectl** command using HTTP requests.

The main broker CRD is the **broker_v2alpha1_activemqartemis** file in the **deploy/crds** directory of the archive that you download and extract when installing the Operator. This CRD enables you to configure a broker deployment in a given OpenShift project. The other CRDs in the **deploy/crds** directory are for configuring addresses and for the Operator to use when instantiating a scaledown controller .

When deployed, each CRD is a separate controller, running independently within the Operator.

For a complete configuration reference for each CRD see:

- Broker CRD configuration reference

- Addressing CRD configuration reference

2.2.1. Sample broker Custom Resources

The AMQ Broker Operator archive that you download and extract during installation includes sample 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.

basic-deployment.yaml
: Basic broker deployment.

persistence-deployment.yaml
: Broker deployment with persistent storage.

cluster-deployment.yaml
: Deployment of clustered brokers.

persistence-cluster-deployment.yaml
: Deployment of clustered brokers with persistent storage.

ssl-deployment.yaml
: Broker deployment with SSL security.

ssl-persistence-deployment.yaml
: Broker deployment with SSL security and persistent storage.

address-queue-create.yaml
: Address and queue creation.

aio-journal.yaml
: Use of asynchronous I/O (AIO) with the broker journal.

The procedures in the following sections show you how to use an Operator, CRD, and some CRs to create some container-based 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 in a separate StatefulSet containing a Pod in the project. You will use a dedicated CR to define addresses in your broker deployments.

NOTE

You cannot create more than one broker deployment in a given OpenShift project by deploying multiple broker CR instances. However, when you have created a broker deployment in a project, you **can** deploy multiple CR instances for addresses.

2.3. INSTALLING THE AMQ BROKER OPERATOR

The procedures in this section show you how to install and deploy the AMQ Broker Operator on OpenShift Container Platform. In subsequent procedures, you use this Operator to deploy some broker instances.

NOTE

Deploying the Custom Resource Definitions (CRDs) that accompany the AMQ Broker Operator requires administrator privileges for your OpenShift cluster. When the Operator is deployed, a regular user can deploy broker instances via the provided Custom Resources (CRs).

2.3.1. Getting the Operator code

This procedure shows you how to access and prepare the code you need to install the AMQ Broker Operator.

Procedure

1. In your web browser, navigate to the AMQ Broker 7.5.0 Software Downloads page.

2. Click **Download** next to the Operator archive file that you want to install. Choose an archive file based on the information in the following table.

Platform	Download title	Compressed archive file name
OpenShift Container Platform	AMQ Broker 7.5 Operator Installation Files	amq-broker-operator-7.5.0-ocp-install-examples.zip
OpenShift Container Platform on IBM Z	AMQ Broker 7.5 Operator Installation Files for IBM zSeries	amq-broker-operator-7.5.0-Z-ocp-install-examples.zip

3. When the download is complete, move the archive to your chosen installation directory.
   This example moves the OpenShift Container Platform Operator archive to a directory called **~/broker/operator**.

```
mkdir ~/broker/operator
mv amq-broker-operator-7.5.0-ocp-install-examples.zip ~/broker/operator
```

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

```
cd ~/broker/operator
unzip amq-broker-operator-7.5.0-ocp-install-examples.zip
```

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

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

6. Create or log in to the project in which you want to install the Operator.

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

   or

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

7. 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. Set the **kind** element to **ServiceAccount**.

    c. In the **metadata** section, assign a name to the service account. The default name is **amq-broker-operator**.

8. 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. Set the **kind** element to **Role**.

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

9. 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.
Open the **role_binding.yaml** file. Add lines that look like the following:

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

2.3.2. Deploying the Operator

The procedure in this section shows you how to deploy the AMQ Broker Operator in your OpenShift project.

Prerequisites

- Starting in AMQ Broker 7.3, you use a new version of the Red Hat Container Registry 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 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 persistent volumes 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 in OpenShift Container Platform, see Understanding persistent storage in the OpenShift Container Platform documentation.

Procedure

1. In the OpenShift Container Platform web console, open the project you created, or the existing project in which you want your broker deployment.
   If you created a new project, it is currently empty. You see that there are no deployments, StatefulSets, Pods, Services, or Routes.

2. Prepare the project to receive the operator.

   a. Create the service account.

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

   b. Create the role.

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

   c. Create the role binding.

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

   d. Deploy the broker CRD to the OpenShift cluster.

   ```
   $ oc create -f deploy/crds/broker_v2alpha1_activemqartemis_crd.yaml
   ```

   NOTE

   You must install the CRDs before deploying and starting the Operator. If not, the Operator logs will show messages instructing you to do so.

   e. Deploy the addressing CRD.

   ```
   $ oc create -f deploy/crds/broker_v2alpha1_activemqartemisaddress_crd.yaml
   ```

   f. Deploy the scaledown CRD.

   ```
   $ oc create -f deploy/crds/broker_v2alpha1_activemqartemisscaledown_crd.yaml
   ```

3. Link the pull secret associated with the account used for authentication in the Red Hat Container Registry 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>
   ```

NOTE

In OpenShift Container Platform 4.1, you can also use the web console to associate a pull secret with a project in which you want to deploy container images such as the AMQ Broker Operator. To do this, click **Administration → Service Accounts**. Specify the pull secret associated with the account that you use for authentication in the Red Hat Container Registry.

4. In the **deploy** directory of the Operator archive that you downloaded and extracted, open the **operator.yaml** file. Update **spec.containers.image** with the full path to the latest Operator image for AMQ Broker 7.5 in the Red Hat Container Registry.
   Specify the Operator image name for your platform, based on the information in the following table.

Platform	Repository name	Latest version tag
OpenShift Container Platform	amq7/amq-broker-rhel7-operator	0.9
OpenShift Container Platform on IBM Z	amq7/amq-broker-rhel8-operator	0.10

   For example, to deploy the Operator for OpenShift Container Platform, specify the latest version tag for the Operator container image in the **amq7/amq-broker-rhel7-operator** repository, as shown below.

```
spec:
  template:
    spec:
      containers:
        image: registry.redhat.io/amq7/amq-broker-rhel7-operator:0.9
```

5. Deploy the Operator.

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

   In your OpenShift project, the **amq-broker-operator** image that you deployed starts in a new Pod.

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

   In addition, if you click the **Logs** tab within the Pod, the output includes line like 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.

2.4. DEPLOYING A BASIC BROKER

The following procedures show you how to deploy a basic broker instance in your OpenShift project when you have installed the AMQ Broker Operator.

NOTE

You cannot create more than one broker deployment in a given OpenShift project by deploying multiple broker CR instances. However, when you have created a broker deployment in a project, you **can** deploy multiple CR instances for addresses.

Prerequisites

- Starting in AMQ Broker 7.3, you use a new version of the Red Hat Container Registry 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 .

- The Broker Operator is already installed. See Installing the Broker Operator.

Procedure

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

1. In the **deploy/crs** directory of the Operator archive that you downloaded and extracted, open the **broker_v2alpha1_activemqartemis_cr.yaml** file. This file is an instance of a basic broker Custom Resource.
For the broker Operator for OpenShift Container Platform, the default contents of the file look as follows:

```
apiVersion: broker.amq.io/v2alpha1
kind: ActiveMQArtemis
metadata:
  name: ex-aao
  application: ex-aao-app
  namespace: aao-demo-0
  labels:
    ActiveMQArtemis: ex-aao
    application: ex-aao-app
...
spec:
    deploymentPlan:
        size: 2
        image: registry.redhat.io/amq7/amq-broker:7.5
```

size

Specifies the number of brokers to deploy. For a clustered deployment, this value is **2** or greater. However, for a basic broker instance, change the value to **1**.

image

Specifies the container image to use to launch the broker. Default values for the **image** attribute are shown in the following table.

Platform	Image
OpenShift Container Platform	registry.redhat.io/amq7/amq-broker:7.5
OpenShift Container Platform on IBM Z	registry.redhat.io/amq7/amq-broker-openj9-11-rhel8:7.5

2. Deploy a basic broker, based on the **broker_v2alpha1_activemqartemis** CR.

```
$ oc create -f deploy/crs/broker_v2alpha1_activemqartemis_cr.yaml
```

In the OpenShift Container Platform web console, click **Workloads → Stateful Sets** (OpenShift Container Platform 4.1) or **Applications → Stateful Sets** (OpenShift Container Platform 3.11). You see a new Stateful Set called **ex-aao-ss**.

Expand the **ex-aao-ss Stateful Set** section. You see that there is one Pod, corresponding to the single broker that you defined in the Custom Resource.

On the **Events** tab of the running Pod, you see that the broker has started.

NOTE

To delete a broker deployment, delete the Custom Resource instance that you created for the deployment. It is not sufficient to delete only the Stateful Set.

Additional resources

- To learn how to connect a running broker to the AMQ Broker management console, see Connecting a broker to the AMQ Broker management console .

2.5. APPLYING CUSTOM RESOURCE CHANGES TO RUNNING BROKER DEPLOYMENTS

The following are some 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.

- If the **image** attribute in your CR uses a floating tag such as **7.5**, then your deployment automatically pulls new image versions as they become available in the Red Hat Container Registry, provided that the **imagePullPolicy** attribute in your deployment configuration or Stateful Set is set to **Always**. For example, if your deployment currently uses a broker image version, **7.5-2**, and a newer broker image version, **7.5-3**, becomes available, then your deployment automatically pulls and uses the new image version. To use the new image, each broker in the deployment scales down and then back up. If you have multiple brokers in your deployment, each broker scales down and back up, in sequence.

- 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.

- 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 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 Custom Resource 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 scale down and then back up. If you have multiple brokers in your deployment, only one broker scales down at a time.

2.6. CONFIGURING OPERATOR-BASED BROKER DEPLOYMENTS FOR CLIENT CONNECTIONS

2.6.1. Configuring brokers to accept client connections

2.6.1.1. Configuring acceptors

To enable client connections to a broker in your OpenShift deployment, you define *acceptors* on the broker Pod. Acceptors define how the broker accepts connections.

You define acceptors in the Custom Resource (CR) used for your broker deployment. A single acceptor can accept multiple client connections, up to a maximum limit specified by the **connectionsAllowed** parameter of your acceptor configuration . You can define acceptors for both internal clients (that is, client applications in the same OpenShift cluster as the broker) and external clients (applications outside OpenShift). For each acceptor that you define, a dedicated Service and Route is created in the broker Pod.

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 be exposed to use these protocols.

If you do not define any acceptors in your CR, then your broker Pods use a minimum configuration of a single acceptor, created by default, on port 61616. This default acceptor has only the Core protocol specified. The reason that all broker use this minimum acceptor configuration is that clustering requires the configuration, and clustering is enabled by default.

In addition, port 8161 is automatically exposed on the broker Pod for use by the AMQ Broker management console. Within the OpenShift network, this console port can be accessed via the *headless* service that runs in your broker deployment.

You can also specify whether to enable SSL on the acceptor, using the **sslEnabled** parameter. If the acceptor uses SSL, you can specify information such as:

- The secret name used to store SSL credentials (required).
- The cipher suites and and protocols to use for SSL communication.
- Whether the acceptor uses two-way SSL, that is, mutual authentication between the broker and the client.

NOTE

If the acceptor that you define uses SSL, then the SSL credentials used by the acceptor must be stored in a secret. You must create your own secret and specify this secret name in the **sslSecret** parameter of your acceptor configuration. If you do not specify a custom secret name in the **sslSecret** parameter, the acceptor assumes a default secret name. The default secret name uses the format **<Custom Resource name>-<acceptor-name>-secret**. For example, **ex-aao-amqp-secret**. The SSL credentials required in the secret are **broker.ks**, which must be a base64-encoded keystore, **client.ts**, which must be a base64-encoded truststore, and **keyStorePassword** and **trustStorePassword**, which are passwords specified in raw text. This requirement is the same for any connectors that you configure. For information about generating credentials for SSL connections, see Generating credentials for SSL connections.

To connect to the broker from outside OpenShift via a NodePort, use a URI formatted like **protocol://any.ocp.node.ip:ProtocolPortNumber**. If you have configured a Route, you need to specify the Route name. The Route name must resolve to the node that's hosting the OpenShift router. The OpenShift router uses the specified hostname to determine where to send the traffic inside the OpenShift internal network.

IMPORTANT

To configure acceptors, your Operator-based broker deployment must specify a broker container image for AMQ Broker 7.5 or later. For an example of specifying a broker container image in your deployment, see Deploying a basic broker.

NOTE

The preceding information applies **only** to broker deployments based on the AMQ Broker Operator. If you have used application templates to create your broker deployment instead, you cannot create individual acceptors to directly connect external clients to the protocol-specific ports that OpenShift exposes on the broker Pod. For more information, see Connecting external clients to templates-based broker deployments .

Additional resources

- For a complete configuration reference for the main broker Custom Resource Definition (CRD), including configuration of acceptors, see Custom Resource Definition configuration reference.
- For information about generating credentials for SSL connections, see Generating credentials for SSL connections.

2.6.1.2. Generating credentials for SSL connections

For SSL connections, AMQ Broker requires a broker keystore, a client keystore, and a client truststore that includes the broker keystore. This procedure shows you how to generate the credentials. The procedure uses Java Keytool, a package included with the Java Development Kit.

Procedure

1. Generate a self-signed certificate for the broker keystore.

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

2. Export the certificate, so that it can be shared with clients.

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

3. Generate a self-signed certificate for the client keystore.

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

4. Create a client truststore that imports the broker certificate.

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

5. Use the broker keystore file to create a secret to store the SSL credentials, as shown in the example below.

