Red Hat AMQ 2021.Q1 Using AMQ Online on OpenShift

For use with AMQ Online 1.7
Abstract

This guide describes how to use AMQ Online.
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAKING OPEN SOURCE MORE INCLUSIVE</strong></td>
<td>5</td>
</tr>
<tr>
<td><strong>PRODUCT LIFE CYCLE</strong></td>
<td>6</td>
</tr>
<tr>
<td><strong>CHAPTER 1. INTRODUCTION</strong></td>
<td>7</td>
</tr>
<tr>
<td>1.1. AMQ ONLINE OVERVIEW</td>
<td>7</td>
</tr>
<tr>
<td>1.2. SUPPORTED FEATURES</td>
<td>7</td>
</tr>
<tr>
<td>1.3. AMQ ONLINE USER ROLES</td>
<td>8</td>
</tr>
<tr>
<td>1.4. SUPPORTED CONFIGURATIONS</td>
<td>9</td>
</tr>
<tr>
<td>1.5. DOCUMENT CONVENTIONS</td>
<td>9</td>
</tr>
<tr>
<td>1.5.1. Variable text</td>
<td>9</td>
</tr>
<tr>
<td><strong>CHAPTER 2. MANAGING ADDRESS SPACES</strong></td>
<td>10</td>
</tr>
<tr>
<td>2.1. ADDRESS SPACE</td>
<td>10</td>
</tr>
<tr>
<td>2.2. STANDARD ADDRESS SPACE</td>
<td>10</td>
</tr>
<tr>
<td>2.2.1. Standard address types</td>
<td>10</td>
</tr>
<tr>
<td>2.2.1.1. Queue</td>
<td>11</td>
</tr>
<tr>
<td>2.2.1.2. Topic</td>
<td>11</td>
</tr>
<tr>
<td>2.2.1.2.1. Hierarchical topics and wildcards</td>
<td>11</td>
</tr>
<tr>
<td>2.2.1.2.2. Known issue with creating a subscriber on a hierarchical topic</td>
<td>11</td>
</tr>
<tr>
<td>2.2.1.3. Anycast</td>
<td>12</td>
</tr>
<tr>
<td>2.2.1.4. Multicast</td>
<td>12</td>
</tr>
<tr>
<td>2.2.1.5. Subscription</td>
<td>12</td>
</tr>
<tr>
<td>2.3. BROKERED ADDRESS SPACE</td>
<td>12</td>
</tr>
<tr>
<td>2.3.1. Brokered address types</td>
<td>12</td>
</tr>
<tr>
<td>2.3.1.1. Queue</td>
<td>13</td>
</tr>
<tr>
<td>2.3.1.2. Topic</td>
<td>13</td>
</tr>
<tr>
<td>2.3.1.2.1. Hierarchical topics and wildcards</td>
<td>13</td>
</tr>
<tr>
<td>2.3.1.2.2. Known issue with creating a subscriber on a hierarchical topic</td>
<td>13</td>
</tr>
<tr>
<td>2.4. ADDRESS SPACE PLANS</td>
<td>13</td>
</tr>
<tr>
<td>2.5. LISTING AVAILABLE ADDRESS SPACE PLANS USING THE COMMAND LINE</td>
<td>13</td>
</tr>
<tr>
<td>2.6. LISTING AVAILABLE AUTHENTICATION SERVICES USING THE COMMAND LINE</td>
<td>14</td>
</tr>
<tr>
<td>2.7. ADDRESS SPACE EXAMPLES</td>
<td>14</td>
</tr>
<tr>
<td>2.7.1. Address space example</td>
<td>14</td>
</tr>
<tr>
<td>2.7.2. Address space example using an authentication service</td>
<td>14</td>
</tr>
<tr>
<td>2.7.3. Address space example using an external authentication service allowing overrides</td>
<td>15</td>
</tr>
<tr>
<td>2.7.4. Address space examples exposing endpoints externally</td>
<td>15</td>
</tr>
<tr>
<td>2.7.4.1. OpenShift LoadBalancer service example</td>
<td>16</td>
</tr>
<tr>
<td>2.7.4.2. OpenShift route example</td>
<td>16</td>
</tr>
<tr>
<td>2.7.5. Address space certificate provider configuration examples</td>
<td>17</td>
</tr>
<tr>
<td>2.7.5.1. openshift provider</td>
<td>17</td>
</tr>
<tr>
<td>2.7.5.2. selfsigned provider</td>
<td>18</td>
</tr>
<tr>
<td>2.7.5.3. certBundle provider</td>
<td>18</td>
</tr>
<tr>
<td>2.7.6. Address space example exports</td>
<td>19</td>
</tr>
<tr>
<td>2.7.6.1. ConfigMap and Secret type export examples</td>
<td>19</td>
</tr>
<tr>
<td>2.7.6.2. Service type export example</td>
<td>19</td>
</tr>
<tr>
<td>2.8. EXAMPLE ADDRESS SPACE STATUS OUTPUT</td>
<td>19</td>
</tr>
<tr>
<td>2.9. EXAMPLE OF EXPORTING ADDRESS SPACE INFORMATION INTO THE APPLICATION NAMESPACE</td>
<td>20</td>
</tr>
<tr>
<td>2.10. ADDRESS SPACE CONNECTOR EXAMPLES</td>
<td>21</td>
</tr>
<tr>
<td>2.10.1. Address space connector using SASL PLAIN</td>
<td>22</td>
</tr>
<tr>
<td>2.10.2. Address space connector using mutual TLS</td>
<td>23</td>
</tr>
<tr>
<td>2.11. CREATING ADDRESS SPACES USING THE COMMAND LINE</td>
<td>24</td>
</tr>
</tbody>
</table>
2.12. CREATING AN ADDRESS SPACE USING THE RED HAT AMQ CONSOLE

2.13. CHANGING THE ADDRESS SPACE PLAN ASSOCIATED WITH AN ADDRESS SPACE USING THE RED HAT AMQ CONSOLE

2.14. CHANGING THE AUTHENTICATION SERVICE ASSOCIATED WITH AN ADDRESS SPACE USING THE RED HAT AMQ CONSOLE

2.15. DELETING AN ADDRESS SPACE USING THE RED HAT AMQ CONSOLE

2.16. EXAMPLE COMMANDS FOR RETRIEVING ADDRESS SPACE INFORMATION

2.17. REPLACING ADDRESS SPACES USING THE COMMAND LINE

CHAPTER 3. MANAGING ADDRESSES

3.1. ADDRESS

3.2. ADDRESS PLANS

3.2.1. Address example

3.2.2. Topic and subscription address example

3.2.3. Address TTL restriction example

3.2.4. Address message redelivery/dead letter example

3.2.5. Address forwarding examples

3.2.5.1. Forwarding messages from a local queue to a remote AMQP server

3.2.5.2. Forwarding messages from a remote AMQP server to a local queue

3.3. LISTING AVAILABLE ADDRESS PLANS USING THE COMMAND LINE

3.4. CREATING ADDRESSES USING THE COMMAND LINE

3.5. CREATING ADDRESSES USING THE RED HAT AMQ CONSOLE

3.6. REPLACING ADDRESSES USING THE COMMAND LINE

3.7. DELETING ADDRESSES USING THE RED HAT AMQ CONSOLE

CHAPTER 4. USING THE RED HAT AMQ CONSOLE

4.1. RED HAT AMQ CONSOLE USER PERMISSIONS

4.2. ACCESSING THE RED HAT AMQ CONSOLE

4.3. VIEWING MESSAGE AND APPLICATION CONNECTION STATISTICS USING THE RED HAT AMQ CONSOLE

4.4. VIEWING ENDPOINT INFORMATION USING THE RED HAT AMQ CONSOLE

4.5. PURGING QUEUES AND SUBSCRIPTIONS

4.6. CLOSING CONNECTIONS USING THE RED HAT AMQ CONSOLE

CHAPTER 5. USER MODEL

5.1. AUTHENTICATION

5.1.1. Password authentication type

5.1.2. Serviceaccount authentication type

5.2. AUTHORIZATION

5.3. MANAGING USERS

5.3.1. Creating users using the command line

5.3.2. Deleting users using the command line

5.3.3. Managing user permissions using the command line

CHAPTER 6. CONNECTING APPLICATIONS TO AMQ ONLINE

6.1. RETRIEVING THE SELF-SIGNED CA CERTIFICATE

6.2. CLIENT EXAMPLES

6.2.1. AMQ Online Python example

6.2.1.1. Known issue with creating a subscriber on a hierarchical topic

6.2.2. AMQ Online JMS example

6.2.3. AMQ Online JavaScript example

6.2.3.1. AMQ Online JavaScript example using WebSockets

6.2.4. AMQ Online C++ example

6.2.4.1. Known issue with creating a subscriber on a hierarchical topic
6.2.5. AMQ Online .NET example

APPENDIX A. USING YOUR SUBSCRIPTION .......................... 53
Accessing your account 53
Activating a subscription 53
Downloading zip and tar files 53
Registering your system for packages 53

APPENDIX B. AMQ ONLINE RESOURCES FOR MESSAGING TENANTS .................. 54
MAKING OPEN SOURCE MORE INCLUSIVE

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

AMQ Online 1.7 is a Long Term Support (LTS) release version. LTS updates are provided until the product’s EOL on June 30, 2023. These updates are limited to critical bug and security fixes.

