Red Hat AMQ 2020.Q4

Using the AMQ JMS Client

For Use with AMQ Clients 2.8

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Legal Notice

Abstract

This guide describes how to install and configure the client, run hands-on examples, and use your client with other AMQ components.

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CHAPTER 1. OVERVIEW

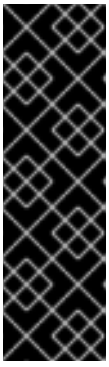
AMQ JMS is a Java Message Service (JMS) 2.0 client for use in messaging applications that send and receive AMQP messages.

AMQ JMS is part of AMQ Clients, a suite of messaging libraries supporting multiple languages and platforms. For an overview of the clients, see AMQ Clients Overview. For information about this release, see AMQ Clients 2.8 Release Notes .

AMQ JMS is based on the JMS implementation from Apache Qpid. For more information about the JMS API, see the JMS API reference and the JMS tutorial.

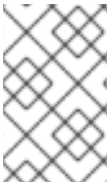
1.1. KEY FEATURES

- JMS 1.1 and 2.0 compatible
- SSL/TLS for secure communication
- Flexible SASL authentication
- Automatic reconnect and failover
- Ready for use with OSGi containers
- Pure-Java implementation
- Distributed tracing based on the OpenTracing standard



IMPORTANT

Distributed tracing in AMQ Clients is a Technology Preview feature only. Technology Preview features are not supported with Red Hat production service level agreements (SLAs) and might not be functionally complete. Red Hat does not recommend using them in production. These features provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process. For more information about the support scope of Red Hat Technology Preview features, see https://access.redhat.com/support/offerings/techpreview/.



NOTE

AMQ JMS does not currently support distributed transactions (XA). If your application requires distributed transactions, it is recommended that you use the AMQ Core Protocol JMS client.

1.2. SUPPORTED STANDARDS AND PROTOCOLS

AMQ JMS supports the following industry-recognized standards and network protocols:

- Version 2.0 of the Java Message Service API
- Version 1.0 of the Advanced Message Queueing Protocol (AMQP)
- Version 1.0 of the AMQP JMS Mapping

- Versions 1.0, 1.1, 1.2, and 1.3 of the Transport Layer Security (TLS) protocol, the successor to SSL
- Simple Authentication and Security Layer (SASL) mechanisms including ANONYMOUS, PLAIN, SCRAM, EXTERNAL, and GSSAPI (Kerberos)
- Modern TCP with IPv6

1.3. SUPPORTED CONFIGURATIONS

AMQ JMS supports the OS and language versions listed below. For more information, see Red Hat AMQ 7 Supported Configurations.

- Red Hat Enterprise Linux 7 and 8 with the following JDKs:
  - OpenJDK 8 and 11
  - Oracle JDK 8
  - IBM JDK 8
- Red Hat Enterprise Linux 6 with the following JDKs:
  - OpenJDK 8
  - Oracle JDK 8
- IBM AIX 7.1 with IBM JDK 8
- Microsoft Windows 10 Pro with Oracle JDK 8
- Microsoft Windows Server 2012 R2 and 2016 with Oracle JDK 8
- Oracle Solaris 10 and 11 with Oracle JDK 8

AMQ JMS is supported in combination with the following AMQ components and versions:

- All versions of AMQ Broker
- All versions of AMQ Interconnect
- A-MQ 6 versions 6.2.1 and newer

1.4. TERMS AND CONCEPTS

This section introduces the core API entities and describes how they operate together.

Table 1.1. API terms

Entity	Description
ConnectionFactory	An entry point for creating connections.
Connection	A channel for communication between two peers on a network. It contains sessions.

Entity	Description
Session	A context for producing and consuming messages. It contains message producers and consumers.
MessageProducer	A channel for sending messages to a destination. It has a target destination.
MessageConsumer	A channel for receiving messages from a destination. It has a source destination.
Destination	A named location for messages, either a queue or a topic.
Queue	A stored sequence of messages.
Topic	A stored sequence of messages for multicast distribution.
Message	An application-specific piece of information.

AMQ JMS sends and receives *messages*. Messages are transferred between connected peers using *message producers* and *consumers*. Producers and consumers are established over *sessions*. Sessions are established over *connections*. Connections are created by *connection factories*.

A sending peer creates a producer to send messages. The producer has a *destination* that identifies a target queue or topic at the remote peer. A receiving peer creates a consumer to receive messages. Like the producer, the consumer has a destination that identifies a source queue or topic at the remote peer.

A destination is either a *queue* or a *topic*. In JMS, queues and topics are client-side representations of named broker entities that hold messages.

A queue implements point-to-point semantics. Each message is seen by only one consumer, and the message is removed from the queue after it is read. A topic implements publish-subscribe semantics. Each message is seen by multiple consumers, and the message remains available to other consumers after it is read.

See the JMS tutorial for more information.

1.5. DOCUMENT CONVENTIONS

The sudo command

In this document, **sudo** is used for any command that requires root privileges. Exercise caution when using **sudo** because any changes can affect the entire system. For more information about **sudo**, see Using the sudo command.

File paths

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

Variable text

This document contains code blocks with variables that you must replace with values specific to your environment. Variable text is enclosed in arrow braces and styled as italic monospace. For example, in the following command, replace ***<project-dir>*** with the value for your environment:

```
$ cd <project-dir>
```

CHAPTER 2. INSTALLATION

This chapter guides you through the steps to install AMQ JMS in your environment.

2.1. PREREQUISITES

- You must have a subscription to access AMQ release files and repositories.
- To build programs with AMQ JMS, you must install Apache Maven.
- To use AMQ JMS, you must install Java.

2.2. USING THE RED HAT MAVEN REPOSITORY

Configure your Maven environment to download the client library from the Red Hat Maven repository.

Procedure

1. Add the Red Hat repository to your Maven settings or POM file. For example configuration files, see Section B.1, “Using the online repository” .

```
<repository>
  <id>red-hat-ga</id>
  <url>https://maven.repository.redhat.com/ga</url>
</repository>
```

2. Add the library dependency to your POM file.

```
<dependency>
  <groupId>org.apache.qpid</groupId>
  <artifactId>qpid-jms-client</artifactId>
  <version>0.53.0.redhat-00001</version>
</dependency>
```

The client is now available in your Maven project.

2.3. INSTALLING A LOCAL MAVEN REPOSITORY

As an alternative to the online repository, AMQ JMS can be installed to your local filesystem as a file-based Maven repository.

Procedure

1. Use your subscription to download the **AMQ Clients 2.8.0 JMS Maven repository**.zip file.
2. Extract the file contents into a directory of your choosing.
   On Linux or UNIX, use the **unzip** command to extract the file contents.

```
$ unzip amq-clients-2.8.0-jms-maven-repository.zip
```

   On Windows, right-click the .zip file and select **Extract All**.

3. Configure Maven to use the repository in the **maven-repository** directory inside the extracted install directory. For more information, see Section B.2, “Using a local repository” .

2.4. INSTALLING THE EXAMPLES

Procedure

1. Use the **git clone** command to clone the source repository to a local directory named **qpid-jms**:

```
$ git clone https://github.com/apache/qpid-jms.git qpid-jms
```

2. Change to the **qpid-jms** directory and use the **git checkout** command to switch to the **0.53.0** branch:

```
$ cd qpid-jms
$ git checkout 0.53.0
```

The resulting local directory is referred to as ***<source-dir>*** throughout this document.

CHAPTER 3. GETTING STARTED

This chapter guides you through the steps to set up your environment and run a simple messaging program.