```
$ oc secrets new ex-aao-amqp-secret broker.ks client.ts
```

6. Add the secret to the service account that you created when installing the Operator, as shown in the example below.

```
$ oc secrets add sa/amq-broker-operator secret/ex-aao-amqp-secret
```

2.6.1.3. 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, **ex-aao-hdls-svc**. The default name of the ping service uses a format of **<Custom Resource name>-ping-svc**, for example, **ex-aao-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.

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

2.6.2. Connecting a broker to the AMQ Broker management console

The broker hosts its own management console at port 8161. Each broker Pod in your deployment has a Service and Route that provide access to the console.

The following procedure shows how to connect to the AMQ Broker management console for a running broker instance.

Prerequisites

- You have deployed a basic broker using the AMQ Broker Operator. For more information, see Deploying a basic broker.

2.6.2.1. Accessing the broker management console

Each broker Pod in your deployment has a service that provides access to the console. The default name of this service uses the format **<Custom Resource name>-wconsj-<broker Pod ordinal>-svc**. For example, for broker Pod **0** of your deployment, the service name is **ex-aao-wconsj-0-svc**. Each Service has a corresponding Route that uses the format `**<Custom Resource name>-wconsj-<broker Pod ordinal>-svc-rte**. For example, **ex-aao-wconsj-0-svc-rte**.

This procedure shows you how to access the AMQ Broker management console for a running broker instance.

Procedure

1. In the OpenShift Container Platform web console, click **Networking → Routes** (OpenShift Container Platform 4.1) or **Applications → Routes** (OpenShift Container Platform 3.11). On the **Routes** pane, you see a Route corresponding to the **wconsj** Service.
2. Under **Hostname**, note the complete URL. You need to specify this URL to access the console.
3. In a web browser, enter the host name URL.
    a. 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.
    b. 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.
4. To log in to the management console, enter the user name and password specified in the **adminUser** and **adminPassword** parameters of your broker deployment Custom Resource. If there are no values specified for **adminUser** and **adminPassword**, follow the instructions in Accessing management console login credentials to retrieve the credentials required to log in to the console.

2.6.2.2. Accessing management console login credentials

If you did not specify a value for **adminUser** and **adminPassword** in your broker Custom Resource (CR), the Operator automatically generates the broker user name and password (required to log in to the AMQ Broker management console) and stores these credentials in a secret. The default secret name has a format of **<Custom Resource name>-credentials-secret**, for example, **ex-aao-credentials-secret**.

This procedure shows you how to access the login credentials required to log in to the management console.

Procedure

1. See the complete list of secrets in your OpenShift project.
    a. From the OpenShift Container Platform web console, click **Workload → Secrets** (OpenShift Container Platform 4.1) or **Resources → Secrets** (OpenShift Container Platform 3.11).

b. From the command line:

```
$ oc get secrets
```

2. Open the appropriate secret to reveal the console login credentials.

   a. From the OpenShift Container Platform web console, click the secret that includes your broker Custom Resource instance in its name. To see the encrypted user name and password values, click the **YAML** tab (OpenShift Container Platform 4.1) or **Actions → Edit YAML** (OpenShift Container Platform 3.11).

   b. From the command line:

   ```
   $ oc edit secret <my_custom_resource_name-credentials-secret>
   ```

2.7. BROKER DEPLOYMENT EXAMPLES

2.7.1. 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 is already deployed. See Deploying a basic broker .

Procedure

1. In the **deploy/crs** directory of the Operator archive that you downloaded and extracted, open the **broker_v2alpha1_activemqartemis_cr.yaml** Custom Resource file.

2. For a minimally-sized clustered deployment, ensure that the value of **deploymentPlan.size** is **2**.

3. At the command line, apply the change:

   ```
   $ oc apply -f deploy/crs/broker_v2alpha1_activemqartemis_cr.yaml
   ```

   In the OpenShift Container Platform web console, a second Pod starts in your project, for the additional broker that you specified in your CR. By default, the two brokers running in your project are clustered.

4. 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
   ```

2.7.2. Creating queues in a broker cluster

The following procedure shows you how to use a Custom Resource Definition (CRD) and example Custom Resource (CR) to add and remove a queue from a broker cluster deployed using an Operator.

Prerequisites

- You have already deployed a broker cluster. See Deploying clustered brokers.

Procedure

1. Deploy the addressing CRD.

```
$ oc create -f deploy/crds/broker_v2alpha1_activemqartemisaddress_crd.yaml
```

2. An example CR file, **broker_v2alpha1_activemqartemisaddress_cr.yaml**, was included in the Operator archive that you downloaded and extracted. The example Custom Resource includes the following:

```
spec:
  # Add fields here
  spec:
    addressName: myAddress0
    queueName: myQueue0
    routingType: anycast
```

With your broker cluster already already deployed and running via the Operator, use the example Custom Resource to create an address on every running broker in your cluster.

```
$ oc create -f deploy/crs/broker_v2alpha1_activemqartemisaddress_cr.yaml
```

Deploying the example CR creates an address **myAddress0** with a queue named **myQueue0** that has an **anycast** routing type. This address is created on every running broker.

NOTE

To create multiple addresses and/or queues in your broker cluster, you need to create separate CR files and deploy them individually, specifying new address and/or queue names in each case.

NOTE

If you add brokers to your cluster after deploying the addressing CR, the new brokers will not have the address you previously created. In this case, you need to delete the addresses and redeploy the addressing CR.

3. To delete queues created from the example CR, use the following command:

```
$ oc delete -f deploy/crs/broker_v2alpha1_activemqartemisaddress_cr.yaml
```

2.8. MIGRATING MESSAGES UPON SCALEDOWN

To migrate messages upon scaledown of your broker deployment, use the main broker Custom Resource Definition (CRD) to enable message migration. The AMQ Broker Operator 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 over 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.

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 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 Deploying a basic broker.
- You should understand how message migration works. For more information, see 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_v2alpha1_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 migrate 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_v2alpha1_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_v2alpha1_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.

2.9. MANAGING THE BROKER OPERATOR USING THE OPERATOR LIFECYCLE MANAGER

2.9.1. Overview of the Operator Lifecycle Manager

In OpenShift Container Platform 4.0 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 4.0, 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. 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 install the AMQ Broker Operator in OperatorHub, you can use the graphical interface to create various broker deployments, such as standalone and clustered brokers.

2.9.2. Installing the AMQ Broker Operator in OperatorHub

If you do not see the AMQ Broker Operator automatically available for use in OperatorHub, follow these instructions to manually install the Operator.

Procedure

1. In your web browser, navigate to the AMQ Broker **Software Downloads** page.
2. In the **Version** drop-down box, ensure the value is set to the latest Broker version, **7.5.0**.
3. Next to **AMQ Broker 7.5 Operator Installation Files**, click **Download**.
   Download of the **amq-broker-operator-7.5.0-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**.

   ```
   sudo mv amq-broker-operator-7.5.0-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-7.5.0-ocp-install-examples.zip
   ```

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

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

7. Deploy the AMQ Broker Operator source bundle from the **deploy** directory of the Operator archive that you downloaded and extracted.

   ```
   $ oc create -f deploy/catalog_resources/courier/amq-broker-operatorsource.yaml
   ```

   After a few minutes, the AMQ Broker Operator is available in the **OperatorHub** section of the OpenShift Container Platform web console. You can then use the OperatorHub graphical interface to create various types of broker deployments.

CHAPTER 3. DEPLOYING AMQ BROKER ON OPENSHIFT CONTAINER PLATFORM USING APPLICATION TEMPLATES

The procedures in this section show:

- How to install the AMQ Broker image streams and application templates
- How to prepare a templates-based broker deployment
- An example of using the OpenShift Container Platform web console to deploy a basic broker instance using an application template. For examples of deploying other broker configurations using templates, see Templates-based broker deployment examples.

3.1. INSTALLING THE IMAGE STREAMS AND APPLICATION TEMPLATES

The AMQ Broker on OpenShift Container Platform image streams and application templates are not available in OpenShift Container Platform by default. You must manually install them using the procedure in this section. When you have completed the manual installation, you can then instantiate a template that enables you to deploy a chosen broker configuration on your OpenShift cluster. For examples of creating various broker configurations in this way, see Deploying AMQ Broker on OpenShift Container Platform and Tutorials.

Procedure

1. At the command line, log in to OpenShift as a cluster administrator (or as a user that has namespace-specific administrator access for the global **openshift** project namespace), for example:

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

   Using the **openshift** project makes the image stream and application templates that you install later in this procedure globally available to all projects in your OpenShift cluster. If you want to explicitly specify that image streams and application templates are imported to the **openshift** project, you can also add **-n openshift** as an optional parameter with the **oc replace** commands that you use later in the procedure.

   As an alternative to using the **openshift** project (e.g., if a cluster administrator is unavailable), you can log in to a specific OpenShift project to which you have administrator access and in which you want to create a broker deployment, for example:

   ```
   $ oc login -u <USERNAME>
   $ oc project <PROJECT_NAME>
   ```

   Logging into a specific project makes the image stream and templates that you install later in this procedure available only in that project’s namespace.

NOTE

AMQ Broker on OpenShift Container Platform uses StatefulSet resources with all ***-persistence*.yaml** templates. For templates that are not ***-persistence*.yaml**, AMQ Broker uses Deployments resources. Both types of resources are Kubernetes-native resources that can consume image streams **only** from the same project namespace in which the template will be instantiated.

2. At the command line, run the following commands to import the broker image streams to your project namespace. Using the **--force** option with the **oc replace** command updates the resources, or creates them if they don't already exist.

```
$ oc replace --force  -f \
https://raw.githubusercontent.com/jboss-container-images/jboss-amq-7-broker-openshift-
image/75-7.5.0.GA/amq-broker-7-image-streams.yaml
```

3. Run the following command to update the AMQ Broker application templates.

```
$ for template in amq-broker-75-basic.yaml \
amq-broker-75-ssl.yaml \
amq-broker-75-custom.yaml \
amq-broker-75-persistence.yaml \
amq-broker-75-persistence-ssl.yaml \
amq-broker-75-persistence-clustered.yaml \
amq-broker-75-persistence-clustered-ssl.yaml;
 do
 oc replace --force -f \
https://raw.githubusercontent.com/jboss-container-images/jboss-amq-7-broker-openshift-
image/75-7.5.0.GA/templates/${template}
 done
```

3.2. PREPARING AN AMQ BROKER DEPLOYMENT

Prerequisites

- Before deploying a broker instance on OpenShift Container Platform, you must have installed the AMQ Broker image streams and application templates. For more information, see Installing the AMQ Broker image streams and application templates.

- The following procedure assumes that the broker image stream and application templates you installed in Installing AMQ Broker on OpenShift Container Platform are available in the global **openshift** project. If you installed the image and application templates in a specific project namespace, then continue to use that project instead of creating a new project such as **amq-demo**.

Procedure

1. Use the command prompt to create a new project:

```
$ oc new-project amq-demo
```

2. Create a service account to be used for the AMQ Broker deployment:

```
$ echo '{"kind": "ServiceAccount", "apiVersion": "v1", "metadata": {"name": "amq-service-account"}}' | oc create -f -
```

3. Add the view role to the service account. The view role enables the service account to view all the resources in the amq-demo namespace, which is necessary for managing the cluster when using the OpenShift dns-ping protocol for discovering the broker cluster endpoints.