For more information on the product life cycle, see the following Red Hat support articles:

- AMQ Online End of Life
- Red Hat Middleware Product Update and Support Policy
- How long are AMQ LTS releases supported?
1.1. AMQ ONLINE OVERVIEW

Red Hat AMQ Online is an OpenShift-based mechanism for delivering messaging as a managed service. With Red Hat AMQ Online, administrators can configure a cloud-native, multi-tenant messaging service either in the cloud or on premise. Developers can provision messaging using the Red Hat AMQ Console. Multiple development teams can provision the brokers and queues from the Console, without requiring each team to install, configure, deploy, maintain, or patch any software.

AMQ Online can provision different types of messaging depending on your use case. A user can request messaging resources by creating an address space. AMQ Online currently supports two address space types, standard and brokered, each with different semantics. The following diagrams illustrate the high-level architecture of each address space type:

**Figure 1.1. Standard address space**

**Figure 1.2. Brokered address space**

1.2. SUPPORTED FEATURES

The following table shows the supported features for AMQ Online 1.7:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Brokered address space</th>
<th>Standard address space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address type</td>
<td>Queue</td>
<td>Yes</td>
</tr>
<tr>
<td>Feature</td>
<td>Brokered address space</td>
<td>Standard address space</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Topic</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Multicast</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Anycast</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Subscription</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Messaging protocol</td>
<td>AMQP</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>MQTT</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>CORE</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>OpenWire</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>STOMP</td>
<td>No</td>
</tr>
<tr>
<td>Transports</td>
<td>TCP</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>WebSocket</td>
<td>Yes</td>
</tr>
<tr>
<td>Durable subscriptions</td>
<td>JMS durable subscriptions</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>&quot;Named&quot; durable subscriptions</td>
<td>No</td>
</tr>
<tr>
<td>JMS</td>
<td>Transaction support</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Selectors on queues</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Message ordering guarantees (including prioritization)</td>
<td>Yes</td>
</tr>
<tr>
<td>Scalability</td>
<td>Scalable distributed queues and topics</td>
<td>No</td>
</tr>
</tbody>
</table>

### 1.3. AMQ ONLINE USER ROLES

AMQ Online users can be defined broadly in terms of two user roles: service administrator and messaging tenant. Depending on the size of your organization, these roles might be performed by the same person or different people.
The messaging tenant can request messaging resources, using both cloud-native APIs and tools. The messaging tenant can also manage the users and permissions of a particular address space within the messaging system as well as create address spaces and addresses. *Using AMQ Online on OpenShift* provides information about how to accomplish these tasks.

The service administrator role performs the initial installation and any subsequent upgrades. The service administrator might also deploy and manage the messaging infrastructure, such as monitoring the routers, brokers, and administration components; and creating the address space plans and address plans. For more information about how to set up and manage AMQ Online as well as configure the infrastructure and plans, see *Installing and Managing AMQ Online on OpenShift*.

### 1.4. SUPPORTED CONFIGURATIONS

For more information about AMQ Online supported configurations see *Red Hat AMQ 7 Supported Configurations*.

### 1.5. DOCUMENT CONVENTIONS

#### 1.5.1. Variable text

This document contains code blocks with variables that you must replace with values specific to your installation. In this document, such text is styled as italic monospace.

For example, in the following code block, replace `my-namespace` with the namespace used in your installation:

```
sed -i 's/amq-online-infra/my-namespace/' install/bundles/enmasse-with-standard-authservice/*.yaml
```
CHAPTER 2. MANAGING ADDRESS SPACES

AMQ Online is configured to support managing address spaces using the OpenShift command-line tools. Address spaces are managed like any other OpenShift resource using oc.

2.1. ADDRESS SPACE

An address space is a group of addresses that can be accessed through a single connection (per protocol). This means that clients connected to the endpoints of an address space can send messages to or receive messages from any authorized address within that address space. An address space can support multiple protocols, as defined by the address space type.

NOTE

You cannot modify endpoints for an existing address space.

AMQ Online has two types of address spaces:

- Standard
- Brokered

2.2. STANDARD ADDRESS SPACE

The standard address space is the default address space in AMQ Online. It consists of an AMQP router network in combination with attachable storage units. Clients connect to a message router, which forwards messages to or from one or more message brokers. This address space type is appropriate when you have many connections and addresses. However, the standard address space has the following limitations:

- No transaction support
- No message ordering
- No selectors on queues
- No browsing on queues
- No message groups
- Restrictions affecting the use of some AMQP delivery states, such as the undeliverable-here=true modified delivery state when there are competing consumers attached to the same message router.

Clients connect and send and receive messages in this address space using the AMQP protocol.

2.2.1. Standard address types

The standard address space supports five different address types:

- queue
- topic
2.2.1.1. Queue

The queue address type is a store-and-forward queue. This address type is appropriate for implementing a distributed work queue, handling traffic bursts, and other use cases when you want to decouple the producer and consumer. A queue can be sharded across multiple storage units. By sharding the queue, throughput may be higher in some cases and the queue’s availability is improved in that the queue continues to be available even if one of the storage units hosting a portion of the queue is temporarily offline. However, messages on the offline storage unit are unavailable until the storage unit returns. When queues are sharded, message ordering is lost.

2.2.1.2. Topic

The topic address type supports the publish-subscribe messaging pattern where there are 1..N producers and 1..M consumers. Each message published to a topic address is forwarded to all subscribers for that address. A subscriber can also be durable, in which case messages are kept until the subscriber has acknowledged them.

NOTE

If you create a subscription on a topic, any senders to that topic must specify the topic capability.

2.2.1.2.1. Hierarchical topics and wildcards

A client receiving from a topic address can specify a wildcard address with the topic address as the root. The wildcard behavior follows the MQTT syntax:

- `/` is a separator
- `+` matches one level
- `#` matches one or more levels

So, for example:

- `a/#/b` matches `a/foo/b`, `a/bar/b`, and `a/foo/bar/b`
- `a/+/b` matches `a/foo/b` and `a/bar/b`, but would not match `a/foo/bar/b`

In the standard address space, the first level must always be a defined topic address; that is, `#` and `+` are not valid as the first characters of a subscribing address.

2.2.1.2.2. Known issue with creating a subscriber on a hierarchical topic

A known issue exists where creating a subscriber on a hierarchical topic in AMQ Online causes the broker to instead create it as a competing consumer (handling the address like a queue rather than a topic). For more information about the specific workaround for your client, see the applicable client example section in Connecting applications to AMQ Online.
2.2.1.3. Anycast

The anycast address type is a scalable direct address for sending messages to one consumer. Messages sent to an anycast address are not stored, but are instead forwarded directly to the consumer. This method makes this address type ideal for request-reply (RPC) uses or even work distribution. This is the cheapest address type as it does not require any persistence.

2.2.1.4. Multicast

The multicast address type is a scalable direct address for sending messages to multiple consumers. Messages sent to a multicast address are forwarded to all consumers receiving messages on that address. Because message acknowledgments from consumers are not propagated to producers, only pre-settled messages can be sent to multicast addresses.

2.2.1.5. Subscription

Using the subscription address type you can create a subscription for a topic that holds messages published to the topic even if the subscriber is not attached. The consumer accesses the subscription using the following address syntax: <topic-address>::<subscription-address>. For example, for a subscription `mysub` on a topic `mytopic` the consumer accesses the subscription from the address `mytopic::mysub`. The default setting permits only a single consumer per subscription. This setting can be changed by editing the `maxConsumers` field of the subscription address.

**NOTE**

The `maxConsumers` setting cannot be modified for existing subscriptions.

2.3. BROKERED ADDRESS SPACE

The brokered address space is designed to support broker-specific features, at the cost of limited scale in terms of the number of connections and addresses. This address space supports JMS transactions, message groups, and selectors on queues and topics.

Clients can connect as well as send and receive messages in this address space using the following protocols:

- AMQP
- CORE
- OpenWire
- MQTT
- STOMP

2.3.1. Brokered address types

The brokered address space supports two address types:

- queue
- topic
2.3.1.1. Queue

The queue address type is a store-and-forward queue. This address type is appropriate for implementing a distributed work queue, handling traffic bursts, and other use cases where you want to decouple the producer and consumer. A queue in the brokered address space supports selectors, message groups, transactions, and other JMS features. Message order can be lost with released messages.

2.3.1.2. Topic

The topic address type supports the publish-subscribe messaging pattern in which there are 1..N producers and 1..M consumers. Each message published to a topic address is forwarded to all subscribers for that address. A subscriber can also be durable, in which case messages are kept until the subscriber has acknowledged them.