3.1. PREREQUISITES

- To build the example, Maven must be configured to use the Red Hat repository or a local repository.
- You must install the examples.
- You must have a message broker listening for connections on **localhost**. It must have anonymous access enabled. For more information, see Starting the broker.
- You must have a queue named **queue**. For more information, see Creating a queue.

3.2. RUNNING HELLO WORLD

The Hello World example creates a connection to the broker, sends a message containing a greeting to the **queue** queue, and receives it back. On success, it prints the received message to the console.

Procedure

1. Use Maven to build the examples by running the following command in the ***<source-dir>*/qpid-jms-examples** directory:

```
$ mvn clean package dependency:copy-dependencies -DincludeScope=runtime -DskipTests
```

   The addition of **dependency:copy-dependencies** results in the dependencies being copied into the **target/dependency** directory.

2. Use the **java** command to run the example.
   On Linux or UNIX:

```
$ java -cp "target/classes:target/dependency/*" org.apache.qpid.jms.example.HelloWorld
```

   On Windows:

```
> java -cp "target\classes;target\dependency\*" org.apache.qpid.jms.example.HelloWorld
```

For example, running it on Linux results in the following output:

```
$ java -cp "target/classes/:target/dependency/*" org.apache.qpid.jms.example.HelloWorld
Hello world!
```

The source code for the example is in the ***<source-dir>*/qpid-jms-examples/src/main/java** directory. The JNDI and logging configuration is in the ***<source-dir>*/qpid-jms-examples/src/main/resources** directory.

CHAPTER 4. CONFIGURATION

This chapter describes the process for binding the AMQ JMS implementation to your JMS application and setting configuration options.

JMS uses the Java Naming Directory Interface (JNDI) to register and look up API implementations and other resources. This enables you to write code to the JMS API without tying it to a particular implementation.

Configuration options are exposed as query parameters on the connection URI.

4.1. CONFIGURING THE JNDI INITIAL CONTEXT

JMS applications use a JNDI **InitialContext** object obtained from an **InitialContextFactory** to look up JMS objects such as the connection factory. AMQ JMS provides an implementation of the **InitialContextFactory** in the **org.apache.qpid.jms.jndi.JmsInitialContextFactory** class.

The **InitialContextFactory** implementation is discovered when the **InitialContext** object is instantiated:

```
javax.naming.Context context = new javax.naming.InitialContext();
```

To find an implementation, JNDI must be configured in your environment. There are three ways of achieving this: using a **jndi.properties** file, using a system property, or using the initial context API.

Using a jndi.properties file

Create a file named **jndi.properties** and place it on the Java classpath. Add a property with the key **java.naming.factory.initial**.

Example: Setting the JNDI initial context factory using a jndi.properties file

```
java.naming.factory.initial = org.apache.qpid.jms.jndi.JmsInitialContextFactory
```

In Maven-based projects, the **jndi.properties** file is placed in the ***<project-dir>*/src/main/resources** directory.

Using a system property

Set the **java.naming.factory.initial** system property.

Example: Setting the JNDI initial context factory using a system property

```
$ java -Djava.naming.factory.initial=org.apache.qpid.jms.jndi.JmsInitialContextFactory ...
```

Using the initial context API

Use the JNDI initial context API to set properties programatically.

Example: Setting JNDI properties programatically

```
Hashtable<Object, Object> env = new Hashtable<>();

env.put("java.naming.factory.initial", "org.apache.qpid.jms.jndi.JmsInitialContextFactory");

InitialContext context = new InitialContext(env);
```

Note that you can use the same API to set the JNDI properties for connection factories, queues, and topics.

4.2. CONFIGURING THE CONNECTION FACTORY

The JMS connection factory is the entry point for creating connections. It uses a connection URI that encodes your application-specific configuration settings.

To set the factory name and connection URI, create a property in the format below. You can store this configuration in a **jndi.properties** file or set the corresponding system property.

The JNDI property format for connection factories

```
connectionFactory.<lookup-name> = <connection-uri>
```

For example, this is how you might configure a factory named **app1**:

Example: Setting the connection factory in a jndi.properties file

```
connectionFactory.app1 = amqp://example.net:5672?jms.clientID=backend
```

You can then use the JNDI context to look up your configured connection factory using the name **app1**:

```
ConnectionFactory factory = (ConnectionFactory) context.lookup("app1");
```

4.3. CONNECTION URIS

Connections are configured using a connection URI. The connection URI specifies the remote host, port, and a set of configuration options, which are set as query parameters. For more information about the available options, see Chapter 5, *Configuration options*.

The connection URI format

```
<scheme>://<host>:<port>[?<option>=<value>[&<option>=<value>...]]
```

The scheme is **amqp** for unencrypted connections and **amqps** for SSL/TLS connections.

For example, the following is a connection URI that connects to host **example.net** at port **5672** and sets the client ID to **backend**:

Example: A connection URI

```
amqp://example.net:5672?jms.clientID=backend
```

Failover URIs

When failover is configured, the client can reconnect to another server automatically if the connection to the current server is lost. Failover URIs have the prefix **failover:** and contain a comma-separated list of connection URIs inside parentheses. Additional options are specified at the end.

The failover URI format

```
failover:(<connection-uri>[,<connection-uri>...])[?<option>=<value>[&<option>=<value>...]]
```

For example, the following is a failover URI that can connect to either of two hosts, **host1** or **host2**:

Example: A failover URI

```
failover:(amqp://host1:5672,amqp://host2:5672)?jms.clientID=backend
```

As with the connection URI example, the client can be configured with a number of different settings using the URI in a failover configuration. These settings are detailed in Chapter 5, *Configuration options*, with the Section 5.5, "Failover options" section being of particular interest.

SSL/TLS Server Name Indication

When the **amqps** scheme is used to specify an SSL/TLS connection, the host segment from the URI can be used by the JVM's TLS Server Name Indication (SNI) extension to communicate the desired server hostname during a TLS handshake. The SNI extension is automatically included if a fully qualified domain name (for example, "myhost.mydomain") is specified, but not when an unqualified name (for example, "myhost") or a bare IP address is used.

4.4. CONFIGURING QUEUE AND TOPIC NAMES

JMS provides the option of using JNDI to look up deployment-specific queue and topic resources.

To set queue and topic names in JNDI, create properties in the following format. Either place this configuration in a **jndi.properties** file or set corresponding system properties.

The JNDI property format for queues and topics

```
queue.<lookup-name> = <queue-name>
topic.<lookup-name> = <topic-name>
```

For example, the following properties define the names **jobs** and **notifications** for two deployment-specific resources:

Example: Setting queue and topic names in a jndi.properties file

```
queue.jobs = app1/work-items
topic.notifications = app1/updates
```

You can then look up the resources by their JNDI names:

```
Queue queue = (Queue) context.lookup("jobs");
Topic topic = (Topic) context.lookup("notifications");
```

4.5. VARIABLE EXPANSION IN JNDI PROPERTIES

JNDI property values can contain variables of the form **${*variable-name*}**. The library resolves the variable value by searching in order in the following locations:

- Java system properties
- OS environment variables
- The JNDI properties file or environment Hashtable

For example, on Linux **${HOME}** resolves to the **HOME** environment variable, the current user's home directory.

A default value can be supplied using the syntax **${*<variable-name>*:-*<default-value>*}**. If no value for ***<variable-name>*** is found, the default value is used instead.

CHAPTER 5. CONFIGURATION OPTIONS

This chapter lists the available configuration options for AMQ JMS.

JMS configuration options are set as query parameters on the connection URI. For more information, see Section 4.3, "Connection URIs".