   ```
   $ oc policy add-role-to-user view system:serviceaccount:amq-demo:amq-service-account
   ```

4. AMQ Broker requires a broker keystore, a client keystore, and a client truststore that includes the broker keystore. This example uses Java Keytool, a package included with the Java Development Kit, to generate dummy credentials for use with the AMQ Broker installation.

   a. Generate a self-signed certificate for the broker keystore:

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

   b. Export the certificate so that it can be shared with clients:

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

   c. Generate a self-signed certificate for the client keystore:

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

   d. Create a client truststore that imports the broker certificate:

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

   e. Use the broker keystore file to create the AMQ Broker secret:

   ```
   $ oc create secret generic amq-app-secret --from-file=broker.ks
   ```

   f. Add the secret to the service account created earlier:

   ```
   $ oc secrets add sa/amq-service-account secret/amq-app-secret
   ```

3.3. DEPLOYING A BASIC BROKER

The procedure in this section shows you how to deploy a basic broker that is ephemeral and does not support SSL.

NOTE

This broker does not support SSL and is not accessible to external clients. Only clients running internally on the OpenShift cluster can connect to the broker. For examples of creating broker configurations that support SSL, see Tutorials.

Prerequisites

- You have already prepared the broker deployment. See Preparing an AMQ Broker deployment .

- The following procedure assumes that the broker image stream and application templates you installed in Installing AMQ Broker on OpenShift Container Platform are available in the global **openshift** project. If you installed the image and application templates in a specific project namespace, then continue to use that project instead of creating a new project such as **amq-demo**.

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

3.3.1. Creating the broker application

Procedure

1. Log in to the **amq-demo** project space, or another, existing project in which you want to deploy a broker.

```
$ oc login -u <USER_NAME>
$ oc project <PROJECT_NAME>
```

2. Create a new broker application, based on the template for a basic broker. The broker created by this template is ephemeral and does not support SSL.

```
$ oc new-app --template=amq-broker-75-basic \
  -p AMQ_PROTOCOL=openwire,amqp,stomp,mqtt,hornetq \
  -p AMQ_QUEUES=demoQueue \
  -p AMQ_ADDRESSES=demoTopic \
  -p AMQ_USER=amq-demo-user \
  -p AMQ_PASSWORD=password \
```

The basic broker application template sets the environment variables shown in the following table.

Table 3.1. Basic broker application template

Environment variable	Display Name	Value	Description
AMQ_PROTOCOL	AMQ Protocols	openwire,amqp,stomp,mqtt,hornetq	The protocols to be accepted by the broker
AMQ_QUEUES	Queues	demoQueue	Creates an anycast queue called demoQueue
AMQ_ADDRESSES	Addresses	demoTopic	Creates an address (or topic) called demoTopic. By default, this address has no assigned routing type.
AMQ_USER	AMQ Username	amq-demo-user	User name that the client uses to connect to the broker

Environment variable	Display Name	Value	Description
AMQ_PASSWORD	AMQ Password	password	Password that the client uses with the user name to connect to the broker

3.3.2. About sensitive credentials

In the AMQ Broker application templates, the values of the following environment variables are stored in a secret:

- AMQ_USER
- AMQ_PASSWORD
- AMQ_CLUSTER_USER (clustered broker deployments)
- AMQ_CLUSTER_PASSWORD (clustered broker deployments)
- AMQ_TRUSTSTORE_PASSWORD (SSL-enabled broker deployments)
- AMQ_KEYSTORE_PASSWORD (SSL-enabled broker deployments)

To retrieve and use the values for these environment variables, the AMQ Broker application templates access the secret specified in the AMQ_CREDENTIAL_SECRET environment variable. By default, the secret name specified in this environment variable is **amq-credential-secret**. Even if you specify a custom value for any of these variables when deploying a template, OpenShift Container Platform uses the value currently stored in the named secret. Furthermore, the application templates always use the default values stored in **amq-credential-secret** unless you edit the secret to change the values, or create and specify a new secret with new values. You can edit a secret using the OpenShift command-line interface, as shown in this example:

```
$ oc edit secrets amq-credential-secret
```

Values in the **amq-credential-secret** use base64 encoding. To decode a value in the secret, use a command that looks like this:

```
$ echo 'dXNlcl9uYW1l' | base64 --decode
user_name
```

3.3.3. Deploying and starting the broker application

After the broker application is created, you need to deploy it. Deploying the application creates a Pod for the broker to run in.

Procedure

1. Click **Deployments** in the OpenShift Container Platform web console.

2. Click the **broker-amq** application.

3. Click **Deploy**.

> **NOTE**
>
> If the application does not deploy, you can check the configuration by clicking the **Events** tab. If something is incorrect, edit the deployment configuration by clicking the **Actions** button.

4. After you deploy the broker application, inspect the current state of the broker Pod.

    a. Click **Deployment Configs**.

    b. Click the **broker-amq** Pod and then click the **Logs** tab to verify the state of the broker. You should see the queue previously created via the application template.
    If the logs show that:

    - The broker is running, skip to step 9 of this procedure.

    - The broker logs have not loaded, and the Pod status shows **ErrImagePull** or **ImagePullBackOff**, your deployment configuration was not able to directly pull the specified broker image from the Red Hat Container Registry. In this case, continue to step 5 of this procedure.

5. To prepare the Pod for installation of the broker container image, scale the number of running brokers to **0**.

    a. Click **Deployment Configs** → **broker-amq**.

    b. Click **Actions** → **Edit Deployment Configs**.

    c. In the deployment config **.yaml** file, set the value of the **replicas** attribute to **0**.

    d. Click **Save**.

    e. The pod restarts, with zero broker instances running.

6. Install the latest broker container image.

    a. In your web browser, navigate to the Red Hat Container Catalog .

    b. In the search box, enter **AMQ Broker**. Click **Search**.

    c. Choose an image repository based on the information in the following table.

Platform	Container image name	Repository name
OpenShift Container Platform	AMQ Broker	amq7/amq-broker
OpenShift Container Platform on IBM Z	AMQ Broker on OpenJ9 11	amq7/amq-broker-openj9-11-rhel8

For example, for the OpenShift Container Platform broker container image, click **AMQ**

Broker. The **amq7/amq-broker** repository opens, with the most recent image version automatically selected. If you want to change to an earlier image version, click the **Tags** tab and choose another version tag.

d. Click the **Get This Image** tab.

e. Under **Authentication with registry tokens**, review the on-page instructions in the **Using OpenShift secrets** section. The instructions describe how to add references to the broker image and the image pull secret name associated with the account used for authentication in the Red Hat Container Registry to your Pod deployment configuration file.
For example, to pull the latest version of the OpenShift Container Platform broker container image for a deployment configuration called **broker-amq** in the **amq-demo** project namespace, include lines that look like the following:

```
apiVersion: apps.openshift.io/v1
kind: DeploymentConfig
..
metadata:
  name: broker-amq
  namespace: amq-demo
..
  spec:
    containers:
        name: broker-amq
        image: 'registry.redhat.io/amq7/amq-broker:7.5'
    ..
    imagePullSecrets:
      - name: {PULL-SECRET-NAME}
```

NOTE

To use the latest version of the broker container image for OpenShift Container Platform on IBM Z, specify the image attribute as **registry.redhat.io/amq7/amq-broker-openj9-11-rhel8:7.5**.

f. Click **Save**.

7. Import the latest broker image version to your project namespace. For example:

```
$ oc import-image amq7/amq-broker:7.5 --from=registry.redhat.io/amq7/amq-broker --
confirm
```

8. Edit the **broker-amq** deployment config again, as previously described. Set the value of the **replicas** attribute back to its original value.
The broker Pod restarts, with all running brokers referencing the new broker image.

9. Click the **Terminal** tab to access a shell where you can start the broker and use the CLI to test sending and consuming messages.

```
sh-4.2$ ./broker/bin/artemis run
sh-4.2$ ./broker/bin/artemis producer --destination queue://demoQueue
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 : 4 s
Producer ActiveMQQueue[demoQueue], thread=0 Elapsed time in milli second : 4584 milli
seconds
sh-4.2$ ./broker/bin/artemis consumer --destination queue://demoQueue
Consumer:: filter = null
Consumer ActiveMQQueue[demoQueue], thread=0 wait until 1000 messages are consumed
Received 1000
Consumer ActiveMQQueue[demoQueue], thread=0 Consumed: 1000 messages
Consumer ActiveMQQueue[demoQueue], thread=0 Consumer thread finished
```

Alternatively, use the OpenShift client to access the shell using the Pod name, as shown in the following example.

```
// Get the Pod names and internal IP Addresses
$ oc get pods -o wide

// Access a broker Pod by name
$ oc rsh <broker-pod-name>
```

CHAPTER 4. UPGRADING AMQ BROKER ON OPENSHIFT CONTAINER PLATFORM

The procedures in this section show how to upgrade Operator- and templates-based broker deployments on OpenShift Container Platform.

IMPORTANT

To upgrade an existing AMQ Broker deployment on OpenShift Container Platform 3.11 to run on OpenShift Container Platform 4.1, you must first upgrade your OpenShift Container Platform installation, before performing a clean installation of AMQ Broker that matches your existing deployment. To perform a clean AMQ Broker installation, use one of these methods:

- Deploying AMQ Broker on OpenShift Container Platform using an Operator (Recommended).
- Deploying AMQ Broker on OpenShift Container Platform using Application Templates

4.1. UPGRADING AN OPERATOR-BASED BROKER DEPLOYMENT

The following procedures show you how to upgrade:

- The broker container image for an Operator-based broker deployment
- The AMQ Broker Operator version in your OpenShift project

4.1.1. Upgrading the broker container image

The following procedure shows how to upgrade the broker container image for a broker deployment based on the AMQ Broker Operator.

NOTE

The procedure assumes that you used version 0.9.0 or greater of the AMQ Broker Operator to create your broker deployment. The name of the main broker Custom Resource (CR) instance included with these versions of the Operator is **broker_v2alpha1_activemqartemis_cr.yaml**. You can also use instructions similar to those below to upgrade the broker container image for a deployment based on version 0.6.3 or earlier of the Operator. For those Operator versions, the name of the included main broker CR instance is **broker_v1alpha1_activemqartemis_cr.yaml**.

Prerequisites

- You have used the AMQ Broker Operator to create a broker deployment. For more information, see Deploying AMQ Broker on OpenShift Container Platform using an Operator .

Procedure

1. In the **deploy/crs** directory of the Operator archive that you downloaded and extracted during your initial installation, open the **broker_v2alpha1_activemqartemis_cr.yaml** Custom Resource (CR).

2. Edit the **image** element to specify the latest AMQ Broker 7.5 container image, as shown below.

```
image: registry.redhat.io/amq7/amq-broker:7.5
```

3. Apply the CR change.

```
$ oc apply -f deploy/crs/broker_v2alpha1_activemqartemis_cr.yaml
```

When you apply the CR change, each broker Pod in your deployment shuts down and then restarts using the new broker container image. If you have multiple brokers in your deployment, only one broker Pod shuts down and restarts at a time.

4.1.2. Upgrading the Operator

The following procedure shows how to upgrade the AMQ Broker Operator version in your OpenShift project.

IMPORTANT

You **cannot** directly upgrade an Operator installation based on version 0.6.3 or earlier to use version 0.9.0 or greater because the Custom Resource Definitions (CRDs) used by versions 0.6.3 or earlier are not compatible with versions 0.9.0 or later. In this case, you must perform a new installation of the Operator before using it to recreate your broker deployments. For more information, see Installing the Broker Operator.

Prerequisites

- You have previously installed and deployed an AMQ Broker Operator based on version 0.9.0 or greater. For more information, see Installing the AMQ Broker Operator.

Procedure

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

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

2. Log in to the project in which you want to upgrade the Operator.

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

3. In the **deploy** directory of the Operator archive that you downloaded and extracted during your original installation, open the **operator.yaml** file.

4. Update the **spec.containers.image** attribute to specify the full path to the latest Operator image for AMQ Broker 7.5 in the Red Hat Container Registry.

```
spec:
  template:
    spec:
      containers:
        image: registry.redhat.io/amq7/amq-broker-rhel7-operator:0.9
```

5. When you have updated the **spec.containers.image** attribute, apply the changes.

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

OpenShift updates your project to use the latest Operator version. The upgrade has no effect on your running broker Pods.

4.2. UPGRADING TEMPLATES-BASED BROKER DEPLOYMENTS

The following procedures show how to upgrade an existing broker deployment that is based on application templates.