2.3.1.2.1. Hierarchical topics and wildcards

A client receiving from a topic address can specify a wildcard address with the topic address as the root. The wildcard behavior follows the MQTT syntax:

- / is a separator
- + matches one level
- # matches one or more levels

So, for example:

- a/#/b matches a/foo/b, a/bar/b, a/foo/bar/b
- a/+/b matches a/foo/b and a/bar/b, but would not match a/foo/bar

2.3.1.2.2. Known issue with creating a subscriber on a hierarchical topic

A known issue exists where creating a subscriber on a hierarchical topic in AMQ Online causes the broker to instead create it as a competing consumer (handling the address like a queue rather than a topic). For more information about the specific workaround for your client, see the applicable client example section in Connecting applications to AMQ Online.

2.4. ADDRESS SPACE PLANS

An address space is configured with an address space plan, which describes the allowed resource usage of that address space. The address space plans are configured by the service administrator and can vary between AMQ Online installations.

The address space plan can be changed if the address space requires more, or less, resources.

2.5. LISTING AVAILABLE ADDRESS SPACE PLANS USING THE COMMAND LINE

You can list the address space plans available for your address space type.

Procedure
1. Log in as a messaging tenant:
   
   oc login -u developer

2. Retrieve the schema showing available address space plans (replace standard with brokered for the brokered address space type):
   
   oc get addressspaceschema standard -o jsonpath='{.spec.plans[*].name}'

### 2.6. LISTING AVAILABLE AUTHENTICATION SERVICES USING THE COMMAND LINE

You can list the authentication services available for your address space type.

**Procedure**

1. Log in as a messaging tenant:
   
   oc login -u developer

2. Retrieve the schema with the authentication services listed (replace standard with brokered for the brokered address space type):
   
   oc get addressspaceschema standard -o jsonpath='{.spec.authenticationServices}'

### 2.7. ADDRESS SPACE EXAMPLES

#### 2.7.1. Address space example

This address space example shows only the required options to create an AddressSpace.

```yaml
apiVersion: enmasse.io/v1beta1
description: AddressSpace
metadata:
  name: myspace
spec:
  type: standard
  plan: standard-unlimited
```

1. The address space type can be either brokered or standard.
2. The address space plan depends on the address space type and what has been configured by the AMQ Online administrator. To view your available address space plans, see Listing available address space plans.

#### 2.7.2. Address space example using an authentication service

This address space example shows how you can configure the authentication service of an AddressSpace.
The authentication service name depends on the available authentication services configured by the AMQ Online administrator. To view the available authentication services for your address space type, see Listing available authentication services.

2.7.3. Address space example using an external authentication service allowing overrides

This address space example shows how you can override the host name, port number, and realm for an external authentication service. Note that the ability to specify overrides depends on how the external authentication service is configured by the AMQ Online administrator.

For more information about how to configure an external authentication service to allow a messaging tenant to override host name, port number, and realm, see External authentication service example allowing overrides.

```yaml
apiVersion: enmasse.io/v1beta1
kind: AddressSpace
metadata:
  name: myspace
spec:
  type: standard
  plan: standard-unlimited
  authenticationService:
    name: standard-authservice
    type: external
    overrides:
      realm: amq-online-infra-space-standard-auth
      host: standard-authservice-amq-online-infra.apps.wfd-28d9.openshiftworkshop.com
      port: 5671
      caCertSecret:
        name: my-ca-cert
```

The authentication service name depends on the available authentication services configured by the AMQ Online administrator. To view the available authentication services for your address space type, see Listing available authentication services.

Specifies the override values.

2.7.4. Address space examples exposing endpoints externally

These address space examples show how you can configure the external endpoints of an AddressSpace to access messaging endpoints outside the OpenShift cluster.
2.7.4.1. OpenShift LoadBalancer service example

To expose AddressSpace endpoints through OpenShift LoadBalancer services, the loadbalancer type is used:

```yaml
apiVersion: enmasse.io/v1beta1
kind: AddressSpace
metadata:
  name: myspace
spec:
  type: standard
  plan: standard-unlimited
  authenticationService:
    name: standard-authtservice
  endpoints:
  - name: messaging
    service: messaging
    expose:
      type: loadbalancer
    loadBalancerPorts:
      - amqp
      - amqps
    annotations:
      mykey: myvalue
    loadBalancerSourceRanges:
      - 10.0.0.0/8
```

1. (Required) The name of the endpoint. The name specified affects the name of the OpenShift service to be created as well as the name of the endpoint in the status section of the AddressSpace.

2. (Required) The service configured for the endpoint. The valid value for service is messaging.

3. (Required) The type of endpoint being exposed. The loadbalancer type creates an OpenShift LoadBalancer service. Valid values are route and loadbalancer.

4. (Required) A list of the ports to be exposed on the LoadBalancer service. For the messaging service, the valid values are amqp and amqps.

5. (Optional) A set of key-value annotation pairs that are added to the LoadBalancer Service object.

6. (Optional) The allowed source ranges that are accepted by the load balancer.

2.7.4.2. OpenShift route example

To expose AddressSpace endpoints as OpenShift routes, the route type is used:

```yaml
apiVersion: enmasse.io/v1beta1
kind: AddressSpace
metadata:
  name: myspace
spec:
  type: standard
```
(Required) The name of the endpoint. The name specified affects the name of the OpenShift service to be created as well as the name of the endpoint in the status section of the AddressSpace.

(Required) The service configured for the endpoint. The valid value for service is messaging.

(Required) The name of the port to be exposed. With the route type, only a single TLS-enabled port can be specified. For the messaging service, the valid values are amqps or https.

(Required) The TLS termination policy to be used for the OpenShift route. For the messaging service, the amqps port requires passthrough to be specified, whereas https (websockets) also allows reencrypt.

(Optional) The host name to use for the created route.

2.7.5. Address space certificate provider configuration examples

The following address space examples show how you can configure the endpoints of an AddressSpace using different certificate providers. The certificate provider determines how certificates are issued for the endpoints of an AddressSpace.

2.7.5.1. openshift provider

The openshift certificate provider can be used to configure endpoints with certificates signed by the OpenShift cluster certificate authority (CA).
(Required) The certificate provider type. Valid values are `openshift` (on OpenShift only), `certBundle`, and `selfsigned` (default value).

### 2.7.5.2. selfsigned provider

The `selfsigned` certificate provider can be used to configure endpoints with self-signed certificates. The CA for these certificates can be found in the `status.caCert` field of the `AddressSpace` resource.

**NOTE**

Using a self-signed certificate in production environments is not recommended.

```yaml
apiVersion: enmasse.io/v1beta1
cr: AddressSpace
metadata:
  name: myspace
spec:
  type: standard
  plan: standard-unlimited
  authenticationService:
    name: standard-authservice
  endpoints:
    - name: messaging
      service: messaging
      cert:
        provider: selfsigned
```

(Required) The certificate provider type. Valid values are `openshift` (on OpenShift only), `certBundle`, and `selfsigned` (default value).

### 2.7.5.3. certBundle provider

The `certBundle` certificate provider can be used to configure endpoints with user-supplied certificates signed by your own CA. Certificate rotation can be performed by updating the `tlsKey` and `tlsCert` fields with updated certificates, and then updating the `AddressSpace` resource.

```yaml
apiVersion: enmasse.io/v1beta1
cr: AddressSpace
metadata:
  name: myspace
spec:
  type: standard
  plan: standard-unlimited
  authenticationService:
    name: standard-authservice
  endpoints:
    - name: messaging
      service: messaging
      cert:
```
(Required) The certificate provider type. Valid values are `openshift` (on OpenShift only), `certBundle`, and `selfsigned` (default value).

(Required) The base64-encoded value of the PEM private key (including the preamble).

(Required) The base64-encoded value of the PEM certificate (including the preamble).

### 2.7.6. Address space example exports

You can export your address space information using the following three export types:

- **ConfigMap**
- **Secret**
- **Service**

#### 2.7.6.1. ConfigMap and Secret type export examples

This example shows the format used by the **ConfigMap** export type. The format of the **Secret** export type uses the same keys as the **ConfigMap** export type, but the values are Base64-encoded.

```
{  
  service.host: messaging.svc  
  service.port.amqp: 5672  
  external.host: external.example.com  
  external.port: 5671  
  ca.crt: // PEM formatted CA  
}
```

#### 2.7.6.2. Service type export example

This example shows the format used by the **Service** export type.

```
{  
  externalName: messaging.svc  
  ports:  
    - name: amqp  
      port: 5672  
      protocol: TCP  
      targetPort: 5672  
}
```

### 2.8. EXAMPLE ADDRESS SPACE STATUS OUTPUT

The **AddressSpace** resource contains a **status** field that can be used to retrieve information about its state and endpoints. The following output is an example of the output you can get from running `oc get addressspace myspace -o yaml`:

```
{  
  apiVersion: enmasse.io/v1beta1  
  kind: AddressSpace  
  metadata:  
}
```
The `isReady` field can be either `true` or `false`.

The `endpointStatuses` field provides information about available endpoints for this address space.

The `cert` field contains the base64-encoded certificate for a given endpoint.

The `serviceHost` field contains the cluster-internal host name for a given endpoint.

The `servicePorts` field contains the available ports for the cluster-internal host.

The `externalHost` field contains the external host name for a given endpoint.

The `externalPorts` field contains the available ports for the external host.