5.1. JMS OPTIONS

These options control the behaviour of JMS objects such as **Connection**, **Session**, **MessageConsumer**, and **MessageProducer**.

jms.username

The user name the client uses to authenticate the connection.

jms.password

The password the client uses to authenticate the connection.

jms.clientID

The client ID that the client applies to the connection.

jms.forceAsyncSend

If enabled, all messages from a **MessageProducer** are sent asynchronously. Otherwise, only certain kinds, such as non-persistent messages or those inside a transaction, are sent asynchronously. It is disabled by default.

jms.forceSyncSend

If enabled, all messages from a **MessageProducer** are sent synchronously. It is disabled by default.

jms.forceAsyncAcks

If enabled, all message acknowledgments are sent asynchronously. It is disabled by default.

jms.localMessageExpiry

If enabled, any expired messages received by a **MessageConsumer** are filtered out and not delivered. It is enabled by default.

jms.localMessagePriority

If enabled, prefetched messages are reordered locally based on their message priority value. It is disabled by default.

jms.validatePropertyNames

If enabled, message property names are required to be valid Java identifiers. It is enabled by default.

jms.receiveLocalOnly

If enabled, calls to **receive** with a timeout argument check a consumer's local message buffer only. Otherwise, if the timeout expires, the remote peer is checked to ensure there are really no messages. It is disabled by default.

jms.receiveNoWaitLocalOnly

If enabled, calls to **receiveNoWait** check a consumer's local message buffer only. Otherwise, the remote peer is checked to ensure there are really no messages available. It is disabled by default.

jms.queuePrefix

An optional prefix value added to the name of any **Queue** created from a **Session**.

jms.topicPrefix

An optional prefix value added to the name of any **Topic** created from a **Session**.

jms.closeTimeout

The time in milliseconds for which the client waits for normal resource closure before returning. The default is 60000 (60 seconds).

jms.connectTimeout

The time in milliseconds for which the client waits for connection establishment before returning with an error. The default is 15000 (15 seconds).

jms.sendTimeout

The time in milliseconds for which the client waits for completion of a *synchronous message send* before returning an error. By default the client waits indefinitely for a send to complete.

jms.requestTimeout

The time in milliseconds for which the client waits for completion of *various synchronous interactions* like opening a producer or consumer (excluding send) with the remote peer before returning an error. By default the client waits indefinitely for a request to complete.

jms.clientIDPrefix

An optional prefix value used to generate client ID values when a new **Connection** is created by the **ConnectionFactory**. The default is **ID:**.

jms.connectionIDPrefix

An optional prefix value used to generate connection ID values when a new **Connection** is created by the **ConnectionFactory**. This connection ID is used when logging some information from the **Connection** object, so a configurable prefix can make breadcrumbing the logs easier. The default is **ID:**.

jms.populateJMSXUserID

If enabled, populate the **JMSXUserID** property for each sent message using the authenticated user name from the connection. It is disabled by default.

jms.awaitClientID

If enabled, a connection with no client ID configured in the URI waits for a client ID to be set programmatically, or for confirmation that none can be set, before sending the AMQP connection "open". It is enabled by default.

jms.useDaemonThread

If enabled, a connection uses a daemon thread for its executor, rather than a non-daemon thread. It is disabled by default.

jms.tracing

The name of a tracing provider. Supported values are **opentracing** and **noop**. The default is **noop**.

Prefetch policy options

Prefetch policy determines how many messages each **MessageConsumer** fetches from the remote peer and holds in a local "prefetch" buffer.

jms.prefetchPolicy.queuePrefetch

The default is 1000.

jms.prefetchPolicy.topicPrefetch

The default is 1000.

jms.prefetchPolicy.queueBrowserPrefetch

The default is 1000.

jms.prefetchPolicy.durableTopicPrefetch

The default is 1000.

jms.prefetchPolicy.all

This can be used to set all prefetch values at once.

The value of prefetch can affect the distribution of messages to multiple consumers on a queue or shared subscription. A higher value can result in larger batches sent at once to each consumer. To achieve more even round-robin distribution, use a lower value.

Redelivery policy options

Redelivery policy controls how redelivered messages are handled on the client.

jms.redeliveryPolicy.maxRedeliveries

Controls when an incoming message is rejected based on the number of times it has been redelivered. A value of 0 indicates that no message redeliveries are accepted. A value of 5 allows a message to be redelivered five times, and so on. The default is -1, meaning no limit.

jms.redeliveryPolicy.outcome

Controls the outcome applied to a message once it has exceeded the configured maxRedeliveries value. Supported values are: **ACCEPTED**, **REJECTED**, **RELEASED**, **MODIFIED_FAILED** and **MODIFIED_FAILED_UNDELIVERABLE**. The default value is **MODIFIED_FAILED_UNDELIVERABLE**.

Message ID policy options

Message ID policy controls the data type of the message ID assigned to messages sent from the client.

jms.messageIDPolicy.messageIDType

By default, a generated **String** value is used for the message ID on outgoing messages. Other available types are **UUID**, **UUID_STRING**, and **PREFIXED_UUID_STRING**.

Presettle policy options

Presettle policy controls when a producer or consumer instance is configured to use AMQP presettled messaging semantics.

jms.presettlePolicy.presettleAll

If enabled, all producers and non-transacted consumers created operate in presettled mode. It is disabled by default.

jms.presettlePolicy.presettleProducers

If enabled, all producers operate in presettled mode. It is disabled by default.

jms.presettlePolicy.presettleTopicProducers

If enabled, any producer that is sending to a **Topic** or **TemporaryTopic** destination operates in presettled mode. It is disabled by default.

jms.presettlePolicy.presettleQueueProducers

If enabled, any producer that is sending to a **Queue** or **TemporaryQueue** destination operates in presettled mode. It is disabled by default.

jms.presettlePolicy.presettleTransactedProducers

If enabled, any producer that is created in a transacted **Session** operates in presettled mode. It is disabled by default.

jms.presettlePolicy.presettleConsumers

If enabled, all consumers operate in presettled mode. It is disabled by default.

jms.presettlePolicy.presettleTopicConsumers

If enabled, any consumer that is receiving from a **Topic** or **TemporaryTopic** destination operates in presettled mode. It is disabled by default.

jms.presettlePolicy.presettleQueueConsumers

If enabled, any consumer that is receiving from a **Queue** or **TemporaryQueue** destination operates in presettled mode. It is disabled by default.

Deserialization policy options

Deserialization policy provides a means of controlling which Java types are trusted to be deserialized from the object stream while retrieving the body from an incoming **ObjectMessage** composed of serialized Java **Object** content. By default all types are trusted during an attempt to deserialize the body. The default deserialization policy provides URI options that allow specifying a whitelist and a blacklist of Java class or package names.

jms.deserializationPolicy.whiteList

A comma-separated list of class and package names that should be allowed when deserializing the contents of an **ObjectMessage**, unless overridden by **blackList**. The names in this list are not pattern values. The exact class or package name must be configured, as in **java.util.Map** or **java.util**. Package matches include sub-packages. The default is to allow all.

jms.deserializationPolicy.blackList

A comma-separated list of class and package names that should be rejected when deserializing the contents of a **ObjectMessage**. The names in this list are not pattern values. The exact class or package name must be configured, as in **java.util.Map** or **java.util**. Package matches include sub-packages. The default is to prevent none.

5.2. TCP OPTIONS

When connected to a remote server using plain TCP, the following options specify the behavior of the underlying socket. These options are appended to the connection URI along with any other configuration options.