4.2.1. Upgrading non-persistent broker deployments

This procedure shows you how to upgrade a non-persistent broker deployment. The non-persistent broker templates in the OpenShift Container Platform service catalog have labels that resemble the following:

- Red Hat AMQ Broker 7.x (Ephemeral, no SSL)
- Red Hat AMQ Broker 7.x (Ephemeral, with SSL)
- Red Hat AMQ Broker 7.x (Custom Config, Ephemeral, no SSL)

Prerequisites

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

Procedure

1. Navigate to the OpenShift Container Platform web console and log in.
2. Click the project in which you want to upgrade a non-persistent broker deployment.
3. Select the Deployment Config (DC) corresponding to your broker deployment.
    a. In OpenShift Container Platform 4.1, click **Workloads → Deployment Configs**.
    b. In OpenShift Container Platform 3.11, click **Applications → Deployments**. Within your broker deployment, click the **Configuration** tab.
4. From the **Actions** menu, click **Edit Deployment Config** (OpenShift Container Platform 4.1) or **Edit YAML** (OpenShift Container Platform 3.11).
   The **YAML** tab of the Deployment Config opens, with the **.yaml** file in an editable mode.
5. Edit the **image** attribute to specify the latest AMQ Broker 7.5 container image, **registry.redhat.io/amq7/amq-broker:7.5**.
6. Add the **imagePullSecrets** attribute to specify the image pull secret associated with the account used for authentication in the Red Hat Container Registry.
   Changes based on the previous two steps are shown in the example below:

```
...
```

```
spec:
  containers:
    image: 'registry.redhat.io/amq7/amq-broker:7.5'
..
imagePullSecrets:
 - name: {PULL-SECRET-NAME}
```

> **NOTE**
>
> In AMQ Broker, container image tags increment by **1** for each new version of the container image added to the Red Hat image registry, for example, 7.5-1, 7.5-2, and so on. If you specify a tag name without a final digit (**7.5**, for example), this tag is known as a *floating tag*. When you specify a floating tag, OpenShift Container Platform automatically identifies the most recent available image (that is, the image tag with the highest final number) and uses this image to upgrade your broker deployment.

7. Click **Save**.
   If a newer broker image than the one currently installed is available in the Red Hat Container Registry, OpenShift Container Platform upgrades your broker deployment. To do this, OpenShift Container Platform stops the existing broker Pod and then starts a new Pod that uses the new image.

4.2.2. Upgrading persistent broker deployments

This procedure shows you how to upgrade a persistent broker deployment. The persistent broker templates in the OpenShift Container Platform service catalog have labels that resemble the following:

- Red Hat AMQ Broker 7.x (Persistence, clustered, no SSL)
- Red Hat AMQ Broker 7.x (Persistence, clustered, with SSL)
- Red Hat AMQ Broker 7.x (Persistence, with SSL)

Prerequisites

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

Procedure

1. Navigate to the OpenShift Container Platform web console and log in.
2. Click the project in which you want to upgrade a persistent broker deployment.
3. Select the StatefulSet (SS) corresponding to your broker deployment.
   a. In OpenShift Container Platform 4.1, click **Workloads → Stateful Sets**.
   b. In OpenShift Container Platform 3.11, click **Applications → Stateful Sets**.

4. From the **Actions** menu, click **Edit Stateful Set** (OpenShift Container Platform 4.1) or **Edit YAML** (OpenShift Container Platform 3.11).
   The **YAML** tab of the StatefulSet opens, with the **.yaml** file in an editable mode.

5. To prepare your broker deployment for upgrade, scale the deployment down to zero brokers.

   a. If the **replicas** attribute is currently set to **1** or greater, set it to **0**.

   b. Click **Save**.

6. When all broker Pods have shut down, edit the Stateful Set **.yaml** file again. Edit the **image** attribute to specify the latest AMQ Broker 7.5 container image, **registry.redhat.io/amq7/amq-broker:7.5**.

7. Add the **imagePullSecrets** attribute to specify the image pull secret associated with the account used for authentication in the Red Hat Container Registry.
   Changes based on the previous two steps are shown in the example below:

```
...
spec:
    containers:
        image: 'registry.redhat.io/amq7/amq-broker:7.5'
..
imagePullSecrets:
  - name: {PULL-SECRET-NAME}
```

8. Set the **replicas** attribute back to the original value.

9. Click **Save**.
   If a newer broker image than the one currently installed is available in the Red Hat Container Registry, OpenShift Container Platform upgrades your broker deployment. To do this, OpenShift Container Platform restarts the broker Pod.

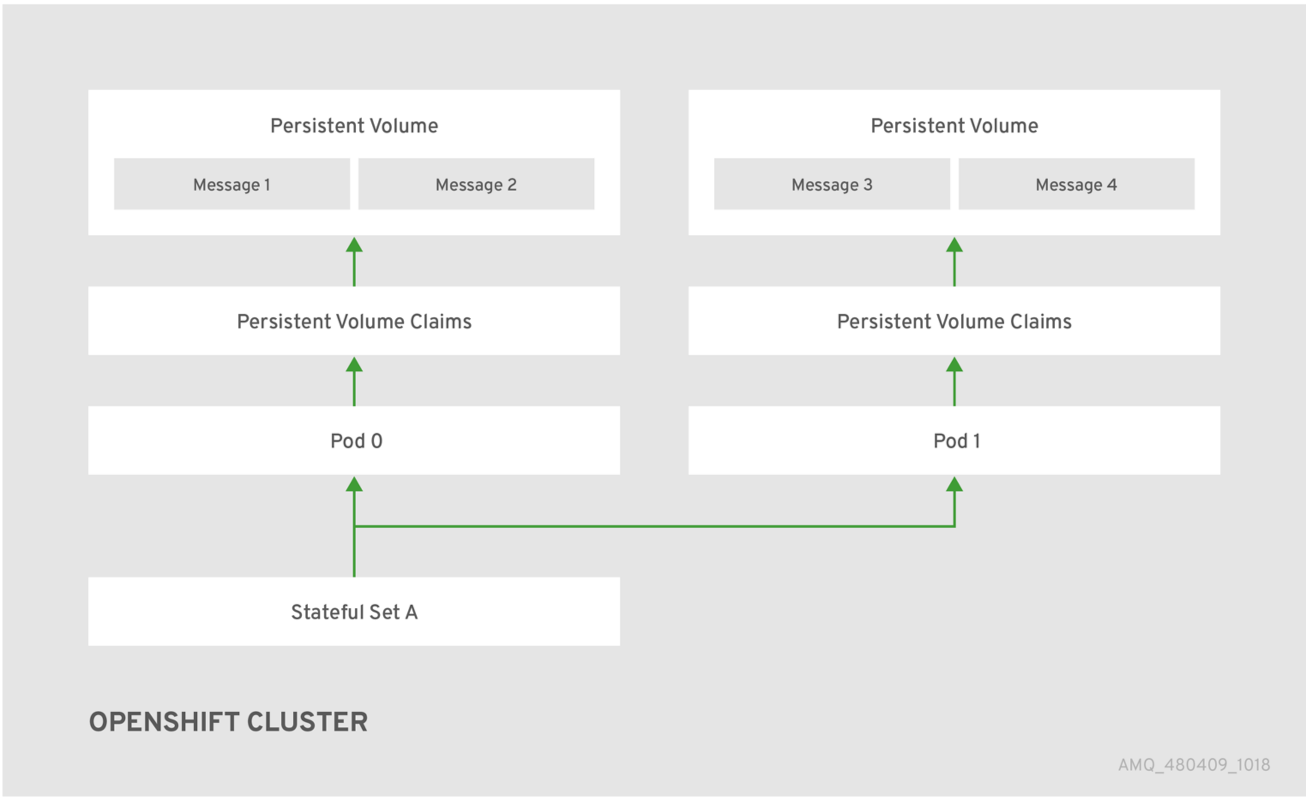
CHAPTER 5. HIGH AVAILABILITY

5.1. HIGH AVAILABILITY OVERVIEW

The term *high availability* refers to a system that is capable of remaining operational, even when part of that system fails or is taken offline. With Broker on OCP, specifically, HA refers to both maintaining the availability of brokers and the integrity of the messaging data if a broker fails.

In an HA configuration on AMQ Broker on OpenShift Container Platform, you run multiple instances of a broker pod simultaneously. Each individual broker pod writes its message data to a *persistent volume* (PVs), which logically define the storage volumes in the system. If a broker pod fails or is taken offline, the message data stored in that PV is redistributed to an alternative available broker, which then stores it in its own PV.

Figure 5.1. StatefulSet working normally



When you take a broker pod offline, the StatefulSet is scaled down and you must manage what happens to the message data in the unattached PV. To migrate the messages held in the PV associated with the now-offline pod, you use the scaledown controller. The process of migrating message data in this fashion is sometimes referred to as *pod draining*.

5.2. MESSAGE MIGRATION

5.2.1. Message migration overview

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. Message migration, which uses a method called *Pod draining*, refers to the removal and redistribution of "orphaned" messages from the persistent volume used by the broker to store messaging data. With message migration enabled, the scaledown controller, which is part of the AMQ Broker Operator, detects shutdown of any broker Pods in your deployment. The scaledown controller starts a dedicated drainer Pod for each broker Pod that is shut down, to prepare for message migration. Each drainer Pod connects to one of the remaining live broker Pods in the cluster and migrates messages over to that live broker Pod. After migration is complete, each drainer Pod shuts down. Persistent volumes previously used by running brokers are returned to a "Released" state.

NOTE

The scaledown controller within the AMQ Broker Operator can operate only within a single OpenShift project. The controller cannot migrate messages between brokers in separate projects.

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 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.

5.2.1.1. How does message migration work?

When you enable message migration in a broker deployment created using the AMQ Broker Operator, a scaledown controller is started by the Operator within the same project namespace as the broker Pods.

The scaledown controller registers itself and listens for Kubernetes events that are related to persistent volume claims (PVCs) in the project namespace.

The scaledown controller checks for PVCs that have been orphaned by looking at the ordinal on the volume claim. The ordinal on the volume claim is compared to the ordinal on the existing broker Pods, which are part of the StatefulSet in the project namespace.

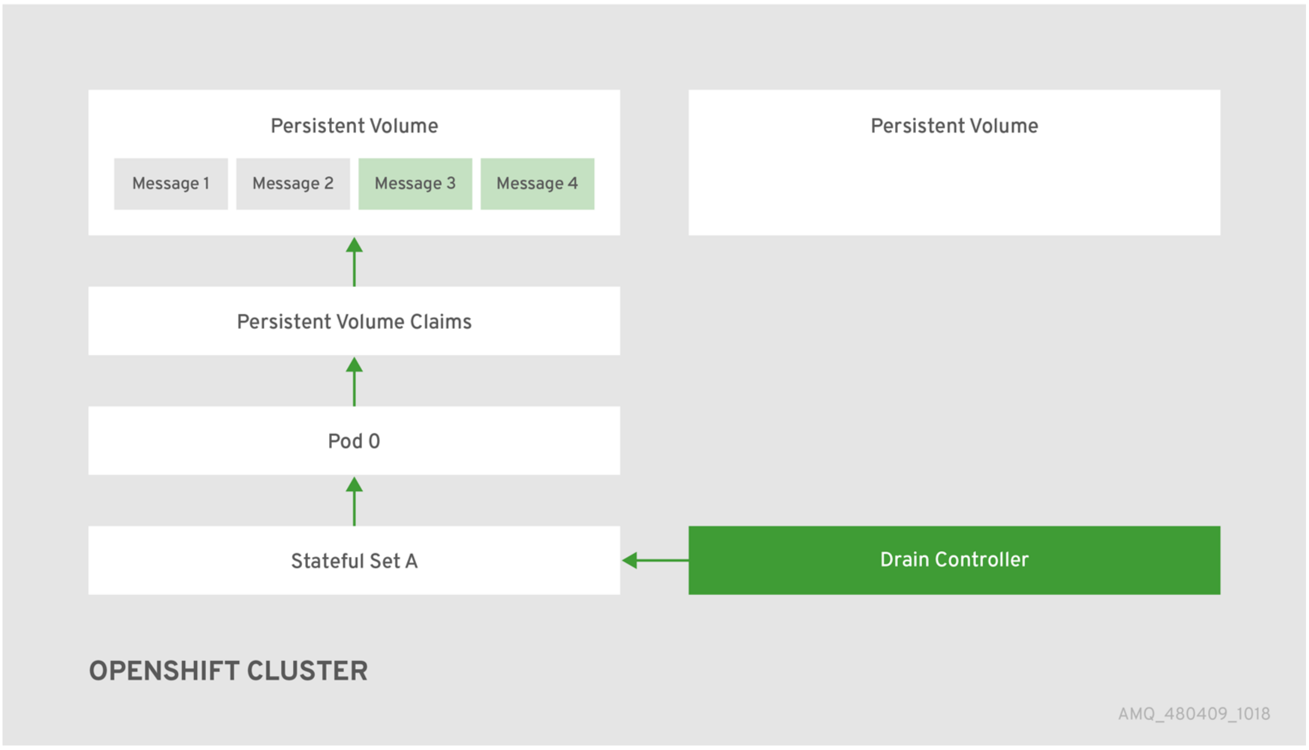
If the ordinal on the volume claim is greater than the ordinal on the existing broker Pods, then the Pod at that ordinal has been terminated and the data must be migrated to another broker.