**2.9. EXAMPLE OF EXPORTING ADDRESS SPACE INFORMATION INTO THE APPLICATION NAMESPACE**

This address space example shows how you can export the endpoint information of an `AddressSpace` resource to a `ConfigMap`, `Secret`, or `Service` in the same namespace as the messaging application.

```yaml
apiVersion: enmasse.io/v1beta1
kind: AddressSpace
metadata:
  name: myspace
spec:
  type: standard
  plan: standard-unlimited
  authenticationService:
    name: standard-autbservice
  endpoints:
    - name: messaging
```
(Required) The type of export: **ConfigMap**, **Secret**, or **Service**. The resulting **ConfigMap** contains the values in the format shown in example exports format. For **Secret**, the same keys are used, but the values are base64-encoded. For **Service**, a OpenShift service of the type **ExternalName** is created. This provides applications running on OpenShift with a way to inject endpoint information or provide a proxy service in the same namespace as the application. For more information, see example exports format.

(Required) The name of the resource to create and update.

When exporting endpoint information, the **system:serviceaccounts:_amq-online-infra_** group must be granted privileges to create, update, and delete the configmap specified in the exports list. You can do this by creating an RBAC role and role-binding such as this one:

```yaml
apiVersion: rbac.authorization.k8s.io/v1
kind: Role
metadata:
  name: rbac
rules:
- apiGroups: [""]
  resources: ["configmaps"]
  verbs: ["create"]
- apiGroups: [""]
  resources: ["configmaps"]
  resourceNames: ["my-config"]
  verbs: ["get", "update", "patch"]
---
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: rbac-binding
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: Role
  name: rbac
subjects:
- kind: Group
  name: system:serviceaccounts:_amq-online-infra_
```

### 2.10. ADDRESS SPACE CONNECTOR EXAMPLES

You can federate a **standard** address space type with another AMQP server. Two methods of operation are supported: remote address connection and message store-and-forward.

Remote address connection involves mapping addresses on a remote AMQP endpoint into an address space. For example, suppose an AMQP server is running on the host **messaging.example.com** that you want to access by connecting using the AMQ Online endpoints. To enable remote address connection, you need to create an address space connector.
Message store-and-forward involves enabling address forwarding. First you need to create an address space connector. Then, you need to create an address forwarder for each address. For more information about address forwarding, see Address forwarding examples.

The following examples show how you can configure an address space connector.

### 2.10.1. Address space connector using SASL PLAIN

You can use SASL PLAIN when you do not want to use mutual TLS for authentication. Not enabling TLS is not recommended, since any user names and passwords are then sent as plain text.

```yaml
apiVersion: enmasse.io/v1beta1
kind: AddressSpace
metadata:
  name: myspace
spec:
  type: standard
  plan: standard-unlimited
  connectors:
  - name: remote1
    endpointHosts:
      - host: messaging.example.com
        port: 5672
      - host: messaging2.example.com
    idleTimeout: 3
    maxFrameSize: 4
    credentials:
      username:
        value: test
      password:
        valueFromSecret:
          name: password-secret
          key: password.txt
    addresses:
      - name: p1
        pattern: "prices/*"
      - name: p2
        pattern: "clients/*/1"
```

1. (Required) Specifies the name of the connector. All remote addresses are prefixed with the connector name and a forward slash, `/`.
2. (Required) Specifies a list of endpoints for this connector. This list must contain at least one entry, and any additional entries are used for failover. If not otherwise specified, the `port` field value is set to the registered IANA port for AMQP (or AMQPS if TLS is enabled).
3. (Optional) Idle timeout of the AMQP connection (seconds). 0 disables the idle timeout.
4. (Optional) Max frame size of the AMQP connection.
5. (Optional) Enable TLS. The connector trusts global root CAs by default. To use a custom CA, specify a value for the `caCert` field.
(Optional) Specifies the username and password credentials to use for this connector. The values can be specified inline or by referencing a secret along with an optional key specifying the location.

(Required) Role of the connector. Valid values are "normal", "edge", and "route-container" (default value).

(Required) Specifies a list of patterns matching addresses to be exposed on the remote endpoint. The pattern consists of one or more tokens separated by a forward slash, /. A token can be one of the following: a * character, a # character, or a sequence of characters that do not include /, *, or #. The * token matches any single token. The # token matches zero or more tokens. * has higher precedence than #, and exact match has the highest precedence.

2.10.2. Address space connector using mutual TLS

Configuring a client TLS certificate enables SASL EXTERNAL to be used for authentication. The certificates can be specified inline or using a secret reference.

```
apiVersion: enmasse.io/v1beta1
kind: AddressSpace
metadata:
  name: myspace
spec:
  type: standard
  plan: standard-unlimited
  connectors:
  - name: remote1
    endpointHosts:
    - host: messaging.example.com
      port: 5671
    tls:
      caCert: 3
      valueFromSecret:
        name: remote-certs
        key: ca.crt
      clientCert: 4
      valueFromSecret:
        name: remote-certs
        key: tls.crt
      clientKey: 5
      valueFromSecret:
        name: remote-certs
        key: tls.key
    addresses:
    - name: p1
      pattern: "**"  
```

1. (Required) Specifies the name of the connector. All remote addresses are prefixed with the connector name and a forward slash, /.

2. (Required) Specifies a list of endpoints for this connector. This list must contain at least one entry, and any additional entries are used for failover. If not otherwise specified, the port field value is set to the registered IANA port for AMQP (or AMQPS if TLS is enabled).

3. (Optional) Specifies the CA certificate to trust for the remote connection. The referenced secret must be readable by the system:serviceaccounts: amq-online-infra group.
2.11. CREATING ADDRESS SPACES USING THE COMMAND LINE

In AMQ Online, you create address spaces using standard command-line tools.

Procedure

1. Log in as a messaging tenant:
   
   ```
   oc login -u developer
   ```

2. Create the project for the messaging application:

   ```
   oc new-project myapp
   ```

3. Create an address space definition:

   ```
   apiVersion: enmasse.io/v1beta1
   kind: AddressSpace
   metadata:
   name: myspace
   spec:
   type: standard
   plan: standard-unlimited
   ```

4. Create the address space:

   ```
   oc create -f standard-address-space.yaml
   ```

5. Check the status of the address space:

   ```
   oc get addressspace myspace -o jsonpath={.status.isReady}
   ```

   The address space is ready for use when the previous command outputs `true`.

2.12. CREATING AN ADDRESS SPACE USING THE RED HAT AMQ CONSOLE

You can create a new address space using the Red Hat AMQ Console, including configuring the endpoints of an address space using different certificate providers and creating endpoints to make the address space available for messaging applications to use.
NOTE
If you choose not to configure endpoints for your address space, the system creates a default set of endpoints as OpenShift routes for AMQPS and AMQP-WSS, secured with a system generated (self-signed) certificate and a cluster service.

Procedure

1. Log in to the Red Hat AMQ Console.
   For more information about how to access the Red Hat AMQ Console, see Accessing the Red Hat AMQ Console.

2. Click Create Address Space. The Create an instance wizard opens.

3. Complete the required fields and when you are finished, click Finish to create the new address space.

When the address space has been successfully created, you can click the address space name to view information about the newly created address space, including messaging and application statistics and endpoint information.

2.13. CHANGING THE ADDRESS SPACE PLAN ASSOCIATED WITH AN ADDRESS SPACE USING THE RED HAT AMQ CONSOLE

You can change the address space plan that is associated with an address space using the Red Hat AMQ Console.

Prerequisites

- You must have already created an address space. For more information, see Creating an address space using the Red Hat AMQ Console.

Procedure

1. Log in to the Red Hat AMQ Console. For more information, see Accessing the Red Hat AMQ Console.

2. Locate the address space for which you want to change the address space plan.

3. In the far right column, click the vertical ellipsis icon and select Edit. The Edit window opens.

4. In the Address space plan field, select a different plan from the list and click Confirm. The address space plan is changed for that address space.

2.14. CHANGING THE AUTHENTICATION SERVICE ASSOCIATED WITH AN ADDRESS SPACE USING THE RED HAT AMQ CONSOLE

You can change the authentication service that is associated with an address space using the Red Hat AMQ Console.

Prerequisites

- You must have already created an address space. For more information, see Creating an address space using the Red Hat AMQ Console.
2.15. DELETING AN ADDRESS SPACE USING THE RED HAT AMQ CONSOLE

You can delete an existing address space using the Red Hat AMQ Console.

Procedure

1. Log in to the Red Hat AMQ Console. For more information about how to access the Red Hat AMQ Console, see Accessing the Red Hat AMQ Console.

2. Locate the address space that you want to delete.

3. In the far right column, click the vertical ellipsis icon and select Delete. The delete confirmation window opens.

4. Confirm your selection by clicking Delete. The address space is deleted.

2.16. EXAMPLE COMMANDS FOR RETRIEVING ADDRESS SPACE INFORMATION

The following table shows the commands for retrieving address space information.