Example: A connection URI with transport options

```
amqp://localhost:5672?jms.clientID=foo&transport.connectTimeout=30000
```

The complete set of TCP transport options is listed below.

transport.sendBufferSize

The send buffer size in bytes. The default is 65536 (64 KiB).

transport.receiveBufferSize

The receive buffer size in bytes. The default is 65536 (64 KiB).

transport.trafficClass

The default is 0.

transport.connectTimeout

The default is 60 seconds.

transport.soTimeout

The default is -1.

transport.soLinger

The default is -1.

transport.tcpKeepAlive

The default is false.

transport.tcpNoDelay

If enabled, do not delay and buffer TCP sends. It is enabled by default.

transport.useEpoll

When available, use the native epoll IO layer instead of the NIO layer. This can improve performance. It is enabled by default.

5.3. SSL/TLS OPTIONS

The SSL/TLS transport is enabled by using the **amqps** URI scheme. Because the SSL/TLS transport extends the functionality of the TCP-based transport, all of the TCP transport options are valid on an SSL/TLS transport URI.

Example: A simple SSL/TLS connection URI

```
amqps://myhost.mydomain:5671
```

The complete set of SSL/TLS transport options is listed below.

transport.keyStoreLocation

The path to the SSL/TLS key store. If unset, the value of the **javax.net.ssl.keyStore** system property is used.

transport.keyStorePassword

The password for the SSL/TLS key store. If unset, the value of the **javax.net.ssl.keyStorePassword** system property is used.

transport.trustStoreLocation

The path to the SSL/TLS trust store. If unset, the value of the **javax.net.ssl.trustStore** system property is used.

transport.trustStorePassword

The password for the SSL/TLS trust store. If unset, the value of the **javax.net.ssl.trustStorePassword** system property is used.

transport.keyStoreType

If unset, the value of the **javax.net.ssl.keyStoreType** system property is used. If the system property is unset, the default is **JKS**.

transport.trustStoreType

If unset, the value of the **javax.net.ssl.trustStoreType** system property is used. If the system property is unset, the default is **JKS**.

transport.storeType

Sets both **keyStoreType** and **trustStoreType** to the same value. If unset, **keyStoreType** and **trustStoreType** default to the values specified above.

transport.contextProtocol

The protocol argument used when getting an SSLContext. The default is **TLS**, or **TLSv1.2** if using OpenSSL.

transport.enabledCipherSuites

A comma-separated list of cipher suites to enable. If unset, the context-default ciphers are used. Any disabled ciphers are removed from this list.

transport.disabledCipherSuites

A comma-separated list of cipher suites to disable. Ciphers listed here are removed from the enabled ciphers.

transport.enabledProtocols

A comma-separated list of protocols to enable. If unset, the context-default protocols are used. Any disabled protocols are removed from this list.

transport.disabledProtocols

A comma-separated list of protocols to disable. Protocols listed here are removed from the enabled protocol list. The default is **SSLv2Hello,SSLv3**.

transport.trustAll

If enabled, trust the provided server certificate implicitly, regardless of any configured trust store. It is disabled by default.

transport.verifyHost

If enabled, verify that the connection hostname matches the provided server certificate. It is enabled by default.

transport.keyAlias

The alias to use when selecting a key pair from the key store if required to send a client certificate to the server.

transport.useOpenSSL

If enabled, use native OpenSSL libraries for SSL/TLS connections if available. It is disabled by default.
For more information, see Section 7.1, “Enabling OpenSSL support”.

5.4. AMQP OPTIONS

The following options apply to aspects of behavior related to the AMQP wire protocol.

amqp.idleTimeout

The time in milliseconds after which the connection is failed if the peer sends no AMQP frames. The default is 60000 (1 minute).

amqp.vhost

The virtual host to connect to. This is used to populate the SASL and AMQP hostname fields. The default is the main hostname from the connection URI.

amqp.saslLayer

If enabled, SASL is used when establishing connections. It is enabled by default.

amqp.saslMechanisms

A comma-separated list of SASL mechanisms the client should allow selection of, if offered by the server and usable with the configured credentials. The supported mechanisms are EXTERNAL, SCRAM-SHA-256, SCRAM-SHA-1, CRAM-MD5, PLAIN, ANONYMOUS, and GSSAPI for Kerberos. The default is to allow selection from all mechanisms except GSSAPI, which must be explicitly included here to enable.

amqp.maxFrameSize

The maximum AMQP frame size in bytes allowed by the client. This value is advertised to the remote peer. The default is 1048576 (1 MiB).

amqp.drainTimeout

The time in milliseconds that the client waits for a response from the remote peer when a consumer drain request is made. If no response is seen in the allotted timeout period, the link is considered failed and the associated consumer is closed. The default is 60000 (1 minute).

amqp.allowNonSecureRedirects

If enabled, allow AMQP redirects to alternative hosts when the existing connection is secure and the alternative connection is not. For example, if enabled this would permit redirecting an SSL/TLS connection to a raw TCP connection. It is disabled by default.

5.5. FAILOVER OPTIONS

Failover URIs start with the prefix **failover:** and contain a comma-separated list of connection URIs inside parentheses. Additional options are specified at the end. Options prefixed with **jms.** are applied to the overall failover URI, outside of parentheses, and affect the **Connection** object for its lifetime.

Example: A failover URI with failover options

```
failover:(amqp://host1:5672,amqp://host2:5672)?
jms.clientID=foo&failover.maxReconnectAttempts=20
```

The individual broker details within the parentheses can use the **transport.** or **amqp.** options defined earlier. These are applied as each host is connected to.

Example: A failover URI with per-connection transport and AMQP options

```
failover:(amqp://host1:5672?amqp.option=value,amqp://host2:5672?transport.option=value)?
jms.clientID=foo
```

All of the configuration options for failover are listed below.

failover.initialReconnectDelay

The time in milliseconds the client waits before the first attempt to reconnect to a remote peer. The default is 0, meaning the first attempt happens immediately.

failover.reconnectDelay

The time in milliseconds between reconnection attempts. If the backoff option is not enabled, this value remains constant. The default is 10.

failover.maxReconnectDelay

The maximum time that the client waits before attempting to reconnect. This value is only used when the backoff feature is enabled to ensure that the delay does not grow too large. The default is 30 seconds.

failover.useReconnectBackOff

If enabled, the time between reconnection attempts grows based on a configured multiplier. It is enabled by default.

failover.reconnectBackOffMultiplier

The multiplier used to grow the reconnection delay value. The default is 2.0.

failover.maxReconnectAttempts

The number of reconnection attempts allowed before reporting the connection as failed to the client. The default is -1, meaning no limit.

failover.startupMaxReconnectAttempts

For a client that has never connected to a remote peer before, this option controls how many attempts are made to connect before reporting the connection as failed. If unset, the value of **maxReconnectAttempts** is used.

failover.warnAfterReconnectAttempts

The number of failed reconnection attempts until a warning is logged. The default is 10.

failover.randomize

If enabled, the set of failover URIs is randomly shuffled before attempting to connect to one of them. This can help to distribute client connections more evenly across multiple remote peers. It is disabled by default.

failover.amqpOpenServerListAction

Controls how the failover transport behaves when the connection "open" frame from the server provides a list of failover hosts to the client. Valid values are **REPLACE**, **ADD**, or **IGNORE**. If **REPLACE** is configured, all failover URIs other than the one for the current server are replaced with those provided by the server. If **ADD** is configured, the URIs provided by the server are added to the existing set of failover URIs, with deduplication. If **IGNORE** is configured, any updates from the server are ignored and no changes are made to the set of failover URIs in use. The default is **REPLACE**.

