Abstract

This guide describes how to install, configure, and manage Red Hat AMQ Streams to build a large-scale messaging network.
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CHAPTER 1. OVERVIEW OF AMQ STREAMS

Red Hat AMQ Streams is a massively-scalable, distributed, and high-performance data streaming platform based on the Apache Zookeeper and Apache Kafka projects. It consists of the following main components:

**Zookeeper**
- Service for highly reliable distributed coordination.

**Kafka Broker**
- Messaging broker responsible for delivering records from producing clients to consuming clients.

**Kafka Connect**
- A toolkit for streaming data between Kafka brokers and other systems using Connector plugins.

**Kafka Consumer and Producer APIs**
- Java based APIs for producing and consuming messages to and from Kafka brokers.

**Kafka Streams API**
- API for writing stream processor applications.

A cluster of Kafka brokers is the hub connecting all these components. The broker uses Apache Zookeeper for storing configuration data and for cluster coordination. Before running Apache Kafka, an Apache Zookeeper cluster has to be ready.

Figure 1.1. Example Architecture diagram of AMQ Streams

1.1. KEY FEATURES

- Scalability and performance
  - Designed for horizontal scalability

- Message ordering guarantee
  - At partition level

- Message rewind/replay
  - "Long term" storage
  - Allows to reconstruct application state by replaying the messages
  - Combined with compacted topics allows to use Kafka as key-value store
1.2. SUPPORTED CONFIGURATIONS

In order to be running in a supported configuration, AMQ Streams must be running in one of the following JVM versions and on one of the supported operating systems.

Table 1.1. List of supported Java Virtual Machines

<table>
<thead>
<tr>
<th>Java Virtual Machine</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>OpenJDK</td>
<td>1.8, 11[a]</td>
</tr>
<tr>
<td>OracleJDK</td>
<td>1.8</td>
</tr>
<tr>
<td>IBM JDK</td>
<td>1.8</td>
</tr>
</tbody>
</table>

[a] For RHEL 8.x

Table 1.2. List of supported Operating Systems

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Architecture</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Hat Enterprise Linux</td>
<td>x86_64</td>
<td>7.x, 8.x</td>
</tr>
</tbody>
</table>

1.3. DOCUMENT CONVENTIONS

Replaceables

In this document, replaceable text is styled in monospace and surrounded by angle brackets.

For example, in the following code, you will want to replace `<bootstrap-address>` and `<topic-name>` with your own address and topic name:

```
bin/kafka-console-consumer.sh --bootstrap-server <bootstrap-address> --topic <topic-name> --from-beginning
```
CHAPTER 2. GETTING STARTED

2.1. AMQ STREAMS DISTRIBUTION

AMQ Streams is distributed as single ZIP file. This ZIP file contains AMQ Streams components:

- Apache Zookeeper
- Apache Kafka
- Apache Kafka Connect
- Apache Kafka Mirror Maker
- Kafka Exporter

2.2. DOWNLOADING AN AMQ STREAMS ARCHIVE

An archived distribution of AMQ Streams is available for download from the Red Hat website. You can download a copy of the distribution by following the steps below.

Procedure

- Download the latest version of the Red Hat AMQ Streams archive from the Customer Portal.

2.3. INSTALLING AMQ STREAMS

Follow this procedure to install the latest version of AMQ Streams on Red Hat Enterprise Linux.

For instructions on upgrading an existing cluster to AMQ Streams 1.3, see AMQ Streams and Kafka upgrades.

Prerequisites

- Download the installation archive.
- Review the Section 1.2, “Supported Configurations”

Procedure

1. Add new kafka user and group.

```
sudo groupadd kafka
sudo useradd -g kafka kafka
sudo passwd kafka
```

2. Create directory /opt/kafka.

```
sudo mkdir /opt/kafka
```

3. Create a temporary directory and extract the contents of the AMQ Streams ZIP file.
4. Move the extracted contents into /opt/kafka directory and delete the temporary directory.

```
mkdir /tmp/kafka
unzip amq-streams_y.y-x.x.x.zip -d /tmp/kafka
```

```
sudo mv /tmp/kafka/kafka_y.y-x.x.x/* /opt/kafka/
rm -r /tmp/kafka
```

5. Change the ownership of the /opt/kafka directory to the kafka user.

```
sudo chown -R kafka:kafka /opt/kafka
```

6. Create directory /var/lib/zookeeper for storing Zookeeper data and set its ownership to the kafka user.

```
sudo mkdir /var/lib/zookeeper
sudo chown -R kafka:kafka /var/lib/zookeeper
```

7. Create directory /var/lib/kafka for storing Kafka data and set its ownership to the kafka user.

```
sudo mkdir /var/lib/kafka
sudo chown -R kafka:kafka /var/lib/kafka
```

### 2.4. DATA STORAGE CONSIDERATIONS

An efficient data storage infrastructure is essential to the optimal performance of AMQ Streams.

AMQ Streams requires block storage and works well with cloud-based block storage solutions, such as Amazon Elastic Block Store (EBS). The use of file storage is not recommended.

Choose local storage when possible. If local storage is not available, you can use a Storage Area Network (SAN) accessed by a protocol such as Fibre Channel or iSCSI.

#### 2.4.1. Apache Kafka and Zookeeper storage support

Use separate disks for Apache Kafka and Zookeeper.

Kafka supports JBOD (Just a Bunch of Disks) storage, a data storage configuration of multiple disks or volumes. JBOD provides increased data storage for Kafka brokers. It can also improve performance.

Solid-state drives (SSDs), though not essential, can improve the performance of Kafka in large clusters where data is sent to and received from multiple topics asynchronously. SSDs are particularly effective with Zookeeper, which requires fast, low latency data access.

**NOTE**

You do not need to provision replicated storage because Kafka and Zookeeper both have built-in data replication.

#### 2.4.2. File systems
It is recommended that you configure your storage system to use the XFS file system. AMQ Streams is also compatible with the ext4 file system, but this might require additional configuration for best results.

Additional resources

- For more information about XFS, see The XFS File System.

### 2.5. RUNNING SINGLE NODE AMQ STREAMS CLUSTER

This procedure will show you how to run a basic AMQ Streams cluster consisting of single Zookeeper and single Apache Kafka node both running on the same host. It is using the default configuration files for both Zookeeper and Kafka.

**WARNING**

A single node AMQ Streams cluster does not provide reliability and high availability and is suitable only for development purposes.

#### Prerequisites

- AMQ Streams is installed on the host

#### Running the cluster

1. Edit the Zookeeper configuration file `/opt/kafka/config/zookeeper.properties`. Set the `dataDir` option to `/var/lib/zookeeper/`.

   ```bash
   dataDir=/var/lib/zookeeper/
   ```

2. Start Zookeeper.

   ```bash
   su - kafka
   /opt/kafka/bin/zookeeper-server-start.sh -daemon /opt/kafka/config/zookeeper.properties
   ```

3. Make sure that Apache Zookeeper is running.

   ```bash
   jcmd | grep zookeeper
   ```

4. Edit the Kafka configuration file `/opt/kafka/config/server.properties`. Set the `log.dirs` option to `/var/lib/kafka/`.