When these conditions are met, a drainer Pod is started. The drainer Pod runs the broker and executes the message migration. Then, the drainer Pod identifies an alternative broker Pod to which the orphaned PVC messages can be migrated.

NOTE

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

Figure 5.2. The scaledown controller registers itself, deletes the PVC, and redistributes messages on the persistent volume.



After the messages are successfully migrated to an operational broker Pod, the drainer Pod shuts down and the scaledown controller removes the orphaned PVC. The persistent volume is returned to a "Released" state.

Additional resources

- For an example of message migration when you scale down a broker deployment, see Migrating Messages Upon Scaledown.

CHAPTER 6. CONNECTING EXTERNAL CLIENTS TO TEMPLATES-BASED BROKER DEPLOYMENTS

This section describes how to configure SSL to enable connections from clients outside OpenShift Container Platform to brokers deployed using application templates.

6.1. CONFIGURING SSL

For a minimal SSL configuration to allow connections outside of OpenShift Container Platform, AMQ Broker requires a broker keystore, a client keystore, and a client truststore that includes the broker keystore. The broker keystore is also used to create a secret for the AMQ Broker on OpenShift Container Platform image, which is added to the service account.

The following example commands use Java KeyTool, a package included with the Java Development Kit, to generate the necessary certificates and stores.

For a more complete example of deploying a broker instance that supports SSL, see Deploying a basic broker with SSL.

Procedure

1. Generate a self-signed certificate for the broker keystore:

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

2. Export the certificate so that it can be shared with clients:

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

3. Generate a self-signed certificate for the client keystore:

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

4. Create a client truststore that imports the broker certificate:

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

5. Export the client’s certificate from the keystore:

   ```
   $ keytool -export -alias client -keystore client.ks -file client_cert
   ```

6. Import the client’s exported certificate into a broker SERVER truststore:

   ```
   $ keytool -import -alias client -keystore broker.ts -file client_cert
   ```

6.2. GENERATING THE AMQ BROKER SECRET

The broker keystore can be used to generate a secret for the namespace, which is also added to the service account so that the applications can be authorized.

Procedure

- At the command line, run the following commands:

```
$ oc create secret generic <secret-name> --from-file=<broker-keystore> --from-file=<broker-
truststore>
$ oc secrets add sa/<service-account-name> secret/<secret-name>
```

6.3. CREATING AN SSL ROUTE

To enable client applications outside your OpenShift cluster to connnect to a broker, you need to create an SSL Route for the broker Pod. You can expose only SSL-enabled Routes to external clients because the OpenShift router requires Server Name Indication (SNI) to send traffic to the correct Service.

When you use an application template to deploy a broker on OpenShift Container Platform, you use the **AMQ_PROTOCOL** template parameter to specify the messaging protocols that the broker uses, in a comma-separated list. Available options are **amqp**, **mqtt**, **openwire**, **stomp**, and **hornetq**. If you do not specify any protocols, all protocols are made available.

For each messaging protocol that the broker uses, OpenShift exposes a dedicated port on the broker Pod. In addition, OpenShift automatically creates a multiplexed, *all protocols* port. Client applications outside OpenShift always use the multiplexed, all protocols port to connect to the broker, regardless of which of the supported protocols they are using.

Connections to the all protocols port are via a Service that OpenShift automatically creates, and an SSL Route that you create. A headless service within the broker Pod provides access to the other protocol-specific ports, which do not have their own Services and Routes that clients can access directly.

The ports that OpenShift exposes for the various AMQ Broker transport protocols are shown in the following table. Brokers listen on the non-SSL ports for traffic within the OpenShift cluster. Brokers listen on the SSL-enabled ports for traffic from clients outside OpenShift, if you created your deployment using an SSL-based (that is, ***-ssl.yaml**) template.

Table 6.1. Default ports for AMQ Broker transport protocols

AMQ Broker transport protocol	Default port
All protocols (OpenWire, AMQP, STOMP, MQTT, and HornetQ)	61616
All protocols -SSL (OpenWire AMQP, STOMP, MQTT, and HornetQ)	61617
AMQP	5672
AMQP (SSL)	5671
MQTT	1883
MQTT (SSL)	8883
STOMP	61613
STOMP (SSL)	61612

Below are some other things to note when creating an SSL Route on your broker Pod:

- When you create a Route, setting **TLS Termination** to **Passthrough** relays all communication to AMQ Broker without the OpenShift router decrypting and resending it.

  NOTE

  Regular HTTP traffic does not require a TLS passthrough Route because the OpenShift router uses **HAProxy**, which is an HTTP proxy.

- External broker clients must specify the OpenShift router port (443, by default) when setting the broker URL for SSL connections. When a client connection specifies the OpenShift router port, the router determines the appropriate port on the broker Pod to which the client traffic should be directed.

  NOTE

  By default, the OpenShift router uses port 443. However, the router might be configured to use a different port number, based on the value specified for the **ROUTER_SERVICE_HTTPS_PORT** environment variable. For more information, see OpenShift Container Platform Routes.

- Including the failover protocol in the broker URL preserves the client connection in case the Pod is restarted or upgraded, or a disruption occurs on the router.
  Both of the previous settings are shown in the example below.

```
...
factory.setBrokerURL("failover://ssl://<broker-pod-route-name>:443");
...
```

Additional resources

- For a complete example of deploying a broker that supports SSL and of creating an SSL Route to enable external client access, see Deploying a basic broker with SSL .

- For an example of creating Routes for clustered brokers to connect to their own instances of the AMQ Broker management console, see Creating routes for the AMQ Broker management console.

CHAPTER 7. CUSTOMIZING AMQ BROKER CONFIGURATION FILES FOR DEPLOYMENT

If you are using a template from an alternative repository, AMQ Broker configuration files such as **artemis-users.properties** can be included. When the image is downloaded for deployment, these files are copied from **<amq-home>**/**conf**/ to the **<broker-instance-dir>**/**etc**/ directory on AMQ Broker, which is committed to the container and pushed to the OpenShift registry.

NOTE

If using this method, ensure that the placeholders in the configuration files (such as **AUTHENTICATION**) are not removed. The placeholders are necessary for building the AMQ Broker on OpenShift Container Platform image.

CHAPTER 8. TEMPLATES-BASED BROKER DEPLOYMENT EXAMPLES

Prerequisites

- These procedures assume an OpenShift Container Platform 4.1 instance similar to that created in OpenShift Container Platform 4.1 Getting Started .
- In the AMQ Broker application templates, the values of the AMQ_USER, AMQ_PASSWORD, AMQ_CLUSTER_USER, AMQ_CLUSTER_PASSWORD, AMQ_TRUSTSTORE_PASSWORD, and AMQ_KEYSTORE_PASSWORD environment variables are stored in a secret. To learn more about using and modifying these environment variables when you deploy a template in any of tutorials that follow, see About sensitive credentials.

The following procedures example how to use application templates to create various deployments of brokers.

8.1. DEPLOYING A BASIC BROKER WITH SSL

Deploy a basic broker that is ephemeral and supports SSL.

8.1.1. Deploying the image and template

Prerequisites

- This tutorial builds upon Preparing a Broker.
- Completion of the Deploying a Basic Broker tutorial is recommended.

Procedure

1. Navigate to the OpenShift web console and log in.
2. Select the **amq-demo** project space.
3. Click **Add to Project** > **Browse Catalog** to list all of the default image streams and templates.
4. Use the **Filter** search bar to limit the list to those that match **amq**. You might need to click **See all** to show the desired application template.
5. Select the **amq-broker-75-ssl** template which is labeled **Red Hat AMQ Broker 7.5 (Ephemeral, with SSL)**.
6. Set the following values in the configuration and click **Create**.

Table 8.1. Example template

Environment variable	Display Name	Value	Description
AMQ_PROTOCOL	AMQ Protocols	openwire,amqp,stomp,mqtt,hornetq	The protocols to be accepted by the broker

Environment variable	Display Name	Value	Description
AMQ_QUEUES	Queues	demoQueue	Creates an anycast queue called demoQueue
AMQ_ADDRESSES	Addresses	demoTopic	Creates an address (or topic) called demoTopic. By default, this address has no assigned routing type.
AMQ_USER	AMQ Username	amq-demo-user	The username the client uses
AMQ_PASSWORD	AMQ Password	password	The password the client uses with the username
AMQ_TRUSTSTORE	Trust Store Filename	broker.ts	The SSL truststore file name
AMQ_TRUSTSTORE_PASSWORD	Truststore Password	password	The password used when creating the Truststore
AMQ_KEYSTORE	AMQ Keystore Filename	broker.ks	The SSL keystore file name
AMQ_KEYSTORE_PASSWORD	AMQ Keystore Password	password	The password used when creating the Keystore

8.1.2. Deploying the application

After creating the application, deploy it to create a Pod and start the broker.

Procedure

1. Click **Deployments** in the OpenShift Container Platform web console.
2. Click the **broker-amq** deployment.
3. Click **Deploy** to deploy the application.
4. Click the broker Pod and then click the **Logs** tab to verify the state of the broker.
   If the broker logs have not loaded, and the Pod status shows **ErrImagePull** or **ImagePullBackOff**, your deployment configuration was not able to directly pull the specified broker image from the Red Hat Container Registry. In this case, edit your deployment configuration to reference the correct broker image name and the image pull secret name associated with the account used for authentication in the Red Hat Container Registry. Then, you can import the broker image and start the broker. To do this, complete steps similar to those in Deploy and start the broker application .

8.1.3. Creating a Route

Create a Route for the broker so that clients outside of OpenShift Container Platform can connect using SSL. By default, the secured broker protocols are available through the 61617/TCP port. In addition, there are SSL and non-SSL ports exposed on the broker Pod for each messaging protocol that the broker supports. However, external client cannot connect directly to these ports on the broker. Instead, external clients connect to OpenShift via the Openshift router, which determines how to forward traffic to the appropriate port on the broker Pod.

NOTE

If you scale your deployment up to multiple brokers in a cluster, you must manually create a Service and a Route for each broker, and then use each Service-and-Route combination to direct a given client to a given broker, or broker list. For an example of configuring multiple Services and Routes to connect clustered brokers to their own instances of the AMQ Broker management console, see Creating Routes for the AMQ Broker management console.

Prerequisites

- Before creating an SSL Route, you should understand how external clients use this Route to connect to the broker. For more information, see Creating an SSL Route .

Procedure

1. Click **Services → broker-amq-tcp-ssl**.
2. Click **Actions → Create a route**.
3. To display the TLS parameters, select the **Secure route** check box.
4. From the **TLS Termination** drop-down menu, choose **Passthrough**. This selection relays all communication to AMQ Broker without the OpenShift router decrypting and resending it.
5. To view the Route, click **Routes**. For example:

```
https://broker-amq-tcp-amq-demo.router.default.svc.cluster.local
```

This hostname will be used by external clients to connect to the broker using SSL with SNI.

Additional resources

- For more information about creating SSL Routes, see Creating an SSL Route .
- For more information on Routes in the OpenShift Container Platform, see Routes.

8.2. DEPLOYING A BASIC BROKER WITH PERSISTENCE AND SSL

Deploy a persistent broker that supports SSL. When a broker needs persistence, the broker is deployed as a StatefulSet and stores messaging data on a persistent volume associated with the broker Pod via a persistent volume claim. When a broker Pod is created, it uses storage that remains in the event that you shut down the Pod, or if the Pod shuts down unexpectedly. This configuration means that messages are not lost, as they would be with a standard deployment.

Prerequisites

- This tutorial builds upon Preparing a broker.
- Completion of the Deploying a basic broker tutorial is recommended.
- You must have sufficient persistent storage provisioned to your OpenShift cluster to associate with your broker Pod via a persistent volume claim. For more information, see Understanding persistent storage.

8.2.1. Deploy the image and template

Procedure

1. Navigate to the OpenShift web console and log in.
2. Select the **amq-demo** project space.
3. Click **Add to Project → Browse catalog** to list all of the default image streams and templates.
4. Use the **Filter** search bar to limit the list to those that match **amq**. You might need to click **See all** to show the desired application template.
5. Select the **amq-broker-75-persistence-ssl** template, which is labelled **Red Hat AMQ Broker 7.5 (Persistence, with SSL)**.
6. Set the following values in the configuration and click **create**.