The failover URI also supports defining nested options as a means of specifying AMQP and transport option values applicable to all the individual nested broker URIs. This is accomplished using the same **transport.** and **amqp.** URI options outlined earlier for a non-failover broker URI but prefixed with **failover.nested.**. For example, to apply the same value for the **amqp.vhost** option to every broker connected to you might have a URI like the following:

Example: A failover URI with shared transport and AMQP options

```
failover:(amqp://host1:5672,amqp://host2:5672)?
jms.clientID=foo&failover.nested.amqp.vhost=myhost
```

5.6. DISCOVERY OPTIONS

The client has an optional discovery module that provides a customized failover layer where the broker URIs to connect to are not given in the initial URI but instead are discovered by interacting with a discovery agent. There are currently two discovery agent implementations: a file watcher that loads URIs from a file and a multicast listener that works with ActiveMQ 5.x brokers that are configured to broadcast their broker addresses for listening clients.

The general set of failover-related options when using discovery are the same as those detailed earlier, with the main prefix changed from **failover.** to **discovery.**, and with the **nested** prefix used to supply URI options common to all the discovered broker URIs. For example, without the agent URI details, a general discovery URI might look like the following:

Example: A discovery URI

```
discovery:(<agent-uri>)?
discovery.maxReconnectAttempts=20&discovery.discovered.jms.clientID=foo
```

To use the file watcher discovery agent, create an agent URI like the following:

Example: A discovery URI using the file watcher agent

```
discovery:(file:///path/to/monitored-file?updateInterval=60000)
```

The URI options for the file watcher discovery agent are listed below.

updateInterval

The time in milliseconds between checks for file changes. The default is 30000 (30 seconds).

To use the multicast discovery agent with an ActiveMQ 5.x broker, create an agent URI like the following:

Example: A discovery URI using the multicast listener agent

```
discovery:(multicast://default?group=default)
```

Note that the use of **default** as the host in the multicast agent URI above is a special value that is substituted by the agent with the default **239.255.2.3:6155**. You can change this to specify the actual IP address and port in use with your multicast configuration.

The URI option for the multicast discovery agent is listed below.

group

The multicast group used to listen for updates. The default is **default**.

CHAPTER 6. EXAMPLES

This chapter demonstrates the use of AMQ JMS through example programs.

For more examples, see the AMQ JMS example suite and the Qpid JMS examples.

6.1. CONFIGURING THE JNDI CONTEXT

Applications using JMS typically use JNDI to obtain the **ConnectionFactory** and **Destination** objects used by the application. This keeps the configuration separate from the program and insulates it from the particular client implementation.

For the purpose of using these examples, a file named **jndi.properties** should be placed on the classpath to configure the JNDI context, as detailed previously.

The contents of the **jndi.properties** file should match what is shown below, which establishes that the client's **InitialContextFactory** implementation should be used, configures a **ConnectionFactory** to connect to a local server, and defines a destination queue named **queue**.

```
# Configure the InitialContextFactory class to use
java.naming.factory.initial = org.apache.qpid.jms.jndi.JmsInitialContextFactory

# Configure the ConnectionFactory
connectionfactory.myFactoryLookup = amqp://localhost:5672

# Configure the destination
queue.myDestinationLookup = queue
```

6.2. SENDING MESSAGES

This example first creates a JNDI **Context**, uses it to look up a **ConnectionFactory** and **Destination**, creates and starts a **Connection** using the factory, and then creates a **Session**. Then a **MessageProducer** is created to the **Destination**, and a message is sent using it. The **Connection** is then closed, and the program exits.

A runnable variant of this **Sender** example is in the **<source-dir>/qpid-jms-examples** directory, along with the Hello World example covered previously in Chapter 3, *Getting started*.

Example: Sending messages

```
package org.jboss.amq.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.MessageProducer;
import javax.jms.Session;
import javax.jms.TextMessage;
import javax.naming.Context;
import javax.naming.InitialContext;
```

```
public class Sender {
  public static void main(String[] args) throws Exception {
    try {
      Context context = new InitialContext(); (1)

      ConnectionFactory factory = (ConnectionFactory) context.lookup("myFactoryLookup");
      Destination destination = (Destination) context.lookup("myDestinationLookup"); (2)

      Connection connection = factory.createConnection("<username>", "<password>");
      connection.setExceptionListener(new MyExceptionListener());
      connection.start(); (3)

      Session session = connection.createSession(false, Session.AUTO_ACKNOWLEDGE); (4)

      MessageProducer messageProducer = session.createProducer(destination); (5)

      TextMessage message = session.createTextMessage("Message Text!"); (6)
      messageProducer.send(message, DeliveryMode.NON_PERSISTENT,
                           Message.DEFAULT_PRIORITY, Message.DEFAULT_TIME_TO_LIVE); (7)

      connection.close(); (8)
    } catch (Exception exp) {
      System.out.println("Caught exception, exiting.");
      exp.printStackTrace(System.out);
      System.exit(1);
    }
  }

  private static class MyExceptionListener implements ExceptionListener {
    @Override
    public void onException(JMSException exception) {
      System.out.println("Connection ExceptionListener fired, exiting.");
      exception.printStackTrace(System.out);
      System.exit(1);
    }
  }
}
```

(1) Creates the JNDI **Context** to look up **ConnectionFactory** and **Destination** objects. The configuration is picked up from the **jndi.properties** file as detailed earlier.

(2) The ConnectionFactory and Destination objects are retrieved from the JNDI Context using their lookup names.

(3) The factory is used to create the **Connection**, which then has an **ExceptionListener** registered and is then started. The credentials given when creating the connection will typically be taken from an appropriate external configuration source, ensuring they remain separate from the application itself and can be updated independently.

(4) A non-transacted, auto-acknowledge **Session** is created on the **Connection**.

(5) The **MessageProducer** is created to send messages to the **Destination**.

(6) A **TextMessage** is created with the given content.

7 The **TextMessage** is sent. It is sent non-persistent, with default priority and no expiration.

8 The **Connection** is closed. The **Session** and **MessageProducer** are closed implicitly.

Note that this is only an example. A real-world application would typically use a long-lived MessageProducer and send many messages using it over time. Opening and then closing a **Connection**, **Session**, and **MessageProducer** per message is generally not efficient.

6.3. RECEIVING MESSAGES

This example starts by creating a JNDI Context, using it to look up a **ConnectionFactory** and **Destination**, creating and starting a **Connection** using the factory, and then creates a **Session**. Then a **MessageConsumer** is created for the **Destination**, a message is received using it, and its contents are printed to the console. The Connection is then closed and the program exits. The same JNDI configuration is used as in the sending example.

An executable variant of this **Receiver** example is contained within the examples directory of the client distribution, along with the Hello World example covered previously in Chapter 3, *Getting started*.

Example: Receiving messages

```
package org.jboss.amq.example;

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

public class Receiver {
  public static void main(String[] args) throws Exception {
    try {
      Context context = new InitialContext(); 1

      ConnectionFactory factory = (ConnectionFactory) context.lookup("myFactoryLookup");
      Destination destination = (Destination) context.lookup("myDestinationLookup"); 2

      Connection connection = factory.createConnection("<username>", "<password>");
      connection.setExceptionListener(new MyExceptionListener());
      connection.start(); 3

      Session session = connection.createSession(false, Session.AUTO_ACKNOWLEDGE); 4

      MessageConsumer messageConsumer = session.createConsumer(destination); 5

      Message message = messageConsumer.receive(5000); 6

      if (message == null) { 7
```

```
            System.out.println("A message was not received within given time.");
        } else {
            System.out.println("Received message: " + ((TextMessage) message).getText());
        }

        connection.close(); 8
    } catch (Exception exp) {
        System.out.println("Caught exception, exiting.");
        exp.printStackTrace(System.out);
        System.exit(1);
    }
}

private static class MyExceptionListener implements ExceptionListener {
    @Override
    public void onException(JMSException exception) {
        System.out.println("Connection ExceptionListener fired, exiting.");
        exception.printStackTrace(System.out);
        System.exit(1);
    }
}
}
```

1. Creates the JNDI **Context** to look up **ConnectionFactory** and **Destination** objects. The configuration is picked up from the **jndi.properties** file as detailed earlier.