   ```bash
   log.dirs=/var/lib/kafka/
   ```

5. Start Kafka.

   ```bash
   su - kafka
   /opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server.properties
   ```
6. Make sure that Kafka is running.

   `jcmd | grep kafka`

Additional resources

- For more information about installing AMQ Streams, see Section 2.3, “Installing AMQ Streams”.
- For more information about configuring AMQ Streams, see Section 2.8, “Configuring AMQ Streams”.

2.6. USING THE CLUSTER

Prerequisites

- AMQ Streams is installed on the host
- Zookeeper and Kafka are up and running

Procedure

1. Start the Kafka console producer.

   `bin/kafka-console-producer.sh --broker-list <bootstrap-address> --topic <topic-name>
   For example:
   `bin/kafka-console-producer.sh --broker-list localhost:9092 --topic my-topic`

2. Type your message into the console where the producer is running.

3. Press Enter to send.

4. Press Ctrl+C to exit the Kafka console producer.

5. Start the message receiver.

   `bin/kafka-console-consumer.sh --bootstrap-server <bootstrap-address> --topic <topic-name> --from-beginning`
   For example:
   `bin/kafka-console-consumer.sh --bootstrap-server localhost:9092 --topic my-topic --from-beginning`

6. Confirm that you see the incoming messages in the consumer console.

7. Press Ctrl+C to exit the Kafka console consumer.

2.7. STOPPING THE AMQ STREAMS SERVICES
You can stop the Kafka and Zookeeper services by running a script. All connections to the Kafka and Zookeeper services will be terminated.

Prerequisites

- AMQ Streams is installed on the host
- Zookeeper and Kafka are up and running

Procedure

1. Stop the Kafka broker.

   ```bash
   su - kafka
   /opt/kafka/bin/kafka-server-stop.sh
   ```

2. Confirm that the Kafka broker is stopped.

   ```bash
   jcmd | grep kafka
   ```

3. Stop Zookeeper.

   ```bash
   su - kafka
   /opt/kafka/bin/zookeeper-server-stop.sh
   ```

2.8. CONFIGURING AMQ STREAMS

Prerequisites

- AMQ Streams is downloaded and installed on the host

Procedure

1. Open Zookeeper and Kafka broker configuration files in a text editor. The configuration files are located at:

   **Zookeeper**
   
   `/opt/kafka/config/zookeeper.properties`

   **Kafka**
   
   `/opt/kafka/config/server.properties`

2. Edit the configuration options. The configuration files are in the Java properties format. Every configuration option should be on separate line in the following format:

   ```
   <option> = <value>
   ```

   Lines starting with `#` or `!` will be treated as comments and will be ignored by AMQ Streams components.

     ```
     # This is a comment
     ```

   Values can be split into multiple lines by using `\` directly before the newline / carriage return.
```java
sasl.jaas.config=org.apache.kafka.common.security.plain.PlainLoginModule required \
    username="bob" \n    password="bobs-password";
```

3. Save the changes

4. Restart the Zookeeper or Kafka broker

5. Repeat this procedure on all the nodes of the cluster.
CHAPTER 3. CONFIGURING ZOOKEEPER

Kafka uses Zookeeper to store configuration data and for cluster coordination. It is strongly recommended to run a cluster of replicated Zookeeper instances.

3.1. BASIC CONFIGURATION

The most important Zookeeper configuration options are:

**tickTime**
Zookeeper’s basic time unit in milliseconds. It is used for heartbeats and session timeouts. For example, minimum session timeout will be two ticks.

**dataDir**
The directory where Zookeeper stores its transaction log and snapshots of its in-memory database. This should be set to the `/var/lib/zookeeper/` directory created during installation.

**clientPort**
Port number where clients can connect. Defaults to 2181.

An example zookeeper configuration file `config/zookeeper.properties` is located in the AMQ Streams installation directory. It is recommended to place the `dataDir` directory on a separate disk device to minimize the latency in Zookeeper.

Zookeeper configuration file should be located in `/opt/kafka/config/zookeeper.properties`. A basic example of the configuration file can be found below. The configuration file has to be readable by the `kafka` user.

```
timeTick=2000
dataDir=/var/lib/zookeeper/
clientPort=2181
```

3.2. ZOOKEEPER CLUSTER CONFIGURATION

For reliable ZooKeeper service, you should deploy ZooKeeper in a cluster. Hence, for production use cases, you must run a cluster of replicated Zookeeper instances. Zookeeper clusters are also referred as ensembles.

Zookeeper clusters usually consist of an odd number of nodes. Zookeeper requires a majority of the nodes in the cluster should be up and running. For example, a cluster with three nodes, at least two of them must be up and running. This means it can tolerate one node being down. A cluster consisting of five nodes, at least three nodes must be available. This means it can tolerate two nodes being down. A cluster consisting of seven nodes, at least four nodes must be available. This means it can tolerate three nodes being down. Having more nodes in the Zookeeper cluster delivers better resiliency and reliability of the whole cluster.

Zookeeper can run in clusters with an even number of nodes. The additional node, however, does not increase the resiliency of the cluster. A cluster with four nodes requires at least three nodes to be available and can tolerate only one node being down. Therefore it has exactly the same resiliency as a cluster with only three nodes.

The different Zookeeper nodes should be ideally placed into different data centers or network segments. Increasing the number of Zookeeper nodes increases the workload spent on cluster synchronization. For most Kafka use cases Zookeeper cluster with 3, 5 or 7 nodes should be fully sufficient.
Replicated Zookeeper configuration supports all configuration options supported by the standalone configuration. Additional options are added for the clustering configuration:

**initLimit**
Amount of time to allow followers to connect and sync to the cluster leader. The time is specified as a number of ticks (see the `timeTick` option for more details).

**syncLimit**
Amount of time for which followers can be behind the leader. The time is specified as a number of ticks (see the `timeTick` option for more details).

In addition to the options above, every configuration file should contain a list of servers which should be members of the Zookeeper cluster. The server records should be specified in the format `server.id=hostname:port1:port2`, where:

**id**
The ID of the Zookeeper cluster node.

**hostname**
The hostname or IP address where the node listens for connections.

**port1**
The port number used for intra-cluster communication.

**port2**
The port number used for leader election.

The following is an example configuration file of a Zookeeper cluster with three nodes:

```plaintext
timeTick=2000
dataDir=/var/lib/zookeeper/
clientPort=2181
initLimit=5
syncLimit=2

server.1=172.17.0.1:2888:3888
server.2=172.17.0.2:2888:3888
server.3=172.17.0.3:2888:3888
```

Each node in the Zookeeper cluster has to be assigned with a unique ID. Each node’s ID has to be configured in `myid` file and stored in the `dataDir` folder like `/var/lib/zookeeper/`. The `myid` files should contain only a single line with the written ID as text. The ID can be any integer from 1 to 255. You must manually create this file on each cluster node. Using this file, each Zookeeper instance will use the configuration from the corresponding `server` line in the configuration file to configure its listeners. It will also use all other `server` lines to identify other cluster members.
In the above example, there are three nodes, so each one will have a different `myid` with values 1, 2, and 3 respectively.