Table 2.1. Retrieving address space information commands table

<table>
<thead>
<tr>
<th>To retrieve the…</th>
<th>Run this command:</th>
</tr>
</thead>
<tbody>
<tr>
<td>status of an address space</td>
<td><code>oc get addressspace myspace -o jsonpath={.status.isReady}</code></td>
</tr>
<tr>
<td>base64-encoded PEM certificate for the messaging endpoint</td>
<td><code>oc get addressspace myspace -o 'jsonpath={.status.caCert}'</code></td>
</tr>
<tr>
<td>host name for the messaging endpoint</td>
<td><code>oc get addressspace myspace -o 'jsonpath={.status.endpointStatuses[?(@.name==&quot;messaging&quot;)].externalHost}''</code></td>
</tr>
</tbody>
</table>

2.17. REPLACING ADDRESS SPACES USING THE COMMAND LINE

Address spaces can be replaced in order to change the plan, endpoints, or network policies, or to replace...
certificates if using the certBundle certificate provider. When changing the plan, AMQ Online will attempt to apply the new plan if the current set of addresses fits within the new quota. If it does not, an error is provided on the AddressSpace resource.

**Procedure**

1. Log in as a messaging tenant:
   ```
   oc login -u developer
   ```

2. Select the project for the messaging application:
   ```
   oc project myapp
   ```

3. Update address space definition:
   ```
   apiVersion: enmasse.io/v1beta1
   kind: AddressSpace
   metadata:
     name: myspace
   spec:
     type: standard
     plan: standard-small
   ```

4. Replace the address space:
   ```
   oc replace -f standard-address-space-replace.yaml
   ```

5. Check the status of the address space:
   ```
   oc get addressspace myspace -o jsonpath={.status.isReady}
   ```
   The address space is ready for use when the above command outputs `true`. 
CHAPTER 3. MANAGING ADDRESSES

AMQ Online is configured to support managing addresses using the OpenShift command-line tools and the Red Hat AMQ Console. Address resources can be managed like any other OpenShift API resource using oc.

3.1. ADDRESS

An address is part of an address space and represents a destination for sending and receiving messages. An address has a type, which defines the semantics of sending messages to and receiving messages from that address.

The types of addresses available in AMQ Online depend on the address space type.

3.2. ADDRESS PLANS

An address is configured with an address plan, which describes the resource usage of that address. The address plans are configured by the service administrator and can vary between AMQ Online installations. The number of addresses that can be created, and what plans are available, depends on quota enforced by the address space plan.

Some address types also support changing the plan field: queue, anycast, and multicast address types in the standard address space support changing the plan as long as the new plan does not exceed the allowed quota. For queues, addresses are dynamically migrated across brokers, which might cause reordering of messages.

3.2.1. Address example

```
apiVersion: enmasse.io/v1beta1
kind: Address
metadata:
  name: myspace.myqueue
spec:
  address: myqueue
  type: queue
  plan: standard-small-queue
```

1 The address name must be prefixed with the address space name and a dot. Address names can only include alphanumeric characters.

2 The address is the messaging address this address resource represents.

3 The address type dictates the semantics of this address.

4 The address plan describes the resource usage for the address. For more information about how to view the available plans, see Listing available address plans.

3.2.2. Topic and subscription address example

When using topics and subscriptions, the subscription references the topic to which it belongs using the topic: field, as shown in the following example.
The address of topic that this subscription refers to.

### 3.2.3. Address TTL restriction example

<table>
<thead>
<tr>
<th>apiVersion: enmasse.io/v1beta1</th>
</tr>
</thead>
<tbody>
<tr>
<td>kind: Address</td>
</tr>
<tr>
<td>metadata:</td>
</tr>
<tr>
<td>name: myspace.mytopic</td>
</tr>
<tr>
<td>spec:</td>
</tr>
<tr>
<td>address: mytopic</td>
</tr>
<tr>
<td>type: topic</td>
</tr>
<tr>
<td>plan: standard-small-topic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>apiVersion: enmasse.io/v1beta1</th>
</tr>
</thead>
<tbody>
<tr>
<td>kind: Address</td>
</tr>
<tr>
<td>metadata:</td>
</tr>
<tr>
<td>name: myspace.mysub</td>
</tr>
<tr>
<td>spec:</td>
</tr>
<tr>
<td>address: mysub</td>
</tr>
<tr>
<td>type: subscription</td>
</tr>
<tr>
<td>plan: standard-small-subscription</td>
</tr>
<tr>
<td>topic: mytopic</td>
</tr>
</tbody>
</table>

1. (Optional) Destination for expired messages. This address must be of type `deadletter`.

2. (Optional) Restricts message time-to-live (TTL). Applies to address types `queue` and `topic` only.

The `messageTtl` field is used to restrict the effective `absolute-expiry-time` of any message put to a queue or topic. The `maximum` and `minimum` values are defined in milliseconds. The system adjusts the TTL value of an incoming message to a particular address based on these values:

- If a message arrives at the address with a TTL value that is greater than the `maximum` value, the system changes the message TTL to the maximum value.

- If a message arrives at the address with a TTL value that is less than the `minimum` value, the system changes the message TTL to the minimum value.

Messages that arrive without a TTL defined are considered to have a TTL value of infinity.
TTL restrictions may also be imposed by the address plan. If a TTL restriction is imposed at both the plan and the address, the address TTL restriction can only further narrow the TTL restriction. The address status section shows the TTL values that are in force.

If the address has an expiry address assigned, expired messages are automatically moved to it. If the address has no expiry address assigned or if the address is a temporary topic subscription, expired messages are removed. These messages are lost. Message expiration occurs periodically at an interval of 30 seconds.

3.2.4. Address message redelivery/dead letter example

```yaml
apiVersion: enmasse.io/v1beta1
kind: Address
metadata:
  name: myspace.myqueue
spec:
  address: myqueue
  type: queue
  plan: standard-small-queue
deadletter: mydeadletter
messageRedelivery:
  maximumDeliveryAttempts: 3
  redeliveryDelay: 5000
  redeliveryDelayMultiplier: 1.5
  maximumDeliveryDelay: 30000

1 (Optional) Destination for messages that have exceeded the maximum number of delivery attempts. This address must be of type deadletter.

2 (Optional) Provides message redelivery settings. Applies to address types queue and subscription only.

3 (Optional) Maximum number of delivery attempts made for a message before the message is directed to a deadletter address (or dropped). Set to -1 for infinite re-deliveries. Defaults to 10.

4 (Optional) The number of milliseconds to wait before redelivery. Set to 0 for no redelivery delay. Defaults to 0.

5 (Optional) The redelivery multiplier. This factor is applied to the last redelivery delay. Defaults to 1.

6 (Optional) The maximum delivery delay in milliseconds. Imposes an upper limit on the delivery delay. Set to 0 for no maximum. Defaults to 0.
```

The messageRedelivery field is used to control the behavior of a queue or subscription when a receiver is unsuccessful in its processing a message and the system returns the message to the queue for redelivery. By default, the system redelivers messages indefinitely. However, the messageRedelivery field allows you to modify the behavior either by delaying redelivery or redirecting the message to a deadletter address.

Message redelivery settings may also be defined by the address plan. If both the address and address plan provide a message redelivery setting, the value provided by the address takes priority. The address status section shows the message redelivery settings that are in force.
If the address has a deadletter address assigned, messages that have exceeded the maximum number of delivery attempts are automatically moved to it.

If the address has no deadletter address assigned, the system drops the messages. These messages are lost permanently. However, the standard address space supports a global DLQ mode. If set to true in the standardinfraconfig resources, the system establishes a fallback global dead letter address named !!GLOBAL_DLQ and routes the undelivered messages to it. To remove messages from this address and prevent the broker(s) from becoming full, connect a consuming application to the !!GLOBAL_DLQ address.

3.2.5. Address forwarding examples

You can use forwarders to:

- automatically forward messages from a local address to a remote AMQP server outside of AMQ Online, or
- forward messages from a remote AMQP server to a local address.

To use an address forwarder, you must first configure a connector to the remote AMQP server for the address space. For more information about address space connectors, see Address space connector examples.

Address forwarding is supported only in the standard address space type, and only for the queue and subscription address types. With the queue address type, you can forward messages to a remote AMQP server or from a remote AMQP server to a local queue. With the subscription address type, you can create a forwarder to a remote AMQP address, but you cannot create a forwarder that copies messages to the subscription. That is, the subscription address type supports forwarding in the out direction only, as shown in the example.

For outgoing forwarders, you can assign a priority value to the consumer associated with the forwarder. This allows you to influence message routing within the AMQP network by favoring one link over another. If the forwarder has a lower priority than other consumers, messages will only flow through the forwarder when the other consumers do not have credit or cannot accept a message for other reasons (for example, message selectors). The value must be an integral number in the range -2^31 to 2^31-1. Values lower than zero reduce the forwarder’s priority relative to other consumers, while values greater than zero raise it. If the priority is unassigned, a default value of 0 is used.

In the following examples, it is assumed that a connector, remote1, has been configured for the address space.

3.2.5.1. Forwarding messages from a local queue to a remote AMQP server

In this example, messages in myqueue are forwarded to the remote AMQP server with an address of clients/me/1.

```yaml
apiVersion: enmasse.io/v1beta1
kind: Address
metadata:
  name: myspace.myqueue
spec:
  address: myqueue
type: queue
plan: standard-small-queue
forwarders:
  - name: f1
```
(Required) Specifies the name of the forwarder, which is used to ensure a unique identity.