2. The **ConnectionFactory** and **Destination** objects are retrieved from the JNDI **Context** using their lookup names.

3. The factory is used to create the **Connection**, which then has an **ExceptionListener** registered and is then started. The credentials given when creating the connection will typically be taken from an appropriate external configuration source, ensuring they remain separate from the application itself and can be updated independently.

4. A non-transacted, auto-acknowledge **Session** is created on the **Connection**.

5. The **MessageConsumer** is created to receive messages from the **Destination**.

6. A call to receive a message is made with a five second timeout.

7. The result is checked, and if a message was received, its contents are printed, or notice that no message was received. The result is cast explicitly to **TextMessage** as this is what we know the **Sender** sent.

8. The **Connection** is closed. The **Session** and **MessageConsumer** are closed implicitly.

Note that this is only an example. A real-world application would typically use a long-lived **MessageConsumer** and receive many messages using it over time. Opening and then closing a **Connection**, **Session**, and **MessageConsumer** for each message is generally not efficient.

CHAPTER 7. SECURITY

AMQ JMS has a range of security-related configuration options that can be leveraged according to your application's needs.

Basic user credentials such as username and password should be passed directly to the **ConnectionFactory** when creating the **Connection** within the application. However, if you are using the no-argument factory method, it is also possible to supply user credentials in the connection URI. For more information, see the Section 5.1, "JMS options" section.

Another common security consideration is use of SSL/TLS. The client connects to servers over an SSL/TLS transport when the **amqps** URI scheme is specified in the connection URI, with various options available to configure behavior. For more information, see the Section 5.3, "SSL/TLS options" section.

In concert with the earlier items, it may be desirable to restrict the client to allow use of only particular SASL mechanisms from those that may be offered by a server, rather than selecting from all it supports. For more information, see the Section 5.4, "AMQP options" section.

Applications calling **getObject()** on a received **ObjectMessage** may wish to restrict the types created during deserialization. Note that message bodies composed using the AMQP type system do not use the **ObjectInputStream** mechanism and therefore do not require this precaution. For more information, see the the section called "Deserialization policy options" section.

7.1. ENABLING OPENSSL SUPPORT

SSL/TLS connections can be configured to use a native OpenSSL implementation for improved performance. To use OpenSSL, the **transport.useOpenSSL** option must be enabled, and an OpenSSL support library must be available on the classpath.

To use the system-installed OpenSSL libraries on Red Hat Enterprise Linux, install the **openssl** and **apr** RPM packages and add the following dependency to your POM file:

Example: Adding native OpenSSL support

```
<dependency>
  <groupId>io.netty</groupId>
  <artifactId>netty-tcnative</artifactId>
  <version>2.0.31.Final-redhat-00001</version>
  <classifier>linux-x86_64-fedora</classifier>
</dependency>
```

A list of OpenSSL library implementations is available from the Netty project.

7.2. AUTHENTICATING USING KERBEROS

The client can be configured to authenticate using Kerberos when used with an appropriately configured server. To enable Kerberos, use the following steps.

1. Configure the client to use the **GSSAPI** mechanism for SASL authentication using the **amqp.saslMechanisms** URI option.

```
amqp://myhost:5672?amqp.saslMechanisms=GSSAPI
failover:(amqp://myhost:5672?amqp.saslMechanisms=GSSAPI)
```

2. Set the **java.security.auth.login.config** system property to the path of a JAAS login configuration file containing appropriate configuration for a Kerberos **LoginModule**.

```
-Djava.security.auth.login.config=<login-config-file>
```

The login configuration file might look like the following example:

```
amqp-jms-client {
   com.sun.security.auth.module.Krb5LoginModule required
   useTicketCache=true;
};
```

The precise configuration used will depend on how you wish the credentials to be established for the connection, and the particular **LoginModule** in use. For details of the Oracle **Krb5LoginModule**, see the Oracle **Krb5LoginModule** class reference. For details of the IBM Java 8 **Krb5LoginModule**, see the IBM **Krb5LoginModule** class reference.

It is possible to configure a **LoginModule** to establish the credentials to use for the Kerberos process, such as specifying a principal and whether to use an existing ticket cache or keytab. If, however, the **LoginModule** configuration does not provide the means to establish all necessary credentials, it may then request and be passed the username and password values from the client **Connection** object if they were either supplied when creating the **Connection** using the **ConnectionFactory** or previously configured via its URI options.

Note that Kerberos is supported only for authentication purposes. Use SSL/TLS connections for encryption.

The following connection URI options can be used to influence the Kerberos authentication process.

sasl.options.configScope

The name of the login configuration entry used to authenticate. The default is **amqp-jms-client**.

sasl.options.protocol

The protocol value used during the GSSAPI SASL process. The default is **amqp**.

sasl.options.serverName

The **serverName** value used during the GSSAPI SASL process. The default is the server hostname from the connection URI.

Similar to the **amqp.** and **transport.** options detailed previously, these options must be specified on a per-host basis or as all-host nested options in a failover URI.

CHAPTER 8. MESSAGE DELIVERY

8.1. HANDLING UNACKNOWLEDGED DELIVERIES

Messaging systems use message acknowledgment to track if the goal of sending a message is truly accomplished.

When a message is sent, there is a period of time after the message is sent and before it is acknowledged (the message is "in flight"). If the network connection is lost during that time, the status of the message delivery is unknown, and the delivery might require special handling in application code to ensure its completion.

The sections below describe the conditions for message delivery when connections fail.

Non-transacted producer with an unacknowledged delivery

If a message is in flight, it is sent again after reconnect, provided a send timeout is not set and has not elapsed.

No user action is required.

Transacted producer with an uncommitted transaction

If a message is in flight, it is sent again after reconnect. If the send is the first in a new transaction, then sending continues as normal after reconnect. If there are previous sends in the transaction, then the transaction is considered failed, and any subsequent commit operation throws a **TransactionRolledBackException**.

To ensure delivery, the user must resend any messages belonging to a failed transaction.

Transacted producer with a pending commit

If a commit is in flight, then the transaction is considered failed, and any subsequent commit operation throws a **TransactionRolledBackException**.

To ensure delivery, the user must resend any messages belonging to a failed transaction.

Non-transacted consumer with an unacknowledged delivery

If a message is received but not yet acknowledged, then acknowledging the message produces no error but results in no action by the client.

Because the received message is not acknowledged, the producer might resend it. To avoid duplicates, the user must filter out duplicate messages by message ID.

Transacted consumer with an uncommitted transaction

If an active transaction is not yet committed, it is considered failed, and any pending acknowledgments are dropped. Any subsequent commit operation throws a **TransactionRolledBackException**.

The producer might resend the messages belonging to the transaction. To avoid duplicates, the user must filter out duplicate messages by message ID.

Transacted consumer with a pending commit

If a commit is in flight, then the transaction is considered failed. Any subsequent commit operation throws a **TransactionRolledBackException**.

The producer might resend the messages belonging to the transaction. To avoid duplicates, the user must filter out duplicate messages by message ID.

8.2. EXTENDED SESSION ACKNOWLEDGMENT MODES

The client supports two additional session acknowledgement modes beyond those defined in the JMS specification.