### 3.3. RUNNING MULTI-NODE ZOOKEEPER CLUSTER

This procedure will show you how to configure and run Zookeeper as a multi-node cluster.

**Prerequisites**

- AMQ Streams is installed on all hosts which will be used as Zookeeper cluster nodes.

**Running the cluster**

1. Create the `myid` file in `/var/lib/zookeeper/`. Enter ID 1 for the first Zookeeper node, 2 for the second Zookeeper node, and so on.

   ```
   su - kafka
   echo "-_<NodeID>_" > /var/lib/zookeeper/myid
   ```

   For example:

   ```
   su - kafka
   echo "1" > /var/lib/zookeeper/myid
   ```

2. Edit the Zookeeper `/opt/kafka/config/zookeeper.properties` configuration file for the following:

   - Set the option `dataDir` to `/var/lib/zookeeper/`. Configure the `initLimit` and `syncLimit` options.
   - Add a list of all Zookeeper nodes. The list should include also the current node.

   **Example configuration for a node of Zookeeper cluster with five members**

   ```
   timeTick=2000
   dataDir=/var/lib/zookeeper/
   clientPort=2181
   initLimit=5
   syncLimit=2
   server.1=172.17.0.1:2888:3888
   server.2=172.17.0.2:2888:3888
   server.3=172.17.0.3:2888:3888
   server.4=172.17.0.4:2888:3888
   server.5=172.17.0.5:2888:3888
   ```

3. Start Zookeeper with the default configuration file.

   ```
   su - kafka
   /opt/kafka/bin/zookeeper-server-start.sh -daemon /opt/kafka/config/zookeeper.properties
   ```

4. Verify that the Zookeeper is running.
5. Repeat this procedure on all the nodes of the cluster.

6. Once all nodes of the clusters are up and running, verify that all nodes are members of the cluster by sending a `stat` command to each of the nodes using `ncat` utility.

   **Use ncat stat to check the node status**

   ```bash
   echo stat | ncat localhost 2181
   ```

   In the output you should see information that the node is either **leader** or **follower**.

   **Example output from the ncat command**

   ```
   Zookeeper version: 3.4.13-2d71af4dbe22557fda74f9a9b4309b15a7487f03, built on 06/29/2018 00:39 GMT
   Clients: /0:0:0:0:0:0:0:1:59726[0](queued=0,recv=1,sent=0)
   Latency min/avg/max: 0/0/0
   Received: 2
   Sent: 1
   Connections: 1
   Outstanding: 0
   Zxid: 0x200000000
   Mode: follower
   Node count: 4
   ```

**Additional resources**

- For more information about installing AMQ Streams, see Section 2.3, “Installing AMQ Streams”.

- For more information about configuring AMQ Streams, see Section 2.8, “Configuring AMQ Streams”.

### 3.4. AUTHENTICATION

By default, Zookeeper does not use any form of authentication and allows anonymous connections. However, it supports Java Authentication and Authorization Service (JAAS) which can be used to set up authentication using Simple Authentication and Security Layer (SASL). Zookeeper supports authentication using the DIGEST-MD5 SASL mechanism with locally stored credentials.

#### 3.4.1. Authentication with SASL

JAAS is configured using a separate configuration file. It is recommended to place the JAAS configuration file in the same directory as the Zookeeper configuration (`/opt/kafka/config`). The recommended file name is `zookeeper-jaas.conf`. When using a Zookeeper cluster with multiple nodes, the JAAS configuration file has to be created on all cluster nodes.

JAAS is configured using contexts. Separate parts such as the server and client are always configured with a separate context. The context is a `configuration` option and has the following format:
SASL Authentication is configured separately for server-to-server communication (communication between Zookeeper instances) and client-to-server communication (communication between Kafka and Zookeeper). Server-to-server authentication is relevant only for Zookeeper clusters with multiple nodes.

Server-to-Server authentication

For server-to-server authentication, the JAAS configuration file contains two parts:

- The server configuration
- The client configuration

When using DIGEST-MD5 SASL mechanism, the `QuorumServer` context is used to configure the authentication server. It must contain all the usernames to be allowed to connect together with their passwords in an unencrypted form. The second context, `QuorumLearner`, has to be configured for the client which is built into Zookeeper. It also contains the password in an unencrypted form. An example of the JAAS configuration file for DIGEST-MD5 mechanism can be found below:

```java
QuorumServer {
    org.apache.zookeeper.server.auth.DigestLoginModule required
    user_zookeeper="123456";
};

QuorumLearner {
    org.apache.zookeeper.server.auth.DigestLoginModule required
    username="zookeeper"
    password="123456";
};
```

In addition to the JAAS configuration file, you must enable the server-to-server authentication in the regular Zookeeper configuration file by specifying the following options:

```java
quorum.auth.enableSasl=true
quorum.auth.learnerRequireSasl=true
quorum.auth.serverRequireSasl=true
quorum.auth.learner.loginContext=QuorumLearner
quorum.auth.server.loginContext=QuorumServer
quorum.cnxn.threads.size=20
```

Use the `KAFKA_OPTS` environment variable to pass the JAAS configuration file to the Zookeeper server as a Java property:

```bash
su - kafka
export KAFKA_OPTS="-Djava.security.auth.login.config=/opt/kafka/config/zookeeper-jaas.conf; /
/opt/kafka/bin/zookeeper-server-start.sh -daemon /opt/kafka/config/zookeeper.properties"
```

For more information about server-to-server authentication, see Zookeeper wiki.

Client-to-Server authentication
Client-to-server authentication is configured in the same JAAS file as the server-to-server authentication. However, unlike the server-to-server authentication, it contains only the server configuration. The client part of the configuration has to be done in the client. For information on how to configure a Kafka broker to connect to Zookeeper using authentication, see the Kafka installation section.

Add the Server context to the JAAS configuration file to configure client-to-server authentication. For DIGEST-MD5 mechanism it configures all usernames and passwords:

```java
Server {
    org.apache.zookeeper.server.auth.DigestLoginModule required
    user_super="123456"
    user_kafka="123456"
    user_someoneelse="123456";
}
```

After configuring the JAAS context, enable the client-to-server authentication in the Zookeeper configuration file by adding the following line:

```java
requireClientAuthScheme=sasl
authProvider.1=org.apache.zookeeper.server.auth.SASLAuthenticationProvider
authProvider.2=org.apache.zookeeper.server.auth.SASLAuthenticationProvider
authProvider.3=org.apache.zookeeper.server.auth.SASLAuthenticationProvider
```

You must add the `authProvider.<ID>` property for every server that is part of the Zookeeper cluster.