(Required) Specifies the remote address to forward messages to. The address must be prefixed with the connector name and must be identical to the address matching patterns defined on the connector.

(Required) Specifies the direction of message flow, which is either \texttt{out} or \texttt{in}. A value of \texttt{out} forwards messages to the remote endpoint. A value of \texttt{in} forwards messages from the remote endpoint.

(Optional) Specifies the priority assigned to the consumer used by the forwarder (integral number in the range \(-2^{31}\) to \(2^{31}-1\) with a default of 0). Applies to outgoing forwarders only.

3.2.5.2. Forwarding messages from a remote AMQP server to a local queue

In this example, you receive messages from an address \texttt{prices/milk} on a remote AMQP server. The messages are then moved to a local queue, \texttt{myqueue}.

(Required) Specifies the name of the forwarder, which is used to ensure a unique identity.

(Required) Specifies the remote address to forward messages to. The address must be prefixed with the connector name and must be identical to the address matching patterns defined on the connector.

(Required) Specifies the direction of message flow, which is either \texttt{out} or \texttt{in}. A value of \texttt{out} forwards messages to the remote endpoint. A value of \texttt{in} forwards messages from the remote endpoint.

3.3. LISTING AVAILABLE ADDRESS PLANS USING THE COMMAND LINE

You can list the address plans available for an address type, such as \texttt{queue}.

Procedure
1. Log in as a messaging tenant:

   `oc login -u developer`

2. Retrieve the schema with the address plans listed (replace `standard` with `brokered` for the brokered address space type):

   ```bash
   oc get addressspaceschema standard -o jsonpath={.spec.addressTypes[?(@.name=="queue")].plans[*].name}
   ```

### 3.4. CREATING ADDRESSES USING THE COMMAND LINE

You can create addresses using the command line.

**Procedure**

1. Create an address definition:

   ```yaml
   apiVersion: enmasse.io/v1beta1
   kind: Address
   metadata:
     name: myspace.myqueue
   spec:
     address: myqueue
     type: queue
     plan: standard-small-queue
   ```

   **NOTE**

   Prefixing the name with the address space name is required to ensure addresses from different address spaces do not collide.

2. Create the address:

   `oc create -f standard-small-queue.yaml`

3. List the addresses:

   `oc get addresses -o yaml`

### 3.5. CREATING ADDRESSES USING THE RED HAT AMQ CONSOLE

You can create new addresses using the Red Hat AMQ Console. The type of addresses that you can create are determined by the type of address space.

**Prerequisites**

- You must have created an address space. For more information, see [Creating an address space](#).

**Procedure**

1. Log in to the Red Hat AMQ Console. For more information, see Accessing the Red Hat AMQ Console.

2. Click the address space link for the address space where you want to create a new address.

3. Click Create Address. The Create new address wizard opens.

4. Complete the required fields and when you are finished, click Finish to create the new address. Your address is displayed in the Red Hat AMQ Console.

   **NOTE**
   If you select the subscription address type, from the Topic list, select the topic name to which you want to create a subscription.

### 3.6. REPLACING ADDRESSES USING THE COMMAND LINE

**Procedure**

1. Update an address definition:

   ```yaml
   apiVersion: enmasse.io/v1beta1
   kind: Address
   metadata:
     name: myspace.myqueue
   spec:
     address: myqueue
     type: queue
     plan: standard-xlarge-queue
   ```

2. Replace the address:

   ```bash
   oc replace -f standard-xlarge-queue.yaml
   ```

3. List the addresses:

   ```bash
   oc get addresses -o yaml
   ```

### 3.7. DELETING ADDRESSES USING THE RED HAT AMQ CONSOLE

You can delete existing addresses using the Red Hat AMQ Console.

**Procedure**

1. Log in to the Red Hat AMQ Console.
   For more information about how to access the Red Hat AMQ Console, see Accessing the Red Hat AMQ Console.

2. Click the address space link for the address space where you want to delete an existing address.

3. Locate the address that you want to delete.
4. In the far right column, click the vertical ellipsis icon and select **Delete**. The delete confirmation window opens.

5. Confirm your selection by clicking **Delete**. The address is deleted.
CHAPTER 4. USING THE RED HAT AMQ CONSOLE

You can use the Red Hat AMQ Console to perform tasks such as creating and deleting an address space, creating an address, and viewing message and connection statistics.

4.1. RED HAT AMQ CONSOLE USER PERMISSIONS

Red Hat AMQ Console uses the OpenShift RBAC permissions model.

To use Red Hat AMQ Console, the OpenShift user requires a role that grants access to addressspace and address resources. For example, for edit access, create, update and delete permissions need be to given to the associated role object, and for view-only access, list permissions need to be granted.

For more information about the AMQ Online example roles, see AMQ Online example roles.

4.2. ACCESSING THE RED HAT AMQ CONSOLE

Prerequisites

- On OpenShift Container Platform 3.x, obtain the host name for the Red Hat AMQ Console by running the following command:

  ```bash
  oc get routes console -o jsonpath={.spec.host}
  ```

- On OpenShift Container Platform 4.x, obtain the host name for the Red Hat AMQ Console by running the following command:

  ```bash
  oc get consolelink -l app=enmasse -o jsonpath={.spec.href}
  ```

Procedure

1. In a web browser, navigate to https://console-host-name where console-host-name is the Red Hat AMQ Console host name.

2. Log in with your OpenShift user credentials. The Red Hat AMQ Console opens and lists all the address spaces that you can administer. For information on creating an address space, see Creating an address space using the Red Hat AMQ Console.

4.3. VIEWING MESSAGE AND APPLICATION CONNECTION STATISTICS USING THE RED HAT AMQ CONSOLE
Prerequisites

- You must be logged into the Red Hat AMQ Console.

<table>
<thead>
<tr>
<th>Address type</th>
<th>See the first icon in the second column, Type/plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address plan</td>
<td>See the string that follows the icon in the second column, Type/plan</td>
</tr>
<tr>
<td>Address status</td>
<td>See the third column, Status</td>
</tr>
<tr>
<td>Messages received per second (computed over the last 5 minutes)</td>
<td>See Messages In/sec</td>
</tr>
<tr>
<td>Messages sent per second (computed over the last 5 minutes)</td>
<td>See Messages Out/sec</td>
</tr>
<tr>
<td>Queue and topic address types only: Number of stored messages on the broker or brokers</td>
<td>Stored Messages</td>
</tr>
<tr>
<td>Number of senders attached</td>
<td>See Senders</td>
</tr>
<tr>
<td>Number of receivers attached</td>
<td>See Receivers</td>
</tr>
<tr>
<td>Standard address space only: Message deliveries per second</td>
<td>Click the desired address, which then shows the links page for that address; see the Delivery Rate column.</td>
</tr>
</tbody>
</table>

Table 4.1. Message statistics reference table
Table 4.2. Application connection statistics reference table

<table>
<thead>
<tr>
<th>To view...</th>
<th>On the Connections page...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Messages received per second (computed over the last 5 minutes)</td>
<td>See Messages In/sec</td>
</tr>
<tr>
<td>Standard address space only: Messages sent per second (computed over the last 5 minutes)</td>
<td>See Messages Out/sec</td>
</tr>
<tr>
<td>Total number of messages delivered</td>
<td>Click the desired host name to show the list of senders and receivers; see the Deliveries column.</td>
</tr>
</tbody>
</table>

**NOTE**

For the brokered address space only, on the Connections page, the number of senders is either 0 or 1. As soon as one or more senders exist, 1 is displayed rather than reflecting the actual number of senders.

4.4. VIEWING ENDPOINT INFORMATION USING THE RED HAT AMQ CONSOLE

You can use the Red Hat AMQ Console to view information about the endpoints configured for a given address space. You need this information to connect your messaging application to AMQ Online.

**Prerequisites**

- You must be logged into the Red Hat AMQ Console. For more information, see Accessing the Red Hat AMQ Console.
### Table 4.3. Messaging endpoint information reference table

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Displays the name of the endpoint.</td>
</tr>
<tr>
<td>Type</td>
<td>Displays the type of endpoint. Valid values include:</td>
</tr>
<tr>
<td></td>
<td><strong>cluster</strong></td>
</tr>
<tr>
<td></td>
<td>An endpoint accessible on the OpenShift cluster through a cluster IP address.</td>
</tr>
<tr>
<td></td>
<td><strong>route</strong></td>
</tr>
<tr>
<td></td>
<td>An OpenShift route available outside the cluster.</td>
</tr>
<tr>
<td></td>
<td><strong>loadbalancer</strong></td>
</tr>
<tr>
<td></td>
<td>A LoadBalancer service integrating with an external load balancer.</td>
</tr>
<tr>
<td></td>
<td>For more information, see the following OpenShift documentation:</td>
</tr>
<tr>
<td></td>
<td>● Route Configuration</td>
</tr>
<tr>
<td></td>
<td>● Configuring ingress cluster traffic using a load balancer</td>
</tr>
<tr>
<td>Host</td>
<td>Displays the host name of the endpoint.</td>
</tr>
</tbody>
</table>
### Ports

Displays the port protocol name and port number of the endpoint. Valid port names include:

<table>
<thead>
<tr>
<th>AMQP</th>
<th>Advance Messaging Queuing Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMQPS</td>
<td>Advance Messaging Queuing Protocol over TLS</td>
</tr>
<tr>
<td>AMQP-WS</td>
<td>AMQP-WebSocket protocol</td>
</tr>
<tr>
<td>AMQP-WSS</td>
<td>AMQP-WebSocket protocol over TLS</td>
</tr>
</tbody>
</table>

### 4.5. PURGING QUEUES AND SUBSCRIPTIONS

You can purge—that is, clear all messages from—a **queue** or **subscription** address type of its stored messages by using the Red Hat AMQ Console.