   Table 8.2. Example template

Environment variable	Display Name	Value	Description
AMQ_PROTOCOL	AMQ Protocols	openwire,amqp,stomp,mqtt,hornetq	The protocols to be accepted by the broker
AMQ_QUEUES	Queues	demoQueue	Creates an anycast queue called demoQueue
AMQ_ADDRESSES	Addresses	demoTopic	Creates an address (or topic) called demoTopic. By default, this address has no assigned routing type.
VOLUME_CAPACITY	AMQ Volume Size	1Gi	The persistent volume size created for the journal
AMQ_USER	AMQ Username	amq-demo-user	The username the client uses
AMQ_PASSWORD	AMQ Password	password	The password the client uses with the username

Environment variable	Display Name	Value	Description
AMQ_TRUSTSTORE	Trust Store Filename	broker.ts	The SSL truststore file name
AMQ_TRUSTSTORE_PASSWORD	Truststore Password	password	The password used when creating the Truststore
AMQ_KEYSTORE	AMQ Keystore Filename	broker.ks	The SSL keystore file name
AMQ_KEYSTORE_PASSWORD	AMQ Keystore Password	password	The password used when creating the Keystore

8.2.2. Deploy the application

Once the application has been created it needs to be deployed. Deploying the application creates a Pod and starts the broker.

Procedure

1. Click **Stateful Sets** in the OpenShift Container Platform web console.
2. Click the **broker-amq** deployment.
3. Click **Deploy** to deploy the application.
4. Click the broker Pod and then click the **Logs** tab to verify the state of the broker. You should see the queue created via the template.
   If the broker logs have not loaded, and the Pod status shows **ErrImagePull** or **ImagePullBackOff**, your configuration was not able to directly pull the specified broker image from the Red Hat Container Registry. In this case, edit your deployment configuration to reference the correct broker image name and the image pull secret name associated with the account used for authentication in the Red Hat Container Registry. Then, you can import the broker image and start the broker. To do this, complete steps similar to those in Deploy and start the broker application.
5. Click the **Terminal** tab to access a shell where you can use the CLI to send some messages.

```
sh-4.2$ ./broker/bin/artemis producer --destination queue://demoQueue
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 : 4 s
Producer ActiveMQQueue[demoQueue], thread=0 Elapsed time in milli second : 4584 milli
seconds

sh-4.2$ ./broker/bin/artemis consumer  --destination queue://demoQueue
```

```
Consumer:: filter = null
Consumer ActiveMQQueue[demoQueue], thread=0 wait until 1000 messages are consumed
Received 1000
Consumer ActiveMQQueue[demoQueue], thread=0 Consumed: 1000 messages
Consumer ActiveMQQueue[demoQueue], thread=0 Consumer thread finished
```

Alternatively, use the OpenShift client to access the shell using the Pod name, as shown in the following example.

```
// Get the Pod names and internal IP Addresses
oc get pods -o wide

// Access a broker Pod by name
oc rsh <broker-pod-name>
```

6. Now scale down the broker using the oc command.

```
$ oc scale statefulset broker-amq --replicas=0
statefulset "broker-amq" scaled
```

You can use the console to check that the Pod count is 0

7. Now scale the broker back up to **1**.

```
$ oc scale statefulset broker-amq --replicas=1
statefulset "broker-amq" scaled
```

8. Consume the messages again by using the terminal. For example:

```
sh-4.2$ broker/bin/artemis consumer --destination queue://demoQueue
Consumer:: filter = null
Consumer ActiveMQQueue[demoQueue], thread=0 wait until 1000 messages are consumed
Received 1000
Consumer ActiveMQQueue[demoQueue], thread=0 Consumed: 1000 messages
Consumer ActiveMQQueue[demoQueue], thread=0 Consumer thread finished
```

Additional resources

- For more information on managing stateful applications, see StatefulSets (external).

8.2.3. Creating a Route

Create a Route for the broker so that clients outside of OpenShift Container Platform can connect using SSL. By default, the broker protocols are available through the 61617/TCP port.

NOTE

If you scale your deployment up to multiple brokers in a cluster, you must manually create a Service and a Route for each broker, and then use each Service-and-Route combination to direct a given client to a given broker, or broker list. For an example of configuring multiple Services and Routes to connect clustered brokers to their own instances of the AMQ Broker management console, see Creating routes for the AMQ Broker management console.

Prerequisites

- Before creating an SSL Route, you should understand how external clients use this Route to connect to the broker. For more information, see Creating an SSL Route .

Procedure

1. Click **Services → broker-amq-tcp-ssl**.
2. Click **Actions → Create a route**.
3. To display the TLS parameters, select the **Secure route** check box.
4. From the **TLS Termination** drop-down menu, choose **Passthrough**. This selection relays all communication to AMQ Broker without the OpenShift router decrypting and resending it.
5. To view the Route, click **Routes**. For example:

```
https://broker-amq-tcp-amq-demo.router.default.svc.cluster.local
```

This hostname will be used by external clients to connect to the broker using SSL with SNI.

Additional resources

- For more information on Routes in the OpenShift Container Platform, see Routes.

8.3. DEPLOYING A SET OF CLUSTERED BROKERS

Deploy a clustered set of brokers where each broker runs in its own Pod.

8.3.1. Distributing messages

Message distribution is configured to use *ON_DEMAND*. This means that when messages arrive at a clustered broker, the messages are distributed in a round-robin fashion to any broker that has consumers.

This message distribution policy safeguards against messages getting stuck on a specific broker while a consumer, connected either directly or through the OpenShift router, is connected to a different broker.

The redistribution delay is zero by default. If a message is on a queue that has no consumers, it will be redistributed to another broker.

NOTE

When redistribution is enabled, messages can be delivered out of order.

8.3.2. Deploy the image and template

Prerequisites

- This procedure builds upon Preparing a broker .
- Completion of the Deploying a basic broker tutorial is recommended.

Procedure

1. Navigate to the OpenShift web console and log in.
2. Select the **amq-demo** project space.
3. Click **Add to Project** > **Browse catalog** to list all of the default image streams and templates
4. Use the **Filter** search bar to limit the list to those that match **amq**. Click **See all** to show the desired application template.
5. Select the **amq-broker-75-persistence-clustered** template which is labeled **Red Hat AMQ Broker 7.5 (no SSL, clustered)**.
6. Set the following values in the configuration and click **create**.

Table 8.3. Example template

Environment variable	Display Name	Value	Description
AMQ_PROTOCOL	AMQ Protocols	openwire,amqp,stomp,mqtt,hornetq	The protocols to be accepted by the broker
AMQ_QUEUES	Queues	demoQueue	Creates an anycast queue called demoQueue
AMQ_ADDRESSES	Addresses	demoTopic	Creates an address (or topic) called demoTopic. By default, this address has no assigned routing type.
VOLUME_CAPACITY	AMQ Volume Size	1Gi	The persistent volume size created for the journal
AMQ_CLUSTERED	Clustered	true	This needs to be true to ensure the brokers cluster
AMQ_CLUSTER_USER	cluster user	generated	The username the brokers use to connect with each other
AMQ_CLUSTER_PASSWORD	cluster password	generated	The password the brokers use to connect with each other
AMQ_USER	AMQ Username	amq-demo-user	The username the client uses
AMQ_PASSWORD	AMQ Password	password	The password the client uses with the username

8.3.3. Deploying the application

Once the application has been created it needs to be deployed. Deploying the application creates a Pod and starts the broker.

Procedure

1. Click **Stateful Sets** in the OpenShift Container Platform web console.
2. Click the **broker-amq** deployment.
3. Click **Deploy** to deploy the application.

   NOTE

   The default number of replicas for a clustered template is 0. You should not see any Pods.

4. Scale up the Pods to three to create a cluster of brokers.

```
$ oc scale statefulset broker-amq --replicas=3
statefulset "broker-amq" scaled
```

5. Check that there are three Pods running.

```
$ oc get pods
NAME          READY     STATUS    RESTARTS   AGE
broker-amq-0   1/1       Running   0          33m
broker-amq-1   1/1       Running   0          33m
broker-amq-2   1/1       Running   0          29m
```

6. If the Pod status shows **ErrImagePull** or **ImagePullBackOff**, your deployment was not able to directly pull the specified broker image from the Red Hat Container Registry. In this case, edit your Stateful Set to reference the correct broker image name and the image pull secret name associated with the account used for authentication in the Red Hat Container Registry. Then, you can import the broker image and start the brokers. To do this, complete steps similar to those in Deploy and start the broker application .
7. Verify that the brokers have clustered with the new Pod by checking the logs.

```
$ oc logs broker-amq-2
```

   This shows the logs of the new broker and an entry for a clustered bridge created between the brokers:

```
2018-08-29 07:43:55,779 INFO  [org.apache.activemq.artemis.core.server] AMQ221027:
Bridge ClusterConnectionBridge@1b0e9e9d [name=$.artemis.internal.sf.my-
cluster.4333c830-ab5f-11e8-afb8-0a580a82006e,
queue=QueueImpl[name=$.artemis.internal.sf.my-cluster.4333c830-ab5f-11e8-afb8-
0a580a82006e, postOffice=PostOfficeImpl
[server=ActiveMQServerImpl::serverUUID=9cedb69d-ab5e-11e8-87a4-0a580a82006c],
temp=false]@5e0c0398 targetConnector=ServerLocatorImpl (identity=(Cluster-connection-
bridge::ClusterConnectionBridge@1b0e9e9d [name=$.artemis.internal.sf.my-
cluster.4333c830-ab5f-11e8-afb8-0a580a82006e,
queue=QueueImpl[name=$.artemis.internal.sf.my-cluster.4333c830-ab5f-11e8-afb8-
0a580a82006e, postOffice=PostOfficeImpl
[server=ActiveMQServerImpl::serverUUID=9cedb69d-ab5e-11e8-87a4-0a580a82006c],
temp=false]@5e0c0398 targetConnector=ServerLocatorImpl [initialConnectors=
[TransportConfiguration(name=artemis, factory=org-apache-activemq-artemis-core-remoting-
impl-netty-NettyConnectorFactory) ?port=61616&host=10-130-0-110],
discoveryGroupConfiguration=null]]::ClusterConnectionImpl@806813022[nodeUUID=9cedb69d
-ab5e-11e8-87a4-0a580a82006c, connector=TransportConfiguration(name=artemis,
factory=org-apache-activemq-artemis-core-remoting-impl-netty-NettyConnectorFactory) ?
port=61616&host=10-130-0-108, address=,
server=ActiveMQServerImpl::serverUUID=9cedb69d-ab5e-11e8-87a4-0a580a82006c]))
[initialConnectors=[TransportConfiguration(name=artemis, factory=org-apache-activemq-
artemis-core-remoting-impl-netty-NettyConnectorFactory) ?port=61616&host=10-130-0-110],
discoveryGroupConfiguration=null]] is connected
```

8.3.4. Creating Routes for the AMQ Broker management console

The clustering templates do not expose the AMQ Broker management console by default. This is because the OpenShift proxy performs load balancing across each broker in the cluster and it would not be possible to control which broker console is connected at a given time.

The following example procedure shows how to configure each broker in the cluster to connect to its own management console instance. You do this by creating a dedicated Service-and-Route combination for each broker Pod in the cluster.

Prerequisites

- You have already deployed a clustered set of brokers, where each broker runs in its own Pod. See Deploying a set of clustered brokers .

Procedure

1. Create a regular Service for each Pod in the cluster, using a StatefulSet selector to select between Pods. To do this, deploy a Service template, in **.yaml** format, that looks like the following:

```
apiVersion: v1
kind: Service
metadata:
  annotations:
    description: 'Service for the management console of broker pod XXXX'
  labels:
    app: application2
    application: application2
    template: amq-broker-75-persistence-clustered
  name: amq2-amq-console-XXXX
  namespace: amq75-p-c-ssl-2
spec:
  ports:
    - name: console-jolokia
      port: 8161
      protocol: TCP
      targetPort: 8161
  selector:
    deploymentConfig: application2-amq
    statefulset.kubernetes.io/pod-name: application2-amq-XXXX
  type: ClusterIP
```

In the preceding template, replace **XXXX** with the ordinal value of the broker Pod you want to associate with the Service. For example, to associate the Service with the first Pod in the cluster, set **XXXX** to **0**. To associate the Service with the second Pod, set **XXXX** to **1**, and so on.

Save and deploy an instance of the template for each broker Pod in your cluster.

NOTE

In the example template shown above, the selector uses the Kubernetes-defined Pod name.

2. Create a Route for each broker Pod, so that the AMQ Broker management console can connect to the Pod.
   Click **Routes → Create Route**.