Use the `KAFKA_OPTS` environment variable to pass the JAAS configuration file to the Zookeeper server as a Java property:

```bash
su - kafka
export KAFKA_OPTS="-Djava.security.auth.login.config=/opt/kafka/config/zookeeper-jaas.conf";
/opt/kafka/bin/zookeeper-server-start.sh -daemon /opt/kafka/config/zookeeper.properties
```

For more information about configuring Zookeeper authentication in Kafka brokers, see Section 4.6, “Zookeeper authentication”.

### 3.4.2. Enabling Server-to-server authentication using DIGEST-MD5

This procedure describes how to enable authentication using the SASL DIGEST-MD5 mechanism between the nodes of the Zookeeper cluster.

**Prerequisites**

- AMQ Streams is installed on the host
- Zookeeper cluster is configured with multiple nodes.

**Enabling SASL DIGEST-MD5 authentication**

1. On all Zookeeper nodes, create or edit the `/opt/kafka/config/zookeeper-jaas.conf` JAAS configuration file and add the following contexts:

```java
QuorumServer {
    org.apache.zookeeper.server.auth.DigestLoginModule required
```
The username and password must be the same in both JAAS contexts. For example:

```java
QuorumServer {
    org.apache.zookeeper.server.auth.DigestLoginModule required
    user_zookeeper="123456";
};
QuorumLearner {
    org.apache.zookeeper.server.auth.DigestLoginModule required
    username="zookeeper"
    password="123456";
};
```

2. On all Zookeeper nodes, edit the `/opt/kafka/config/zookeeper.properties` Zookeeper configuration file and set the following options:

```properties
quorum.auth.enableSasl=true
quorum.auth.learnerRequireSasl=true
quorum.auth.serverRequireSasl=true
quorum.auth.learner.loginContext=QuorumLearner
quorum.auth.server.loginContext=QuorumServer
quorum.cnxn.threads.size=20
```

3. Restart all Zookeeper nodes one by one. To pass the JAAS configuration to Zookeeper, use the `KAFKA_OPTS` environment variable.

```bash
su - kafka
export KAFKA_OPTS="-Djava.security.auth.login.config=/opt/kafka/config/zookeeper-jaas.conf"; /opt/kafka/bin/zookeeper-server-start.sh -daemon /opt/kafka/config/zookeeper.properties
```

**Additional resources**

- For more information about installing AMQ Streams, see Section 2.3, “Installing AMQ Streams”.
- For more information about configuring AMQ Streams, see Section 2.8, “Configuring AMQ Streams”.
- For more information about running a Zookeeper cluster, see Section 3.3, “Running multi-node Zookeeper cluster”.

### 3.4.3. Enabling Client-to-server authentication using DIGEST-MD5

This procedure describes how to enable authentication using the SASL DIGEST-MD5 mechanism between Zookeeper clients and Zookeeper.
Prerequisites

- AMQ Streams is installed on the host
- Zookeeper cluster is configured and running.

Enabling SASL DIGEST-MD5 authentication

1. On all Zookeeper nodes, create or edit the `/opt/kafka/config/zookeeper-jaas.conf` JAAS configuration file and add the following context:

   ```
   Server {
     org.apache.zookeeper.server.auth.DigestLoginModule required
     user_super="<SuperUserPassword>"
     user<Username1>_="<Password1>" user<Username2>_="<Password2>";
   }
   ```

   The `super` automatically has administrator privileges. The file can contain multiple users, but only one additional user is required by the Kafka brokers. The recommended name for the Kafka user is `kafka`.

   The following example shows the `Server` context for client-to-server authentication:

   ```
   Server {
     org.apache.zookeeper.server.auth.DigestLoginModule required
     user_super="123456"
     user_kafka="123456";
   }
   ```

2. On all Zookeeper nodes, edit the `/opt/kafka/config/zookeeper.properties` Zookeeper configuration file and set the following options:

   ```
   requireClientAuthScheme=sasl
   authProvider.<ID>=org.apache.zookeeper.server.auth.SASLAuthenticationProvider
   authProvider.<ID>=org.apache.zookeeper.server.auth.SASLAuthenticationProvider
   authProvider.<ID>=org.apache.zookeeper.server.auth.SASLAuthenticationProvider
   requireClientAuthScheme=sasl
   authProvider.1=org.apache.zookeeper.server.auth.SASLAuthenticationProvider
   authProvider.2=org.apache.zookeeper.server.auth.SASLAuthenticationProvider
   authProvider.3=org.apache.zookeeper.server.auth.SASLAuthenticationProvider
   ```

   The `authProvider.<ID>` property has to be added for every node which is part of the Zookeeper cluster. An example three-node Zookeeper cluster configuration must look like the following:

3. Restart all Zookeeper nodes one by one. To pass the JAAS configuration to Zookeeper, use the `KAFKA_OPTS` environment variable.

   ```
   su - kafka
   export KAFKA_OPTS="-Djava.security.auth.login.config=/opt/kafka/config/zookeeper-jaas.conf"; /opt/kafka/bin/zookeeper-server-start.sh -daemon
   /opt/kafka/config/zookeeper.properties
   ```

Additional resources
For more information about installing AMQ Streams, see Section 2.3, “Installing AMQ Streams”.

For more information about configuring AMQ Streams, see Section 2.8, “Configuring AMQ Streams”.

For more information about running a Zookeeper cluster, see Section 3.3, “Running multi-node Zookeeper cluster”.

### 3.5. AUTHORIZATION

Zookeeper supports access control lists (ACLs) to protect data stored inside it. Kafka brokers can automatically configure the ACL rights for all Zookeeper records they create so no other Zookeeper user can modify them.

For more information about enabling Zookeeper ACLs in Kafka brokers, see Section 4.8, “Zookeeper authorization”.

### 3.6. TLS

The version of Zookeeper which is part of AMQ Streams currently does not support TLS for encryption or authentication.

### 3.7. ADDITIONAL CONFIGURATION OPTIONS

You can set the following options based on your use case:

- **maxClientCnxns**: The maximum number of concurrent client connections to a single member of the ZooKeeper cluster.
- **autopurge.snapRetainCount**: Number of snapshots of Zookeeper’s in-memory database which will be retained. Default value is 3.
- **autopurge.purgeInterval**: The time interval in hours for purging snapshots. The default value is 0 and this option is disabled.

All available configuration options can be found in Zookeeper documentation.

### 3.8. LOGGING

Zookeeper is using log4j as their logging infrastructure. Logging configuration is by default read from the log4j.properties configuration file which should be placed either in the /opt/kafka/config directory or in the classpath. The location and name of the configuration file can be changed using the Java property log4j.configuration which can be passed to Zookeeper using the KAFKA_LOG4J_OPTS environment variable:

```
su - kafka
echo "export KAFKA_LOG4J_OPTS=""-Dlog4j.configuration=file:/my/path/to/log4j.properties";" >> /opt/kafka/bin/zookeeper-server-start.sh
```

For more information about Log4j configurations, see Log4j documentation.
Kafka uses a properties file to store static configuration. The recommended location for the configuration file is `/opt/kafka/config/server.properties`. The configuration file has to be readable by the kafka user.