Individual acknowledge

In this mode, messages must be acknowledged individually by the application using the **Message.acknowledge()** method used when the session is in **CLIENT_ACKNOWLEDGE** mode. Unlike with **CLIENT_ACKNOWLEDGE** mode, only the target message is acknowledged. All other delivered messages remain unacknowledged. The integer value used to activate this mode is 101.

```
connection.createSession(false, 101);
```

No acknowledge

In this mode, messages are accepted at the server before being dispatched to the client, and no acknowledgment is performed by the client. The client supports two integer values to activate this mode, 100 and 257.

```
connection.createSession(false, 100);
```

CHAPTER 9. LOGGING

9.1. CONFIGURING LOGGING

The client uses the SLF4J API, enabling users to select a particular logging implementation based on their needs. For example, users can provide the *slf4j-log4j* binding to select the Log4J implementation. More details on SLF4J are available from its website.

The client uses **Logger** names residing within the **org.apache.qpid.jms** hierarchy, which you can use to configure a logging implementation based on your needs.

9.2. ENABLING PROTOCOL LOGGING

When debugging, it is sometimes useful to enable additional protocol trace logging from the Qpid Proton AMQP 1.0 library. There are two ways to achieve this.

- Set the environment variable (not the Java system property) **PN_TRACE_FRM** to **1**. When the variable is set to **1**, Proton emits frame logging to the console.
- Add the option **amqp.traceFrames=true** to your connection URI and configure the **org.apache.qpid.jms.provider.amqp.FRAMES** logger to log level **TRACE**. This adds a protocol tracer to Proton and includes the output in your logs.

You can also configure the client to emit low-level tracing of input and output bytes. To enable this, add the option **transport.traceBytes=true** to your connection URI and configure the **org.apache.qpid.jms.transports.netty.NettyTcpTransport** logger to log level **DEBUG**.

CHAPTER 10. DISTRIBUTED TRACING

The client offers distributed tracing based on the Jaeger implementation of the OpenTracing standard.

10.1. ENABLING DISTRIBUTED TRACING

Use the following steps to enable tracing in your application:

Procedure

1. Add the Jaeger client dependency to your POM file.

```
<dependency>
  <groupId>io.jaegertracing</groupId>
  <artifactId>jaeger-client</artifactId>
  <version>${jaeger-version}</version>
</dependency>
```

${jaeger-version} must be 1.0.0 or later.

2. Add the **jms.tracing** option to your connection URI. Set the value to **opentracing**.

Example: A connection URI with tracing enabled

```
amqps://example.net?jms.tracing=opentracing
```

3. Register the global tracer.

Example: Global tracer registration

```
import io.jaegertracing.Configuration;
import io.opentracing.Tracer;
import io.opentracing.util.GlobalTracer;

public class Example {
    public static void main(String[] args) {
        Tracer tracer = Configuration.fromEnv("<service-name>").getTracer();
        GlobalTracer.registerIfAbsent(tracer);

        // ...
    }
}
```

4. Configure your environment for tracing.

Example: Tracing configuration

```
$ export JAEGER_SAMPLER_TYPE=const
$ export JAEGER_SAMPLER_PARAM=1
$ java -jar example.jar net.example.Example
```

The configuration shown here is for demonstration purposes. For more information about Jaeger configuration, see Configuration via Environment and Jaeger Sampling.

To view the traces your application captures, use the Jaeger Getting Started to run the Jaeger infrastructure and console.

CHAPTER 11. INTEROPERABILITY

This chapter discusses how to use AMQ JMS in combination with other AMQ components. For an overview of the compatibility of AMQ components, see the product introduction.

11.1. INTEROPERATING WITH OTHER AMQP CLIENTS

AMQP messages are composed using the AMQP type system. Having this common format is one of the reasons AMQP clients in different languages are able to interoperate with each other. This section serves to document behaviour around the AMQP payloads sent and received by the client in relation to the various JMS Message types used, to aid in using the client along with other AMQP clients.

11.1.1. Sending messages

This section serves to document the different payloads sent by the client when using the various JMS Message types, so as to aid in using other clients to receive them.

11.1.1.1. Message type

JMS message type	Description of transmitted AMQP message
TextMessage	A TextMessage will be sent using an amqp-value body section containing a utf8 encoded string of the body text, onull if no body text is set. The message annotation with symbol key of "x-opt-jms-msg-type" will be set to abyte value of 5.
BytesMessage	A BytesMessage will be sent using a data body section containing the raw bytes from the BytesMessage body, with the properties section *content-type* field set to the symbol value *"application/octet-stream"*. The message annotation with symbol key of "x-opt-jms-msg-type" will be set to abyte value of 3.
MapMessage	A MapMessage body will be sent using an amqp-value body section containing a single map value. Any byte[] values in the MapMessage body will be encoded as binary entries in the map. The message annotation withsymbol key of "x-opt-jms-msg-type" will be set to a byte value of 2.
StreamMessage	A StreamMessage will be sent using an amqp-sequence body section containing the entries in the StreamMessage body. Any byte[] entries in the StreamMessage body will be encoded as binary entries in the sequence. The message annotation with symbol key of "x-opt-jms-msg-type" will be set to abyte value of 4.
ObjectMessage	An ObjectMessage will be sent using an data body section, containing the bytes from serializing the ObjectMessage body using an ObjectOutputStream, with the properties section *content-type* field set to the symbol value *"application/x-java-serialized-object"*. The message annotation withsymbol key of "x-opt-jms-msg-type" will be set to a byte value of 1.
Message	A plain JMS Message has no body, and will be sent as an amqp-value body section containing a null. The message annotation withsymbol key of "x-opt-jms-msg-type" will be set to a byte value of 0.

11.1.1.2. Message properties

JMS messages support setting application properties of various Java types. This section serves to show the mapping of these property types to AMQP typed values in the application-properties section of the sent message. Both JMS and AMQP use string keys for property names.

JMS property type	AMQP application property type
boolean	boolean
byte	byte
short	short
int	int
long	long
float	float
double	double
String	string or null

11.1.2. Receiving messages

This section serves to document the different payloads received by the client will be mapped to the various JMS Message types, so as to aid in using other clients to send messages for receipt by the JMS client.

11.1.2.1. Message type

If the the "x-opt-jms-msg-type" message-annotation is present on the received AMQP message, its value is used to determine the JMS message type used to represent it, according to the mapping detailed in the following table. This reflects the reverse process of the mappings discussed for messages sent by the JMS client.

AMQP "x-opt-jms-msg-type" message-annotation value (type)	JMS message type
0 (byte)	Message
1 (byte)	ObjectMessage
2 (byte)	MapMessage
3 (byte)	BytesMessage
4 (byte)	StreamMessage

AMQP "x-opt-jms-msg-type" message-annotation value (type)	JMS message type
5 (byte)	TextMessage

If the "x-opt-jms-msg-type" message-annotation is not present, the table below details how the message will be mapped to a JMS Message type. Note that the StreamMessage and MapMessage types are only assigned to annotated messages.

Description of Received AMQP Message without "x-opt-jms-msg-type" annotation	JMS Message Type
• An amqp-value body section containing a string or null. • A data body section, with the properties section *content-type* field set to a symbol value representing a common textual media type such as *"text/plain"*, *"application/xml"*, or *"application/json"*.	TextMessage
• An amqp-value body section containing a binary. • A data body section, with the properties section *content-type* field either not set, set to symbol value *"application/octet-stream"*, or set to any value not understood to be associated with another message type.	BytesMessage
• A data body section, with the properties section *content-type* field set to symbol value *"application/x-java-serialized-object"*. • An amqp-value body section containing a value not covered above. • An amqp-sequence body section. This will be represented as a List inside the ObjectMessage.	ObjectMessage

11.1.2.2. Message properties

This section serves to show the mapping of values in the application-properties section of the received AMQP message to Java types used in the JMS Message.