#### Prerequisites

- You must have a queue or subscription that contains stored messages.

#### Procedure

1. Log in to the Red Hat AMQ Console. For more information, see [Accessing the Red Hat AMQ Console](#).
2. Navigate to the **Addresses** page.
3. Select the check box next to the queue or subscription that you want to purge.
4. At the top of the page, right-click the vertical ellipsis icon and select **Purge**. The queue or subscription is purged, and the **Stored** message count drops to zero for the selected queue or subscription.

### 4.6. CLOSING CONNECTIONS USING THE RED HAT AMQ CONSOLE

If an application has unexpectedly stopped processing messages, you can force the application’s messaging connections to close using the Red Hat AMQ Console. This may be a useful way to return the application to service.

Be aware that closing a connection closes the application’s connection to AMQ Online. If the application is configured to do so, the application should reconnect automatically.

#### Procedure

1. Log in to the Red Hat AMQ Console. For more information, see [Accessing the Red Hat AMQ Console](#).
2. Navigate to the **Connections** page.
3. To close a single connection:
   a. Locate the connection that you want to close.
   b. In the far right column, click the vertical ellipsis icon and select Close.
   c. When prompted, click Confirm to confirm that you want to close the connection. The connection is closed.

4. To close multiple connections in a single operation:
   a. Select the check box next to the connections that you want to close.
   b. At the top of the page, right-click the vertical ellipsis icon and select Close Selected.
   c. When prompted, click Confirm to confirm that you want to close the connections. The connections are closed.
CHAPTER 5. USER MODEL

A messaging client connects using a MessagingUser. A MessagingUser specifies an authorization policy that controls which addresses may be used and the operations that may be performed on those addresses.

Users are configured as MessagingUser resources. Users can be created, deleted, read, updated, and listed.

The following example shows the user-example1.yaml file:

```yaml
apiVersion: user.enmasse.io/v1beta1
kind: MessagingUser
metadata:
  name: myspace.user1
spec:
  username: user1
  authentication:
    type: password
    password: cGFzc3dvcmQ= # Base64 encoded
  authorization:
    - addresses: ["myqueue", "queue1", "queue2", "topic"]
      operations: ["send", "recv"]
    - addresses: ["anycast1"]
      operations: ["send"]
```

The following fields are required:

- metadata.name
- metadata.namespace
- spec.authentication
- spec.authorization

The spec.authentication object defines how the user is authenticated, whereas spec.authorization defines the authorization policies for that user.

5.1. AUTHENTICATION

The supported values for the authentication type are password and serviceaccount. When using the password authentication type, you specify the username and password to be used by your messaging client when connecting. With the serviceaccount authentication type, you use the special string @@serviceaccount@@ as the username, and an OpenShift service account token as the password.

5.1.1. Password authentication type

For the password type, an additional field password must be set to a base64-encoded value of the password for that user. The password will not be printed out when reading the resource.

A password can be base64-encoded on the command line. To encode my-password, for example:

```
$ echo -n my-password | base64
bXktcGFzc3dvcmQ=
```
5.1.2. Serviceaccount authentication type

For the serviceaccount type, the username field must contain the OpenShift serviceaccount name that will be used to authenticate. When connecting with the messaging client, use the string @@serviceaccount@@ as the username, and the service account token as the password. The AMQP client used by the application must be configured to use the SASL mechanism type PLAIN.

5.2. AUTHORIZATION

In addition, authorization policies can be defined using operations and addresses. Valid operations are send, recv, view, and manage.

The manage and view operations apply to all addresses in the address space.

In the standard address space, the asterisk wildcard can be used at the end of an address. The address top* matches addresses topic and topic/sub.

In the brokered address space, the plus sign and asterisk wildcards can be used at the end of an address to match a single word (plus sign) or all words (asterisk) after the forward slash delimiter. So, the address topic/+ matches topic/sub but not topic/s/sub. The address topic/* matches topic/sub and topic/s/sub.

5.3. MANAGING USERS

AMQ Online user management is only supported when using the standard authentication service. On OpenShift, users can be managed using the OpenShift command-line tools.

Prerequisites

- You must have already created an address space.

5.3.1. Creating users using the command line

In AMQ Online users can be created using standard command-line tools.

Prerequisites

- You must have already created an address space.

Procedure

1. To correctly base64 encode a password for the user definition file, run the following command:

   ```bash
   echo -n password | base64 #cGFzc3dvcmQ=
   ```

   **NOTE**

   Be sure to use the -n parameter when running this command. Not specifying that parameter will result in an improperly coded password and cause log-in issues.

2. Save the user definition to a file:
3. Create the user and associated user permissions:

   oc create -f user-example1.yaml

4. Confirm that the user was created:

   oc get messagingusers

5.3.2. Deleting users using the command line

Users can be deleted using standard command-line tools.

Prerequisites

- An address space must have been created.
- A user must have been created.

Procedure

1. List the current users:

   oc get messagingusers

2. Delete the desired user:

   oc delete messaginguser myspace.user1

5.3.3. Managing user permissions using the command line

You can edit the permissions for an existing user using the command line.

Prerequisites

- You must have already created a user. For more information, see Creating users using the command line.

Procedure
Procedure

1. Retrieve the user whose permissions you want to edit:
   ```
   oc get messaginguser myspace.user1 -o yaml > user-example1.yaml
   ```

2. Make the desired permissions change and save the file.

3. From the command line, run the following command to apply the change:
   ```
   oc apply -f user-example1.yaml
   ```

   The new user permissions are applied.
CHAPTER 6. CONNECTING APPLICATIONS TO AMQ ONLINE

You can connect your application to AMQ Online using one of the following client examples.

- AMQ Online Python
- AMQ Online JMS
- AMQ Online JavaScript
- AMQ Online C++
- AMQ Online .NET

To connect to the messaging service from outside the OpenShift cluster, TLS must be used with SNI set to specify the fully qualified host name for the address space. The port used is 443.

The messaging protocols supported depends on the type of address space used. For more information about address space types, see Address space.

6.1. RETRIEVING THE SELF-SIGNED CA CERTIFICATE

If you opted for the selfsigned certificate provider type in your AddressSpace endpoint configuration, the generated CA that signed the AddressSpace server certificate is required when connecting to the messaging client application. You can retrieve the certificate from the AddressSpace using the following procedure.

**WARNING**

Using a self-signed certificate in production environments is not recommended.

**Procedure**

1. Log in as a messaging tenant:

   ```bash
   oc login -u developer
   ```

2. Retrieve the CA certificate from the AddressSpace.
   This will give you a file containing the CA certificate, in PEM format.

   ```bash
   oc get addressspace myspace -n namespace -o jsonpath='{.status.caCert}"\n"' | base64 --decode > ca.crt
   ```

3. If a PKCS12 or JKS format trust store is required, use the following commands to generate one:
   For PKS:

   ```bash
   keytool -import -trustcacerts -alias root -file ca.crt -storetype pkcs12 -keystore ca.pkcs12 -storepass password -noprompt
   ```
For JKS:

```
keytool -import -trustcacerts -alias root -file ca.crt -storetype jks -keystore ca.jks -storepass password -noprompt
```

### 6.2. CLIENT EXAMPLES

#### 6.2.1. AMQ Online Python example

You can use the following AMQ Online Python example to connect your application to AMQ Online. This example assumes you have created an address of type `queue` named `myqueue`.

```python
from __future__ import print_function, unicode_literals
from proton import Message
from proton.handlers import MessagingHandler
from proton.reactor import Container

class HelloWorld(MessagingHandler):
    def __init__(self, server, address):
        super(HelloWorld, self).__init__()
        self.server = server
        self.address = address

    def on_start(self, event):
        conn = event.container.connect(self.server)
        event.container.create_receiver(conn, self.address)
        event.container.create_sender(conn, self.address)

    def on_sendable(self, self, event):
        event.sender.send(Message(body="Hello World!"))
        event.sender.close()

    def on_message(self, self, event):
        print(event.message.body)
        event.connection.close()

Container(HelloWorld("amqps://_messaging-route-hostname_:443", "myqueue")).run()
```

#### 6.2.1.1. Known issue with creating a subscriber on a hierarchical topic

A known issue exists where creating a subscriber on a hierarchical topic in AMQ Online causes the broker to instead create it as a competing consumer (handling the address like a queue rather than a topic).