AMQ Streams ships an example configuration file that highlights various basic and advanced features of the product. It can be found under `config/server.properties` in the AMQ Streams installation directory.

This chapter explains the most important configuration options. For a complete list of supported Kafka broker configuration options, see Appendix A, Broker configuration parameters.

### 4.1. ZOOKEEPER

Kafka brokers need Zookeeper to store some parts of their configuration as well as to coordinate the cluster (for example to decide which node is a leader for which partition). Connection details for the Zookeeper cluster are stored in the configuration file. The field `zookeeper.connect` contains a comma-separated list of hostnames and ports of members of the zookeeper cluster.

For example:

```
zookeeper.connect=zoo1.my-domain.com:2181,zoo2.my-domain.com:2181,zoo3.my-domain.com:2181
```

Kafka will use these addresses to connect to the Zookeeper cluster. With this configuration, all Kafka `znodes` will be created directly in the root of Zookeeper database. Therefore, such a Zookeeper cluster could be used only for a single Kafka cluster. To configure multiple Kafka clusters to use single Zookeeper cluster, specify a base (prefix) path at the end of the Zookeeper connection string in the Kafka configuration file:

```
zookeeper.connect=zoo1.my-domain.com:2181,zoo2.my-domain.com:2181,zoo3.my-domain.com:2181/my-cluster-1
```

### 4.2. LISTENERS

Kafka brokers can be configured to use multiple listeners. Each listener can be used to listen on a different port or network interface and can have different configuration. Listeners are configured in the `listeners` property in the configuration file. The `listeners` property contains a list of listeners with each listener configured as `<listenerName>://<hostname>:<port>`. When the hostname value is empty, Kafka will use `java.net.InetAddress.getCanonicalHostName()` as hostname. The following example shows how multiple listeners might be configured:

```
listeners=INT1://:9092,INT2://:9093,REPLICATION://:9094
```

When a Kafka client wants to connect to a Kafka cluster, it first connects to a bootstrap server. The bootstrap server is one of the cluster nodes. It will provide the client with a list of all other brokers which are part of the cluster and the client will connect to them individually. By default the bootstrap server will provide the client with a list of nodes based on the `listeners` field.

**Advertised listeners**

It is possible to give the client a different set of addresses than given in the `listeners` property. It is useful in situations when additional network infrastructure, such as a proxy, is between the client and the broker, or when an external DNS name should be used instead of an IP address. Here, the broker allows
defining the advertised addresses of the listeners in the advertised.listeners configuration property. This property has the same format as the listeners property. The following example shows how to configure advertised listeners:

```plaintext
listeners=INT1://:9092,INT2://:9093
advertised.listeners=INT1://my-broker-1.my-domain.com:1234,INT2://my-broker-1.my-domain.com:1234:9093
```

**NOTE**

The names of the listeners have to match the names of the listeners from the `listeners` property.

**Inter-broker listeners**

When the cluster has replicated topics, the brokers responsible for such topics need to communicate with each other in order to replicate the messages in those topics. When multiple listeners are configured, the configuration field `inter.broker.listener.name` can be used to specify the name of the listener which should be used for replication between brokers. For example:

```plaintext
inter.broker.listener.name=REPLICATION
```

### 4.3. COMMIT LOGS

Apache Kafka stores all records it receives from producers in commit logs. The commit logs contain the actual data, in the form of records, that Kafka needs to deliver. These are not the application log files which record what the broker is doing.

**Log directories**

You can configure log directories using the `log.dirs` property file to store commit logs in one or multiple log directories. It should be set to `/var/lib/kafka` directory created during installation:

```plaintext
log.dirs=/var/lib/kafka
```

For performance reasons, you can configure `log.dirs` to multiple directories and place each of them on a different physical device to improve disk I/O performance. For example:

```plaintext
log.dirs=/var/lib/kafka1,/var/lib/kafka2,/var/lib/kafka3
```

### 4.4. BROKER ID

Broker ID is a unique identifier for each broker in the cluster. You can assign an integer greater than or equal to 0 as broker ID. The broker ID is used to identify the brokers after restarts or crashes and it is therefore important that the id is stable and does not change over time. The broker ID is configured in the broker properties file:

```plaintext
broker.id=1
```

### 4.5. RUNNING A MULTI-NODE KAFKA CLUSTER
This procedure describes how to configure and run Kafka as a multi-node cluster.

Prerequisites

- AMQ Streams is installed on all hosts which will be used as Kafka brokers.
- A Zookeeper cluster is configured and running.

Running the cluster

For each Kafka broker in your AMQ Streams cluster:

1. Edit the `/opt/kafka/config/server.properties` Kafka configuration file as follows:
   - Set the `broker.id` field to 0 for the first broker, 1 for the second broker, and so on.
   - Configure the details for connecting to Zookeeper in the `zookeeper.connect` option.
   - Configure the Kafka listeners.
   - Set the directories where the commit logs should be stored in the `logs.dir` directory.
     Here we see an example configuration for a Kafka broker:

     ```
     broker.id=0
     zookeeper.connect=zoo1.my-domain.com:2181,zoo2.my-domain.com:2181,zoo3.my-domain.com:2181
     listeners=REPLICATION://:9091,PLAINTEXT://:9092
     inter.broker.listener.name=REPLICATION
     log.dirs=/var/lib/kafka
     ```

     In a typical installation where each Kafka broker is running on identical hardware, only the `broker.id` configuration property will differ between each broker config.

2. Start the Kafka broker with the default configuration file.

   ```
   su - kafka
   /opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server.properties
   ```

3. Verify that the Kafka broker is running.

   ```
   jcmd | grep Kafka
   ```

Verifying the brokers

Once all nodes of the clusters are up and running, verify that all nodes are members of the Kafka cluster by sending a `dump` command to one of the Zookeeper nodes using the `ncat` utility. The command prints all Kafka brokers registered in Zookeeper.

1. Use `ncat stat` to check the node status.

   ```
   echo dump | ncat zoo1.my-domain.com 2181
   ```

   The output should contain all Kafka brokers you just configured and started.

   Example output from the `ncat` command for Kafka cluster with 3 nodes:
4.6. ZOOKEEPER AUTHENTICATION

By default, connections between Zookeeper and Kafka are not authenticated. However, Kafka and Zookeeper support Java Authentication and Authorization Service (JAAS) which can be used to set up authentication using Simple Authentication and Security Layer (SASL). Zookeeper supports authentication using the DIGEST-MD5 SASL mechanism with locally stored credentials.