AMQP application property Type	JMS property type
boolean	boolean
byte	byte
short	short
int	int

AMQP application property Type	JMS property type
long	long
float	float
double	double
string	String
null	String

11.2. CONNECTING TO AMQ BROKER

AMQ Broker is designed to interoperate with AMQP 1.0 clients. Check the following to ensure the broker is configured for AMQP messaging:

- Port 5672 in the network firewall is open.
- The AMQ Broker AMQP acceptor is enabled. See Default acceptor settings.
- The necessary addresses are configured on the broker. See Addresses, Queues, and Topics.
- The broker is configured to permit access from your client, and the client is configured to send the required credentials. See Broker Security.

11.3. CONNECTING TO AMQ INTERCONNECT

AMQ Interconnect works with any AMQP 1.0 client. Check the following to ensure the components are configured correctly:

- Port 5672 in the network firewall is open.
- The router is configured to permit access from your client, and the client is configured to send the required credentials. See Securing network connections.

APPENDIX A. USING YOUR SUBSCRIPTION

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

A.1. ACCESSING YOUR ACCOUNT

Procedure

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

A.2. ACTIVATING A SUBSCRIPTION

Procedure

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

A.3. DOWNLOADING RELEASE FILES

To access .zip, .tar.gz, and other release files, use the customer portal to find the relevant files for download. If you are using RPM packages or the Red Hat Maven repository, this step is not required.

Procedure

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** entries in the **INTEGRATION AND AUTOMATION** category.
3. Select the desired AMQ product. The **Software Downloads** page opens.
4. Click the **Download** link for your component.

A.4. REGISTERING YOUR SYSTEM FOR PACKAGES

To install RPM packages for this product on Red Hat Enterprise Linux, your system must be registered. If you are using downloaded release files, this step is not required.

Procedure

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.

For more information about registering your system, see one of the following resources:

- Red Hat Enterprise Linux 6 - Registering the system and managing subscriptions
- Red Hat Enterprise Linux 7 - Registering the system and managing subscriptions
- Red Hat Enterprise Linux 8 - Registering the system and managing subscriptions

APPENDIX B. USING RED HAT MAVEN REPOSITORIES

This section describes how to use Red Hat-provided Maven repositories in your software.

B.1. USING THE ONLINE REPOSITORY

Red Hat maintains a central Maven repository for use with your Maven-based projects. For more information, see the repository welcome page.

There are two ways to configure Maven to use the Red Hat repository:

- Add the repository to your Maven settings
- Add the repository to your POM file

Adding the repository to your Maven settings

This method of configuration applies to all Maven projects owned by your user, as long as your POM file does not override the repository configuration and the included profile is enabled.

Procedure

1. Locate the Maven **settings.xml** file. It is usually inside the **.m2** directory in the user home directory. If the file does not exist, use a text editor to create it.
   On Linux or UNIX:

   ```
   /home/<username>/.m2/settings.xml
   ```

   On Windows:

   ```
   C:\Users\<username>\.m2\settings.xml
   ```

2. Add a new profile containing the Red Hat repository to the **profiles** element of the **settings.xml** file, as in the following example:

   Example: A Maven settings.xml file containing the Red Hat repository

```
<settings>
  <profiles>
    <profile>
      <id>red-hat</id>
      <repositories>
        <repository>
          <id>red-hat-ga</id>
          <url>https://maven.repository.redhat.com/ga</url>
        </repository>
      </repositories>
      <pluginRepositories>
        <pluginRepository>
          <id>red-hat-ga</id>
          <url>https://maven.repository.redhat.com/ga</url>
          <releases>
            <enabled>true</enabled>
          </releases>
          <snapshots>
```

```
        <enabled>false</enabled>
      </snapshots>
    </pluginRepository>
  </pluginRepositories>
 </profile>
</profiles>
<activeProfiles>
 <activeProfile>red-hat</activeProfile>
</activeProfiles>
</settings>
```

For more information about Maven configuration, see the Maven settings reference.

Adding the repository to your POM file

To configure a repository directly in your project, add a new entry to the **repositories** element of your POM file, as in the following example:

Example: A Maven pom.xml file containing the Red Hat repository

```
<project>
 <modelVersion>4.0.0</modelVersion>

 <groupId>com.example</groupId>
 <artifactId>example-app</artifactId>
 <version>1.0.0</version>

 <repositories>
  <repository>
   <id>red-hat-ga</id>
   <url>https://maven.repository.redhat.com/ga</url>
  </repository>
 </repositories>
</project>
```

For more information about POM file configuration, see the Maven POM reference.

B.2. USING A LOCAL REPOSITORY

Red Hat provides file-based Maven repositories for some of its components. These are delivered as downloadable archives that you can extract to your local filesystem.

To configure Maven to use a locally extracted repository, apply the following XML in your Maven settings or POM file:

```
<repository>
 <id>red-hat-local</id>
 <url>${repository-url}</url>
</repository>
```

${repository-url} must be a file URL containing the local filesystem path of the extracted repository.

Table B.1. Example URLs for local Maven repositories

Operating system	Filesystem path	URL
Linux or UNIX	**/home/alice/maven-repository**	**file:/home/alice/maven-repository**
Windows	**C:\repos\red-hat**	**file:C:\repos\red-hat**

APPENDIX C. USING AMQ BROKER WITH THE EXAMPLES

The AMQ JMS examples require a running message broker with a queue named **queue**. Use the procedures below to install and start the broker and define the queue.

C.1. INSTALLING THE BROKER

Follow the instructions in *Getting Started with AMQ Broker* to install the broker and create a broker instance. Enable anonymous access.

The following procedures refer to the location of the broker instance as ***<broker-instance-dir>***.

C.2. STARTING THE BROKER

Procedure

1. Use the **artemis run** command to start the broker.

```
$ <broker-instance-dir>/bin/artemis run
```

2. Check the console output for any critical errors logged during startup. The broker logs **Server is now live** when it is ready.

```
$ example-broker/bin/artemis run

        __  __  ____    ____           _
       /\   |  \/  |/ __ \  |  _ \         | |
      /  \  | \  / | |  | | | |_) |_ __ ___ | | _____ _ __
     / /\ \ | |\/| | |  | | |  _ <| '__/ _ \| |/ / _ \ '__|
    / ____ \| |  | | |__| | | |_) | | | (_) |   <  __/ |
   /_/    \_\_|  |_|\____\_\ |____/|_|  \___/|_|\_\___|_|

    Red Hat AMQ <version>

2020-06-03 12:12:11,807 INFO  [org.apache.activemq.artemis.integration.bootstrap]
AMQ101000: Starting ActiveMQ Artemis Server
...
2020-06-03 12:12:12,336 INFO  [org.apache.activemq.artemis.core.server] AMQ221007:
Server is now live
...
```

C.3. CREATING A QUEUE

In a new terminal, use the **artemis queue** command to create a queue named **queue**.

```
$ <broker-instance-dir>/bin/artemis queue create --name queue --address queue --auto-create-address --anycast
```

You are prompted to answer a series of yes or no questions. Answer **N** for no to all of them.

Once the queue is created, the broker is ready for use with the example programs.

C.4. STOPPING THE BROKER

When you are done running the examples, use the **artemis stop** command to stop the broker.

```
$ <broker-instance-dir>/bin/artemis stop
```

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