The workaround for this issue involves setting the capability "topic" in the source.

**Procedure**

1. In the `simple_recv.py` file, modify the `from proton.reactor import Container` to add the `ReceiverOption`:

```python
class CapabilityOptions(ReceiverOption):
    def apply(self, receiver):
        receiver.source.capabilities.put_object(symbol("topic"))
```

```
1. Modify the following line to add `options=CapabilityOptions()`:

   ```python
   def on_start(self, event):
       event.container.create_receiver(conn, self.address, options=CapabilityOptions())
   ```

### 6.2.2. AMQ Online JMS example

You can use the following AMQ Online JMS example to connect your application to AMQ Online. This example assumes you have created an address of type `queue` named `myqueue`.

```java
package org.apache.qpid.jms.example;

import javax.jms.Connection;
import javax.jms.ConnectionFactory;
import javax.jms.DeliveryMode;
import javax.jms.Destination;
import javax.jms.ExceptionListener;
import javax.jms.JMSException;
import javax.jms.Message;
import javax.jms.MessageConsumer;
import javax.jms.MessageProducer;
import javax.jms.Session;
import javax.jms.TextMessage;
import javax.naming.Context;
import javax.naming.InitialContext;

public class HelloWorld {
    public static void main(String[] args) throws Exception {
        try {
            // The configuration for the Qpid InitialContextFactory has been supplied in
            // a jndi.properties file in the classpath, which results in it being picked
            // up automatically by the InitialContext constructor.
            Context context = new InitialContext();
            ConnectionFactory factory = (ConnectionFactory) context.lookup("myFactoryLookup");
            Destination queue = (Destination) context.lookup("myQueueLookup");

            Connection connection = factory.createConnection(System.getProperty("USER"),
                                                              System.getProperty("PASSWORD"));
            connection.setExceptionListener(new MyExceptionListener());
            connection.start();

            Session session = connection.createSession(false, Session.AUTO_ACKNOWLEDGE);
            MessageProducer messageProducer = session.createProducer(queue);
            MessageConsumer messageConsumer = session.createConsumer(queue);

            TextMessage message = session.createTextMessage("Hello world!");
            messageProducer.send(message, DeliveryMode.NON_PERSISTENT,
                                  Message.DEFAULT_PRIORITY, Message.DEFAULT_TIME_TO_LIVE);

            TextMessage receivedMessage = (TextMessage) messageConsumer.receive(2000L);

            if (receivedMessage != null) {
                System.out.println(receivedMessage.getText());
            } else {
```
with jndi.properties:

connectionfactory.myFactoryLookup = amqps://messaging-route-hostname:443?
transport.trustAll=true&transport.verifyHost=false
queue.myQueueLookup = myqueue

6.2.3. AMQ Online JavaScript example

You can use the following AMQ Online JavaScript example to connect your application to AMQ Online. This example assumes you have created an address of type queue named myqueue.

```javascript
var container = require('rhea');
container.on('connection_open', function (context) {
    context.connection.open_receiver('myqueue');
    context.connection.open_sender('myqueue');
});
container.on('message', function (context) {
    console.log(context.message.body);
    context.connection.close();
});
container.on('sendable', function (context) {
    context.sender.send({body:'Hello World!'});
    context.sender.detach();
});
container.connect({username: 'username', password: 'password', port:443, host:'messaging-route-hostname', transport:'tls', rejectUnauthorized:false});
```

6.2.3.1. AMQ Online JavaScript example using WebSockets

```javascript
var container = require('rhea');
var WebSocket = require('ws');

container.on('connection_open', function (context) {
```
6.2.4. AMQ Online C++ example

The C++ client has equivalent `simple_recv` and `simple_send` examples with the same options as Python. However, the C++ library does not perform the same level of processing on the URL; in particular it will not accept `amqps://` to imply using TLS, so the example needs to be modified as follows:

```cpp
context.connection.open_receiver('myqueue');
context.connection.open_sender('myqueue');
});
container.on('message', function (context) {
  console.log(context.message.body);
  context.connection.close();
});
container.on('sendable', function (context) {
  context.sender.send({body:'Hello World!'});
  context.sender.detach();
});

var ws = container.websocket_connect(WebSocket);
container.connect({username: 'username', password: 'password', connection_details:
  ws("wss://messaging-route-hostname:443", ['binary'], {rejectUnauthorized: false})});
```

6.2.4. AMQ Online C++ example

The C++ client has equivalent `simple_recv` and `simple_send` examples with the same options as Python. However, the C++ library does not perform the same level of processing on the URL; in particular it will not accept `amqps://` to imply using TLS, so the example needs to be modified as follows:

```cpp
#include <proton/connection.hpp>
#include <proton/container.hpp>
#include <proton/default_container.hpp>
#include <proton/delivery.hpp>
#include <proton/message.hpp>
#include <proton/messaging_handler.hpp>
#include <proton/ssl.hpp>
#include <proton/thread_safe.hpp>
#include <proton/tracker.hpp>
#include <proton/url.hpp>

#include <iostream>
#include "fake_cpp11.hpp"

class hello_world : public proton::messaging_handler {
  private:
    proton::url url;

  public:
    hello_world(const std::string& u) : url(u) {} 

    void on_container_start(proton::container& c) OVERRIDE {
      proton::connection_options co;
      co.ssl_client_options(proton::ssl_client_options());
      c.client_connection_options(co);
      c.connect(url);
    }

    void on_connection_open(proton::connection& c) OVERRIDE {
      c.open_receiver(url.path());
      c.open_sender(url.path());
    }
```
6.2.4.1. Known issue with creating a subscriber on a hierarchical topic

A known issue exists where creating a subscriber on a hierarchical topic in AMQ Online causes the broker to instead create it as a competing consumer (handling the address like a queue rather than a topic).

The workaround involves setting the capability "topic" in the source.

Procedure

- In the **topic_receive.cpp** file, edit the code so that it is similar to what is shown in this example:

```cpp
void on_container_start(proton::container& cont) override {
    proton::connection conn = cont.connect(conn_url_);
    proton::receiver_options opts {};
    proton::source_options sopts {};

    sopts.capabilities(std::vector<proton::symbol> { "topic" });
    opts.source(sopts);

    conn.open_receiver(address_, opts);
}
```

6.2.5. AMQ Online .NET example

You can use the following AMQ Online .NET example to connect your application to AMQ Online. This example assumes you have created an address of type **queue** named **myqueue**.
using System;
using Amqp;

amespace Test
{
public class Program
{
    public static void Main(string[] args)
    {
        String url = (args.Length > 0) ? args[0] : "amqps://messaging-route-hostname:443";
        String address = (args.Length > 1) ? args[1] : "myqueue";

        Connection.DisableServerCertValidation = true;
        Connection connection = new Connection(new Address(url));
        Session session = new Session(connection);
        SenderLink sender = new SenderLink(session, "test-sender", address);

        Message messageSent = new Message("Test Message");
        sender.Send(messageSent);

        ReceiverLink receiver = new ReceiverLink(session, "test-receiver", address);
        Message messageReceived = receiver.Receive(TimeSpan.FromSeconds(2));
        Console.WriteLine(messageReceived.Body);
        receiver.Accept(messageReceived);

        sender.Close();
        receiver.Close();
        session.Close();
        connection.Close();
    }
}
}
APPENDIX A. USING YOUR SUBSCRIPTION

AMQ Online is provided through a software subscription. To manage your subscriptions, access your account at the Red Hat Customer Portal.

Accessing your account

1. Go to access.redhat.com.
2. If you do not already have an account, create one.
3. Log in to your account.

Activating a subscription

1. Go to access.redhat.com.
2. Navigate to My Subscriptions.
3. Navigate to Activate a subscription and enter your 16-digit activation number.

Downloading zip and tar files

To access zip or tar files, use the Red Hat Customer Portal to find the relevant files for download. If you are using RPM packages, this step is not required.

1. Open a browser and log in to the Red Hat Customer Portal Product Downloads page at access.redhat.com/downloads.
2. Locate the Red Hat AMQ Online entries in the JBOSS INTEGRATION AND AUTOMATION category.
3. Select the desired AMQ Online product. The Software Downloads page opens.
4. Click the Download link for your component.

Registering your system for packages

To install RPM packages on Red Hat Enterprise Linux, your system must be registered. If you are using zip or tar files, this step is not required.

1. Go to access.redhat.com.
2. Navigate to Registration Assistant.
3. Select your OS version and continue to the next page.
4. Use the listed command in your system terminal to complete the registration.

To learn more see How to Register and Subscribe a System to the Red Hat Customer Portal.
APPENDIX B. AMQ ONLINE RESOURCES FOR MESSAGING TENANTS

The following table describes the AMQ Online resources that pertain to the messaging tenant role.

Table B.1. AMQ Online messaging tenant resources table

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>addresses</td>
<td>Specifies the address.</td>
</tr>
<tr>
<td>addressspaces</td>
<td>Specifies the address space.</td>
</tr>
<tr>
<td>messagingusers</td>
<td>Specifies the authorization policy that controls which addresses may be used and the operations that may be performed on those addresses.</td>
</tr>
</tbody>
</table>

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