4.6.1. JAAS Configuration

SASL authentication for Zookeeper connections has to be configured in the JAAS configuration file. By default, Kafka will use the JAAS context named Client for connecting to Zookeeper. The Client context should be configured in the /opt/kafka/config/jass.conf file. The context has to enable the PLAIN SASL authentication, as in the following example:

```
Client {
    org.apache.kafka.common.security.plain.PlainLoginModule required
    username="kafka"
    password="123456";
};
```

4.6.2. Enabling Zookeeper authentication

This procedure describes how to enable authentication using the SASL DIGEST-MD5 mechanism when connecting to Zookeeper.

Prerequisites

- Client-to-server authentication is enabled in Zookeeper
Enabling SASL DIGEST-MD5 authentication

1. On all Kafka broker nodes, create or edit the `/opt/kafka/config/jaas.conf` JAAS configuration file and add the following context:

   ```
   Client {
     org.apache.kafka.common.security.plain.PlainLoginModule required
     username="<Username>",
     password="<Password>";
   }
   ```

   The username and password should be the same as configured in Zookeeper.

   Following example shows the Client context:

   ```
   Client {
     org.apache.kafka.common.security.plain.PlainLoginModule required
     username="kafka",
     password="123456";
   }
   ```

2. Restart all Kafka broker nodes one by one. To pass the JAAS configuration to Kafka brokers, use the `KAFKA_OPTS` environment variable.

   ```
   su - kafka
   export KAFKA_OPTS="-Djava.security.auth.login.config=/opt/kafka/config/jaas.conf"
   /opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server.properties
   ```

Additional resources

- For more information about configuring client-to-server authentication in Zookeeper, see Section 3.4, "Authentication".

4.7. AUTHORIZATION

Authorization in Kafka brokers is implemented using authorizer plugins.

You can use your own authorization plugins or SimpleAclAuthorizer, the authorizer plugin provided with Kafka.

In this section we describe how to use SimpleAclAuthorizer.

4.7.1. Simple ACL authorizer

Authorizer plugins, including SimpleAclAuthorizer, are enabled through the `authorizer.class.name` property:

```
authorizer.class.name=kafka.security.auth.SimpleAclAuthorizer
```

A fully-qualified name is required for the chosen authorizer. For SimpleAclAuthorizer, the fully-qualified name is `kafka.security.auth.SimpleAclAuthorizer`.

4.7.1.1. ACL rules
**SimpleAclAuthorizer** uses ACL rules to manage access to Kafka brokers.

ACL rules are defined in the format:

Principal P is allowed / denied operation O on Kafka resource R from host H

For example, a rule might be set so that user:

**John** can **view** the topic **comments** from host **127.0.0.1**

Host is the IP address of the machine that John is connecting from.

In most cases, the user is a producer or consumer application:

**Consumer01** can **write** to the consumer group **accounts** from host **127.0.0.1**

If ACL rules are not present

If ACL rules are not present for a given resource, all actions are denied. This behavior can be changed by setting the property **allow.everyone.if.no.acl.found** to true in the Kafka configuration file `/opt/kafka/config/server.properties`.

### 4.7.1.2. Principals

A *principal* represents the identity of a user. The format of the ID depends on the authentication mechanism used by clients to connect to Kafka:

- **User:**ANONYMOUS when connected without authentication.
- **User:**<username> when connected using simple authentication mechanisms, such as PLAIN or SCRAM. For example **User:**admin or **User:**user1.
- **User:**<DistinguishedName> when connected using TLS client authentication. For example **User:**CN=user1,O=MyCompany,L=Prague,C=CZ.
- **User:**<Kerberos username> when connected using Kerberos.

The *DistinguishedName* is the distinguished name from the client certificate.

The *Kerberos username* is the primary part of the Kerberos principal, which is used by default when connecting using Kerberos. You can use the **sasl.kerberos.principal.to.local.rules** property to configure how the Kafka principal is built from the Kerberos principal.

### 4.7.1.3. Authentication of users

To use authorization, you need to have authentication enabled and used by your clients. Otherwise, all connections will have the principal **User:**ANONYMOUS.

For more information on methods of authentication, see Encryption and authentication.

**Super users**

Super users are allowed to take all actions regardless of the ACL rules.

Super users are defined in the Kafka configuration file using the property **super.users**.
For example:

```
super.users=User:admin,User:operator
```

**Replica broker authentication**

When authorization is enabled, it is applied to all listeners and all connections. This includes the inter-broker connections used for replication of data between brokers. If enabling authorization, therefore, ensure that you use authentication for inter-broker connections and give the users used by the brokers sufficient rights. For example, if authentication between brokers uses the `kafka-broker` user, then `super.user` configuration must include the username `super.users=User:kafka-broker`.

### 4.7.1.4. Supported resources

You can apply Kafka ACLs to these types of resource:

- Topics
- Consumer groups
- The cluster
- TransactionId
- DelegationToken

### 4.7.1.5. Supported operations

**SimpleAclAuthorizer** authorizes operations on resources.

Fields with X in the following table mark the supported operations for each resource.

<table>
<thead>
<tr>
<th></th>
<th>Topics</th>
<th>Consumer Groups</th>
<th>Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Write</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Delete</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Alter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Describe</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ClusterAction</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>All</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

### 4.7.1.6. ACL management options
ACL rules are managed using the `bin/kafka-acls.sh` utility, which is provided as part of the Kafka distribution package.

Use `kafka-acls.sh` parameter options to add, list and remove ACL rules, and perform other functions.

The parameters require a double-hyphen convention, such as `--add`.