   The **Edit Route** page opens.

   a. In the **Services** drop-down menu, select the previously created broker Service that you want to associate the Route with, for example, **amq2-amq-console-0**.

   b. Set **Target Port** to **8161**, to enable access for the AMQ Broker management console.

   c. To display the TLS parameters, select the **Secure route** check box.

      i. From the **TLS Termination** drop-down menu, choose **Passthrough**.
         This selection relays all communication to AMQ Broker without the OpenShift router decrypting and resending it.

   d. Click **Create**.
      When you create a Route associated with one of broker Pods, the resulting **.yaml** file includes lines that look like the following:

```
spec:
  host: amq2-amq-console-0-amq75-p-c-2.apps-ocp311.example.com
  port:
    targetPort: console-jolokia
  tls:
    termination: passthrough
  to:
    kind: Service
    name: amq2-amq-console-0
    weight: 100
  wildcardPolicy: None
```

3. To access the management console for a specific broker instance, copy the **host** URL shown above to a web browser.

Additional resources

- For more information on the clustering of brokers see Enabling message redistribution.

8.4. DEPLOYING A SET OF CLUSTERED SSL BROKERS

Deploy a clustered set of brokers, where each broker runs in its own Pod and the broker is configured to accept connections using SSL.

8.4.1. Distributing messages

Message distribution is configured to use *ON_DEMAND*. This means that when messages arrive at a clustered broker, the messages are distributed in a round-robin fashion to any broker that has consumers.

This message distribution policy safeguards against messages getting stuck on a specific broker while a consumer, connected either directly or through the OpenShift router, is connected to a different broker.

The redistribution delay is non-zero by default. If a message is on a queue that has no consumers, it will be redistributed to another broker.

NOTE

When redistribution is enabled, messages can be delivered out of order.

8.4.2. Deploying the image and template

Prerequisites

- This procedure builds upon Preparing a broker.
- Completion of the Deploying a basic broker example is recommended.

Procedure

1. Navigate to the OpenShift web console and log in.
2. Select the **amq-demo** project space.
3. Click **Add to Project** > **Browse catalog** to list all of the default image streams and templates.
4. Use the **Filter** search bar to limit the list to those that match **amq**. Click **See all** to show the desired application template.
5. Select the **amq-broker-75-persistence-clustered-ssl** template which is labeled **Red Hat AMQ Broker 7.5 (SSL, clustered)**.
6. Set the following values in the configuration and click **create**.

Table 8.4. Example template

Environment variable	Display Name	Value	Description
AMQ_PROTOCOL	AMQ Protocols	openwire,amqp,stomp,mqtt,hornetq	The protocols to be accepted by the broker
AMQ_QUEUES	Queues	demoQueue	Creates an anycast queue called demoQueue

Environment variable	Display Name	Value	Description
AMQ_ADDRESSES	Addresses	demoTopic	Creates an address (or topic) called demoTopic. By default, this address has no assigned routing type.
VOLUME_CAPACITY	AMQ Volume Size	1Gi	The persistent volume size created for the journal
AMQ_CLUSTERED	Clustered	true	This needs to be true to ensure the brokers cluster
AMQ_CLUSTER_USER	cluster user	generated	The username the brokers use to connect with each other
AMQ_CLUSTER_PASSWORD	cluster password	generated	The password the brokers use to connect with each other
AMQ_USER	AMQ Username	amq-demo-user	The username the client uses
AMQ_PASSWORD	AMQ Password	password	The password the client uses with the username
AMQ_TRUSTSTORE	Trust Store Filename	broker.ts	The SSL truststore file name
AMQ_TRUSTSTORE_PASSWORD	Truststore Password	password	The password used when creating the Truststore
AMQ_KEYSTORE	AMQ Keystore Filename	broker.ks	The SSL keystore file name
AMQ_KEYSTORE_PASSWORD	AMQ Keystore Password	password	The password used when creating the Keystore

8.4.3. Deploying the application

Deploy after creating the application. Deploying the application creates a Pod and starts the broker.

Procedure

1. Click **Stateful Sets** in the OpenShift Container Platform web console.
2. Click the **broker-amq** deployment.
3. Click **Deploy** to deploy the application.

NOTE

The default number of replicas for a clustered template is **0**, so you will not see any Pods.

4. Scale up the Pods to three to create a cluster of brokers.

```
$ oc scale statefulset broker-amq --replicas=3
statefulset "broker-amq" scaled
```

5. Check that there are three Pods running.

```
$ oc get pods
NAME          READY     STATUS    RESTARTS   AGE
broker-amq-0   1/1       Running   0          33m
broker-amq-1   1/1       Running   0          33m
broker-amq-2   1/1       Running   0          29m
```

6. If the Pod status shows **ErrImagePull** or **ImagePullBackOff**, your deployment was not able to directly pull the specified broker image from the Red Hat Container Registry. In this case, edit your Stateful Set to reference the correct broker image name and the image pull secret name associated with the account used for authentication in the Red Hat Container Registry. Then, you can import the broker image and start the brokers. To do this, complete steps similar to those in Deploy and start the broker application .

7. Verify the brokers have clustered with the new Pod by checking the logs.

```
$ oc logs broker-amq-2
```

This shows all the logs of the new broker and an entry for a clustered bridge created between the brokers, for example:

```
2018-08-29 07:43:55,779 INFO  [org.apache.activemq.artemis.core.server] AMQ221027:
Bridge ClusterConnectionBridge@1b0e9e9d [name=$.artemis.internal.sf.my-
cluster.4333c830-ab5f-11e8-afb8-0a580a82006e,
queue=QueueImpl[name=$.artemis.internal.sf.my-cluster.4333c830-ab5f-11e8-afb8-
0a580a82006e, postOffice=PostOfficeImpl
[server=ActiveMQServerImpl::serverUUID=9cedb69d-ab5e-11e8-87a4-0a580a82006c],
temp=false]@5e0c0398 targetConnector=ServerLocatorImpl (identity=(Cluster-connection-
bridge::ClusterConnectionBridge@1b0e9e9d [name=$.artemis.internal.sf.my-
cluster.4333c830-ab5f-11e8-afb8-0a580a82006e,
queue=QueueImpl[name=$.artemis.internal.sf.my-cluster.4333c830-ab5f-11e8-afb8-
0a580a82006e, postOffice=PostOfficeImpl
[server=ActiveMQServerImpl::serverUUID=9cedb69d-ab5e-11e8-87a4-0a580a82006c],
temp=false]@5e0c0398 targetConnector=ServerLocatorImpl [initialConnectors=
[TransportConfiguration(name=artemis, factory=org-apache-activemq-artemis-core-remoting-
impl-netty-NettyConnectorFactory) ?port=61616&host=10-130-0-110],
discoveryGroupConfiguration=null]]::ClusterConnectionImpl@806813022[nodeUUID=9cedb69d
-ab5e-11e8-87a4-0a580a82006c, connector=TransportConfiguration(name=artemis,
factory=org-apache-activemq-artemis-core-remoting-impl-netty-NettyConnectorFactory) ?
port=61616&host=10-130-0-108, address=,
server=ActiveMQServerImpl::serverUUID=9cedb69d-ab5e-11e8-87a4-0a580a82006c]))
[initialConnectors=[TransportConfiguration(name=artemis, factory=org-apache-activemq-
artemis-core-remoting-impl-netty-NettyConnectorFactory) ?port=61616&host=10-130-0-110],
discoveryGroupConfiguration=null]] is connected
```

Additional resources

- To learn how to configure each broker in the cluster to connect to its own management console instance, see Creating Routes for the AMQ Broker management console .
- For more information about messaging in a broker cluster, see Enabling Message Redistribution.

8.5. DEPLOYING A BROKER WITH CUSTOM CONFIGURATION

Deploy a broker with custom configuration. Although functionality can be obtained by using templates, broker configuration can be customized if needed.

Prerequisites

- This tutorial builds upon Preparing a broker.
- Completion of the Deploying a basic broker tutorial is recommended.

8.5.1. Deploy the image and template

Procedure

1. Navigate to the OpenShift web console and log in.
2. Select the **amq-demo** project space.
3. Click **Add to Project** > **Browse catalog** to list all of the default image streams and templates.
4. Use the **Filter** search bar to limit results to those that match **amq**. Click **See all** to show the desired application template.
5. Select the **amq-broker-75-custom** template which is labeled **Red Hat AMQ Broker 7.5(Ephemeral, no SSL)**.
6. In the configuration, update **broker.xml** with the custom configuration you would like to use. Click **Create**.

NOTE

Use a text editor to create the broker's XML configuration. Then, cut and paste confguration details into the **broker.xml** field.

NOTE

OpenShift Container Platform does not use a **ConfigMap** object to store the custom configuration that you specify in the **broker.xml** field, as is common for many applications deployed on this platform. Instead, OpenShift temporarily stores the specified configuration in an environment variable, before transferring the configuration to a standalone file when the broker container starts.

8.5.2. Deploy the application

Once the application has been created it needs to be deployed. Deploying the application creates a Pod and starts the broker.

Procedure

1. Click **Deployments** in the OpenShift Container Platform web console.
2. Click the **broker-amq** deployment
3. Click **Deploy** to deploy the application.

8.6. BASIC SSL CLIENT EXAMPLE

Implement a client that sends and receives messages from a broker configured to use SSL, using the Qpid JMS client.

Prerequisites

- This tutorial builds upon Preparing a Broker.
- Completion of the Deploying a Basic Broker with SSL tutorial is recommended.
- AMQ JMS Examples

8.6.1. Configuring the client

Create a sample client that can be updated to connect to the SSL broker. The following procedure builds upon AMQ JMS Examples.

Procedure

1. Add an entry into your /etc/hosts file to map the route name onto the IP address of the OpenShift cluster:

   ```
   10.0.0.1 broker-amq-tcp-amq-demo.router.default.svc.cluster.local
   ```

2. Update the jndi.properties configuration file to use the route, truststore and keystore created previously, for example:

   ```
   connectionfactory.myFactoryLookup = amqps://broker-amq-tcp-amq-
   demo.router.default.svc.cluster.local:8443?transport.keyStoreLocation=<keystore-
   path>client.ks&transport.keyStorePassword=password&transport.trustStoreLocation=
   <truststore-
   path>/client.ts&transport.trustStorePassword=password&transport.verifyHost=false
   ```

3. Update the jndi.properties configuration file to use the queue created earlier.

   ```
   queue.myDestinationLookup = demoQueue
   ```

4. Execute the sender client to send a text message.
5. Execute the receiver client to receive the text message. You should see:

```
Received message: Message Text!
```

8.7. EXTERNAL CLIENTS USING SUB-DOMAINS EXAMPLE

Expose a clustered set of brokers through a node port and connect to it using the core JMS client. This enables clients to connect to a set of brokers which are configured using the **amq-broker-75-persistence-clustered-ssl** template.

8.7.1. Exposing the brokers

Configure the brokers so that the cluster of brokers are externally available and can be connected to directly, bypassing the OpenShift router. This is done by creating a route that exposes each pod using its own hostname.

Prerequisites

- Deploying a set of clustered brokers

Procedure

1. Choose **import YAML/JSON** from **Add to Project** drop down

2. Enter the following and click create.

```
apiVersion: v1
kind: Route
metadata:
  labels:
    app: broker-amq
    application: broker-amq
  name: tcp-ssl
spec:
  port:
    targetPort: ow-multi-ssl
  tls:
    termination: passthrough
  to:
    kind: Service
    name: broker-amq-headless
    weight: 100
  wildcardPolicy: Subdomain
  host: star.broker-ssl-amq-headless.amq-demo.svc
```

NOTE

The important configuration here is the wildcard policy of **Subdomain**. This allows each broker to be accessible through its own hostname.

8.7.2. Connecting the clients

Create a sample client that can be updated to connect to the SSL broker. The steps in this procedure build upon the AMQ JMS Examples.

Procedure

1. Add entries into the /etc/hosts file to map the route name onto the actual IP addresses of the brokers:

```
10.0.0.1 broker-amq-0.broker-ssl-amq-headless.amq-demo.svc broker-amq-1.broker-ssl-
amq-headless.amq-demo.svc broker-amq-2.broker-ssl-amq-headless.amq-demo.svc
```

2. Update the jndi.properties configuration file to use the route, truststore, and keystore created previously, for example:

```
connectionfactory.myFactoryLookup = amqps://broker-amq-0.broker-ssl-amq-headless.amq-
demo.svc:443?transport.keyStoreLocation=/home/ataylor/projects/jboss-amq-7-broker-
openshift-
image/client.ks&transport.keyStorePassword=password&transport.trustStoreLocation=/home/at
aylor/projects/jboss-amq-7-broker-openshift-
image/client.ts&transport.trustStorePassword=password&transport.verifyHost=false
```

3. Update the jndi.properties configuration file to use the queue created earlier.

```
queue.myDestinationLookup = demoQueue
```

4. Execute the sender client code to send a text message.

5. Execute the receiver client code to receive the text message. You should see:

```
Received message: Message Text!
```

Additional resources

- For more information on using the AMQ JMS client, see AMQ JMS Examples.