<table>
<thead>
<tr>
<th>Option</th>
<th>Type</th>
<th>Description</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>add</td>
<td>Action</td>
<td>Add ACL rule.</td>
<td></td>
</tr>
<tr>
<td>remove</td>
<td>Action</td>
<td>Remove ACL rule.</td>
<td></td>
</tr>
<tr>
<td>list</td>
<td>Action</td>
<td>List ACL rules.</td>
<td></td>
</tr>
<tr>
<td>authorizer</td>
<td>Action</td>
<td>Fully-qualified class name of the authorizer.</td>
<td><code>kafka.security.auth.SimpleAclAuthorizer</code></td>
</tr>
</tbody>
</table>
| authorizer-
  properties | Configuration | Key/value pairs passed to the authorizer for initialization. For `SimpleAclAuthorizer`, the example values are: `zookeeper.connect=zoo1.my-domain.com:2181`. |                                      |
<p>| bootstrap-server| Resource      | Host/port pairs to connect to the Kafka cluster.        | Use this option or the <code>authorizer</code> option, not both. |
| command-config  | Resource      | Configuration property file to pass to the Admin Client, which is used in conjunction with the <code>bootstrap-server</code> parameter. |                                      |
| cluster         | Resource      | Specifies a cluster as an ACL resource.                 |                                      |</p>
<table>
<thead>
<tr>
<th>Option</th>
<th>Type</th>
<th>Description</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>topic</td>
<td>Resource</td>
<td>Specifies a topic name as an ACL resource. An asterisk (*) used as a wildcard translates to all topics. A single command can specify multiple --topic options.</td>
<td></td>
</tr>
<tr>
<td>group</td>
<td>Resource</td>
<td>Specifies a consumer group name as an ACL resource. A single command can specify multiple --group options.</td>
<td></td>
</tr>
<tr>
<td>transactional-id</td>
<td>Resource</td>
<td>Specifies a transactional ID as an ACL resource. Transactional delivery means that all messages sent by a producer to multiple partitions must be successfully delivered or none of them. An asterisk (*) used as a wildcard translates to all IDs.</td>
<td></td>
</tr>
<tr>
<td>delegation-token</td>
<td>Resource</td>
<td>Specifies a delegation token as an ACL resource. An asterisk (*) used as a wildcard translates to all tokens.</td>
<td></td>
</tr>
<tr>
<td>Option</td>
<td>Type</td>
<td>Description</td>
<td>Default</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>resource-pattern-</td>
<td>Configuration</td>
<td>Specifies a type of resource pattern for the <code>add</code> parameter or a resource pattern filter value for the <code>list</code> or <code>remove</code> parameters. Use <code>literal</code> or <code>prefixed</code> as the resource pattern type for a resource name. Use <code>any</code> or <code>match</code> as resource pattern filter values, or a specific pattern type filter.</td>
<td><code>literal</code></td>
</tr>
<tr>
<td>type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>allow-principal</td>
<td>Principal</td>
<td>Principal added to an allow ACL rule. A single command can specify multiple <code>--allow-principal</code> options.</td>
<td></td>
</tr>
<tr>
<td>deny-principal</td>
<td>Principal</td>
<td>Principal added to a deny ACL rule. A single command can specify multiple <code>--deny-principal</code> options.</td>
<td></td>
</tr>
<tr>
<td>principal</td>
<td>Principal</td>
<td>Principal name used with the <code>list</code> parameter to return a list of ACLs for the principal. A single command can specify multiple <code>--principal</code> options.</td>
<td></td>
</tr>
<tr>
<td>allow-host</td>
<td>Host</td>
<td>IP address that allows access to the principals listed in <code>--allow-principal</code>. Hostnames or CIDR ranges are not supported. If <code>--allow-principal</code> is specified, defaults to <code>*</code> meaning &quot;all hosts&quot;.</td>
<td>If <code>--allow-principal</code> is specified, defaults to <code>*</code> meaning &quot;all hosts&quot;.</td>
</tr>
<tr>
<td>Option</td>
<td>Type</td>
<td>Description</td>
<td>Default</td>
</tr>
<tr>
<td>------------</td>
<td>-----------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>deny-host</td>
<td>Host</td>
<td>IP address that denies access to the principals listed in <code>--deny-principal</code></td>
<td>if <code>--deny-principal</code> is specified, defaults to * meaning “all hosts”.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hostnames or CIDR ranges are not supported.</td>
<td></td>
</tr>
<tr>
<td>operation</td>
<td>Operation</td>
<td>Allows or denies an operation.</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A single command can specify multiple <code>--operation</code> options can be specified in single command.</td>
<td></td>
</tr>
<tr>
<td>producer</td>
<td>Shortcut</td>
<td>A shortcut to allow or deny all operations needed by a message producer (WRITE and DESCRIBE on topic, CREATE on cluster).</td>
<td></td>
</tr>
<tr>
<td>consumer</td>
<td>Shortcut</td>
<td>A shortcut to allow or deny all operations needed by a message consumer (READ and DESCRIBE on topic, READ on consumer group).</td>
<td></td>
</tr>
<tr>
<td>idempotent</td>
<td>Shortcut</td>
<td>A shortcut to enable idempotence when used with the <code>--producer</code> parameter, so that messages are delivered exactly once to a partition.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Idempotence is enabled automatically if the producer is authorized to send messages based on a specific transactional ID.</td>
<td></td>
</tr>
<tr>
<td>force</td>
<td>Shortcut</td>
<td>A shortcut to accept all queries and do not prompt.</td>
<td></td>
</tr>
</tbody>
</table>
4.7.2. Enabling authorization

This procedure describes how to enable the SimpleAclAuthorizer plugin for authorization in Kafka brokers.

Prerequisites

- AMQ Streams is installed on all hosts used as Kafka brokers.

Procedure

1. Edit the /opt/kafka/config/server.properties Kafka configuration file to use the SimpleAclAuthorizer.

   
   ```
   authorizer.class.name=kafka.security.auth.SimpleAclAuthorizer
   ```

2. (Re)start the Kafka brokers.

Additional resources

- For more information about configuring AMQ Streams, see Section 2.8, “Configuring AMQ Streams”.

- For more information about running a Kafka cluster, see Section 4.5, “Running a multi-node Kafka cluster”.

4.7.3. Adding ACL rules

SimpleAclAuthorizer uses Access Control Lists (ACLs), which define a set of rules describing what users can and cannot do.

This procedure describes how to add ACL rules when using the SimpleAclAuthorizer plugin in Kafka brokers.

Rules are added using the kafka-acls.sh utility and stored in Zookeeper.

Prerequisites

- AMQ Streams is installed on all hosts used as Kafka brokers.

- Authorization is enabled in Kafka brokers.

Procedure

1. Run kafka-acls.sh with the --add option.

   Examples:

   - Allow user1 and user2 access to read from myTopic using the MyConsumerGroup consumer group.

     ```
     bin/kafka-acls.sh --authorizer-properties zookeeper.connect=zoo1.my-domain.com:2181 --add --operation Read --topic myTopic --allow-principal User:user1 --allow-principal User:user2
     ```
Deny user1 access to read myTopic from IP address host 127.0.0.1.

Add user1 as the consumer of myTopic with MyConsumerGroup.

Additional resources
- For a list of all kafka-acls.sh options, see Section 4.7.1, “Simple ACL authorizer”.

4.7.4. Listing ACL rules

This procedure describes how to list existing ACL rules when using the SimpleAclAuthorizer plugin in Kafka brokers.

Rules are listed using the kafka-acls.sh utility.

Prerequisites
- AMQ Streams is installed on all hosts used as Kafka brokers.
- Authorization is enabled in Kafka brokers
- ACLs have been added.

Procedure
- Run kafka-acls.sh with the --list option.
  For example:

  $ bin/kafka-acls.sh --authorizer-properties zookeeper.connect=zoo1.my-domain.com:2181 --list --topic myTopic

  Current ACLs for resource `Topic:myTopic`:

  User:user1 has Allow permission for operations: Read from hosts: *
  User:user2 has Allow permission for operations: Read from hosts: *
  User:user2 has Deny permission for operations: Read from hosts: 127.0.0.1
4.7.5. Removing ACL rules

This procedure describes how to remove ACL rules when using the SimpleAclAuthorizer plugin in Kafka brokers.