8.8. EXTERNAL CLIENTS USING PORT BINDING EXAMPLE

Expose a clustered set of brokers through a NodePort and connect to it using the core JMS client. This enables clients that do not support SNI or SSL. It is used with clusters configured using the **amq-broker-75-persistence-clustered** template.

8.8.1. Exposing the brokers

Configure the brokers so that the cluster of brokers are externally available and can be connected to directly, bypassing the OpenShift router. This is done by creating a service that uses a NodePort to load balance around the clusters.

Prerequisites

- Deploying a set of clustered brokers

Procedure

1. Choose **import YAML/JSON** from **Add to Project** drop down.

2. Enter the following and click create.

```
apiVersion: v1
kind: Service
metadata:
  annotations:
    description: The broker's OpenWire port.
    service.alpha.openshift.io/dependencies: >-
      [{"name": "broker-amq-amqp", "kind": "Service"},{"name":
      "broker-amq-mqtt", "kind": "Service"},{"name": "broker-amq-stomp", "kind":
      "Service"}]
  creationTimestamp: '2018-08-29T14:46:33Z'
  labels:
    application: broker
    template: amq-broker-75-statefulset-clustered
  name: broker-external-tcp
  namespace: amq-demo
  resourceVersion: '2450312'
  selfLink: /api/v1/namespaces/amq-demo/services/broker-amq-tcp
  uid: 52631fa0-ab9a-11e8-9380-c280f77be0d0
spec:
  externalTrafficPolicy: Cluster
  ports:
   -  nodePort: 30001
      port: 61616
      protocol: TCP
      targetPort: 61616
  selector:
    deploymentConfig: broker-amq
  sessionAffinity: None
  type: NodePort
status:
  loadBalancer: {}
```

NOTE

The NodePort configuration is important. The NodePort is the port in which the client will access the brokers and the type is **NodePort**.

8.8.2. Connecting the clients

Create consumers that are round-robinned around the brokers in the cluster using the AMQ broker CLI.

Procedure

1. In a terminal create a consumer and attach it to the IP address where OpenShift is running.

   ```
   artemis consumer --url tcp://<IP_ADDRESS>:30001 --message-count 100 --destination
   queue://demoQueue
   ```

2. Repeat step 1 twice to start another two consumers.

NOTE

You should now have three consumers load balanced across the three brokers.

3. Create a producer to send messages.

```
artemis producer --url tcp://<IP_ADDRESS>:30001 --message-count 300 --destination
queue://demoQueue
```

4. Verify each consumer receives messages.

```
Consumer:: filter = null
Consumer ActiveMQQueue[demoQueue], thread=0 wait until 100 messages are consumed
Consumer ActiveMQQueue[demoQueue], thread=0 Consumed: 100 messages
Consumer ActiveMQQueue[demoQueue], thread=0 Consumer thread finished
```

8.9. MONITORING AMQ BROKER

This tutorial demonstrates how to monitor AMQ Broker.

Prerequisites

- This tutorial builds upon Preparing a broker.
- Completion of the Deploying a basic broker tutorial is recommended.

Procedure

1. Get the list of running pods:

```
$ oc get pods

NAME                READY     STATUS    RESTARTS   AGE
broker-amq-1-ftqmk   1/1       Running   0          14d
```

2. Run the **oc logs** command:

```
$ oc logs -f broker-amq-1-ftqmk

Running /amq-broker-71-openshift image, version 1.3-5
INFO: Loading '/opt/amq/bin/env'
INFO: Using java '/usr/lib/jvm/java-1.8.0/bin/java'
INFO: Starting in foreground, this is just for debugging purposes (stop process by pressing
CTRL+C)
...
INFO | Listening for connections at: tcp://broker-amq-1-ftqmk:61616?
maximumConnections=1000&wireFormat.maxFrameSize=104857600
INFO | Connector openwire started
INFO | Starting OpenShift discovery agent for service broker-amq-tcp transport type tcp
INFO | Network Connector DiscoveryNetworkConnector:NC:BrokerService[broker-amq-1-
ftqmk] started
INFO | Apache ActiveMQ 5.11.0.redhat-621084 (broker-amq-1-ftqmk, ID:broker-amq-1-
ftqmk-41433-1491445582960-0:1) started
INFO | For help or more information please see: http://activemq.apache.org
WARN | Store limit is 102400 mb (current store usage is 0 mb). The data directory:
/opt/amq/data/kahadb only has 9684 mb of usable space - resetting to maximum available
disk space: 9684 mb
```

```
WARN | Temporary Store limit is 51200 mb, whilst the temporary data directory:
/opt/amq/data/broker-amq-1-ftqmk/tmp_storage only has 9684 mb of usable space - resetting
to maximum available 9684 mb.
```

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\",compone
nt=addresses,queue=\"TESTQUEUE\",routing-
type=\"anycast\",subcomponent=queues","attribute":"MaxConsumers","type":"read"},"value":-
1,"timestamp":1528297825,"status":200}
```

CHAPTER 9. REFERENCE

9.1. CUSTOM RESOURCE DEFINITION CONFIGURATION REFERENCE

A Custom Resource Definition (CRD) is a schema of configuration items that you can modify for a custom OpenShift object deployed with an Operator. An accompanying Custom Resource (CR) file enables you to specify values for configuration items in the CRD.

The following sub-sections detail the configuration items available in the broker and addressing CRDs.

9.1.1. Broker CRD configuration reference

The broker Custom Resource Definition (CRD) enables you to configure a broker for deployment in an OpenShift project. 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	Type	Example	Default value	Description
adminUser*		string	my_user	Automatically-generated, random value	Password required for connecting to 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, **ex-aao-credentials-secret**.

Entry	Sub-entry	Type	Example	Default value	Description
adminPassword *		string	my_password	Automatically-generated, random value	Password required for connecting to 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, **ex-aao-credentials-secret**.
deploymentPlan *					Broker deployment configuration
	image*	string	registry.redhat.io/amq7/amq-broker:latest	registry.redhat.io/amq7/amq-broker:7.5	URL of broker container image to pull from Red Hat Container Registry. The default tag matches the broker Operator version.

Entry	Sub-entry	Type	Example	Default value	Description
	size*	int	2	2	Number of broker Pods to create in deployment. If you a 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.
	requireLogin	Boolean	true	true	Specify whether login credentials are required to connect to broker.
	persistenceEnabled	Boolean	false	true	Specify whether to use journal storage via a persistent volume (PV) created with a persistent volume claim (PVC).
	journalType	string	aio	aio	Specify whether to use asynchronous I/O (AIO) or non-blocking I/O (NIO).
	messageMigration	Boolean	true	true	Specify whether to migrate messages upon broker scaledown.
acceptors.acceptor		object			A single acceptor configuration instance.

Entry	Sub-entry	Type	Example	Default value	Description
	name*	string	my_acceptor	Not specified	Name of acceptor.
	port	int	5672	61626 for the first acceptor that you define. Default value increments by 10 for every subsequent acceptor that you define.	Port number to be used for acceptor instance.
	protocols	string	amqp,core	all	Messaging protocols to enable on acceptor instance.
	sslEnabled	Boolean	false	false	Specify whether SSL is enabled on acceptor port. If set to **true**, look in secret for data required to enable SSL on acceptor.

Entry	Sub-entry	Type	Example	Default value	Description
	sslSecret	string	ex-aao-my_acceptor-secret	Not specified	Secret where client truststore and broker keystore (base64-encoded) and **keyStorePassword** and **trustStorePassword** (non-encoded) are stored. If you do not specify a value for **sslSecret**, the acceptor uses the default secret. The default secret name has a format of **<Custom Resource name>-<acceptor name>-secret**.
	enabledCipherSuites	string	SSL_RSA_WITH_RC4_128_SHA,SSL_DH_anon_WITH_3DES_EDE_CBC_SHA	Not specified	Comma-separated list of cipher suites to use for SSL communication.
	enabledProtocols	string	TLSv1,TLSv1.1,TLSv1.2	Not specified	Comma-separated list of protocols to use for SSL communication.
	needClientAuth	Boolean	true	Not specified	Specify whether broker informs client that two-way SSL is required on acceptor. This property overrides **wantClientAuth**.

Entry	Sub-entry	Type	Example	Default value	Description
	wantClientAuth	Boolean	true	Not specified	Specify whether broker tells client that two-way SSL is requested on acceptor, but not required. Overridden by **needClientAuth**.
	verifyHost	Boolean	true	Not specified	Specify whether to compare the Common Name (CN) of client's SSL certificate to its host name, to verify that they match. This option applies only when two-way SSL is used.
	sslProvider	string	JDK	JDK	Specify whether SSL provider is JDK or OPENSSL.
	sniHost	string	some_regular_expression	Not specified	Regular expression to match against **server_name** extension on incoming SSL connections. If the names don't match, connection to the acceptor is rejected.
	expose	Boolean	true	false	Specify whether to expose acceptor outside OpenShift Container Platform
	anycastPrefix	string	jms.topic.	Not specified	Prefix used by client to specify that the **anycast** routing type should be used.

Entry	Sub-entry	Type	Example	Default value	Description
	multicastPrefix	string	/queue/	Not specified	Prefix used by client to specify that the **multicast** routing type should be used.
	connectionsAllowed	integer	2	0	Number of connections allowed on 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.
connectors.connector		object			A single connector configuration instance.
	name*	string	my_connector	N/A	Name of connector
	type	string	tcp	tcp	The type of connector to create, **tcp** or **vm**.
	host*	string	localhost	Not specified	Host name or IP address to connect to.
	port*	int	22222	Not specified	Port number to be used for connector instance.

Entry	Sub-entry	Type	Example	Default value	Description
	sslEnabled	Boolean	false	false	Specify whether SSL is enabled on connector port. If set to **true**, look in secret for data required to enable SSL on connector.
	sslSecret	string	ex-aao-my_connector-secret	Not specified	Secret where client truststore and broker keystore (base64-encoded) and **keyStorePassword** and **trustStorePassword** (non-encoded) are stored. If you do not specify a value for **sslSecret**, the connector uses the default secret. The default secret name has a format of **<Custom Resource name>-<connector name>-secret**.
	enabledCipherSuites	string	SSL_RSA_WITH_RC4_128_SHA, SSL_DH_anon_WITH_3DES_EDE_CBC_SHA	Not specified	Comma-separated list of cipher suites to use for SSL communication.
	enabledProtocols	string	TLSv1,TLSv1.1,TLSv1.2	Not specified	Comma-separated list of protocols to use for SSL communication.

Entry	Sub-entry	Type	Example	Default value	Description
	needClientAuth	Boolean	true	Not specified	Specify whether broker informs client that two-way SSL is required on connector. This property overrides **wantClientAuth**.
	wantClientAuth	Boolean	true	Not specified	Specify whether broker informs client that two-way SSL is requested on connector, but not required. Overridden by **needClientAuth**.
	verifyHost	Boolean	true	Not specified	Specify whether to compare Common Name (CN) of client's SSL certificate to its host name, to verify that they match. This option applies only when two-way SSL is used.
	sslProvider	string	JDK	JDK	Specify whether SSL provider is **JDK** or **OPENSSL**.
	sniHost	string	some_regular_expression	Not specified	Regular expression to match against **server_name** extension on SSL connection. If the names don't match, the connector connection is rejected.

Entry	Sub-entry	Type	Example	Default value	Description
	expose	Boolean	true	false	Specify whether to expose connector outside OpenShift Container Platform.
console					Configuration of broker management console.
	expose	Boolean	true	false	Specify whether to expose management console port.
	sslEnabled	Boolean	true	false	Specify whether to use SSL on management console port.
	sslSecret	string	ex-aao-my_console-secret	Not specified	Secret where client truststore and broker keystore (base64-encoded) and **keyStorePassword** and **trustStorePassword** (non-encoded) are stored. If you do not specify a value for **sslSecret**, the console uses the default secret. The default secret name has a format of **<Custom Resource name>-console-secret**.
	useClientAuth	Boolean	true	false	Specify whether management console requires client authorization.

9.1.2. Addressing CRD configuration reference

The addressing Custom Resource Definition (CRD) enables you to define addresses and queues and associated routing types to be created in your broker. 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	Type	Example	Default value	Description
addressName*	string	address0	Not specified	Address name to be created in broker.
queueName*	string	queue0	Not specified	Queue name to be created in broker.
routingType*	string	anycast	Not specified	Routing type to be used - anycast or multicast.

9.2. 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 9.1. 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.
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.

Parameter	Description
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 stateful sets.
AMQ_DATA_DIR_LOGGING	Specifies the directory for the data directory logging.
AMQ_EXTRA_ARGS	Specifies additional arguments to pass to **artemis create**.
AMQ_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**.
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.

Parameter	Description
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.
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.

Parameter	Description
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

9.3. 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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