Rules are removed using the kafka-acls.sh utility.

Prerequisites

- AMQ Streams is installed on all hosts used as Kafka brokers.
- Authorization is enabled in Kafka brokers.
- ACLs have been added.

Procedure

- Run kafka-acls.sh with the --remove option.
  Examples:

  - Remove the ACL allowing Allow user1 and user2 access to read from myTopic using the MyConsumerGroup consumer group.

    ```
    bin/kafka-acls.sh --authorizer-properties zookeeper.connect=zoo1.my-domain.com:2181 --remove --operation Read --topic myTopic --allow-principal User:user1 --allow-principal User:user2
    ```

  - Remove the ACL adding user1 as the consumer of myTopic with MyConsumerGroup.

    ```
    bin/kafka-acls.sh --authorizer-properties zookeeper.connect=zoo1.my-domain.com:2181 --remove --consumer --topic myTopic --group MyConsumerGroup --allow-principal User:user1
    ```

  - Remove the ACL denying user1 access to read myTopic from IP address host 127.0.0.1.

    ```
    bin/kafka-acls.sh --authorizer-properties zookeeper.connect=zoo1.my-domain.com:2181 --remove --operation Describe --operation Read --topic myTopic --deny-principal User:user1 --deny-host 127.0.0.1
    ```
4.8. ZOOKEEPER AUTHORIZATION

When authentication is enabled between Kafka and Zookeeper, you can use Zookeeper Access Control List (ACL) rules to automatically control access to Kafka’s metadata stored in Zookeeper.

4.8.1. ACL Configuration

Enforcement of Zookeeper ACL rules is controlled by the `zookeeper.set.acl` property in the `config/server.properties` Kafka configuration file.

The property is disabled by default and enabled by setting to `true`:

```bash
zookeeper.set.acl=true
```

If ACL rules are enabled, when a `znode` is created in Zookeeper only the Kafka user who created it can modify or delete it. All other users have read-only access.

Kafka sets ACL rules only for newly created Zookeeper `znodes`. If the ACLs are only enabled after the first start of the cluster, the `zookeeper-security-migration.sh` tool can set ACLs on all existing `znodes`.

Confidentiality of data in Zookeeper

Data stored in Zookeeper includes:

- Topic names and their configuration
- Salted and hashed user credentials when SASL SCRAM authentication is used.

But Zookeeper does not store any records sent and received using Kafka. The data stored in Zookeeper is assumed to be non-confidential.

If the data is to be regarded as confidential (for example because topic names contain customer IDs), the only option available for protection is isolating Zookeeper on the network level and allowing access only to Kafka brokers.

4.8.2. Enabling Zookeeper ACLs for a new Kafka cluster

This procedure describes how to enable Zookeeper ACLs in Kafka configuration for a new Kafka cluster. Use this procedure only before the first start of the Kafka cluster. For enabling Zookeeper ACLs in a cluster that is already running, see Section 4.8.3, “Enabling Zookeeper ACLs in an existing Kafka cluster”.

Prerequisites

- AMQ Streams is installed on all hosts which will be used as Kafka brokers.
- Zookeeper cluster is configured and running.
- Client-to-server authentication is enabled in Zookeeper.
- Zookeeper authentication is enabled in the Kafka brokers.
Kafka brokers have not yet been started.

Procedure

1. Edit the `/opt/kafka/config/server.properties` Kafka configuration file to set the `zookeeper.set.acl` field to `true` on all cluster nodes.

```
zookeeper.set.acl=true
```

2. Start the Kafka brokers.

4.8.3. Enabling Zookeeper ACLs in an existing Kafka cluster

This procedure describes how to enable Zookeeper ACLs in Kafka configuration for a Kafka cluster that is running. Use the `zookeeper-security-migration.sh` tool to set Zookeeper ACLs on all existing znodes. The `zookeeper-security-migration.sh` tool is available as part of AMQ Streams, and can be found in the `bin` directory.

Prerequisites

- Kafka cluster is configured and running.

Enabling the Zookeeper ACLs

1. Edit the `/opt/kafka/config/server.properties` Kafka configuration file to set the `zookeeper.set.acl` field to `true` on all cluster nodes.

```
zookeeper.set.acl=true
```

2. Restart all Kafka brokers one by one.

3. Set the ACLs on all existing Zookeeper znodes using the `zookeeper-security-migration.sh` tool.

```
su - kafka
cd /opt/kafka
KAFKA_OPTS="-Djava.security.auth.login.config=./config/jaas.conf"; ./bin/zookeeper-security-migration.sh --zookeeper.acl=secure --zookeeper.connect=_<ZookeeperURL>_
exit
```

For example:

```
su - kafka
cd /opt/kafka
KAFKA_OPTS="-Djava.security.auth.login.config=./config/jaas.conf"; ./bin/zookeeper-security-migration.sh --zookeeper.acl=secure --zookeeper.connect=zoo1.my-domain.com:2181
exit
```

4.9. ENCRYPTION AND AUTHENTICATION

Kafka supports TLS for encrypting the communication with Kafka clients. Additionally, it supports two types of authentication:
TLS client authentication based on X.509 certificates

SASL Authentication based on a username and password

4.9.1. Listener configuration

Encryption and authentication in Kafka brokers is configured per listener. For more information about Kafka listener configuration, see Section 4.2, “Listeners”.

Each listener in the Kafka broker is configured with its own security protocol. The configuration property `listener.security.protocol.map` defines which listener uses which security protocol. It maps each listener name to its security protocol. Supported security protocols are:

**PLAINTEXT**

Listener without any encryption or authentication.

**SSL**

Listener using TLS encryption and, optionally, authentication using TLS client certificates.

**SASL.PLAINTEXT**

Listener without encryption but with SASL-based authentication.

**SASL_SSL**

Listener with TLS-based encryption and SASL-based authentication.

Given the following listeners configuration:

```
listeners=INT1://:9092,INT2://:9093,REPLICATION://:9094
```

the `listener.security.protocol.map` might look like this:

```
listener.security.protocol.map=INT1:SASL.PLAINTEXT,INT2:SASL_SSL,REPLICATION:SSL
```

This would configure the listener INT1 to use unencrypted connections with SASL authentication, the listener INT2 to use encrypted connections with SASL authentication and the REPLICATION interface to use TLS encryption (possibly with TLS client authentication). The same security protocol can be used multiple times. The following example is also a valid configuration:

```
listener.security.protocol.map=INT1:SSL,INT2:SSL,REPLICATION:SSL
```

Such a configuration would use TLS encryption and TLS authentication for all interfaces. The following chapters will explain in more detail how to configure TLS and SASL.

4.9.2. TLS Encryption

In order to use TLS encryption and server authentication, a keystore containing private and public keys has to be provided. This is usually done using a file in the Java Keystore (JKS) format. A path to this file is set in the `ssl.keystore.location` property. The `ssl.keystore.password` property should be used to set the password protecting the keystore. For example:

```
ssl.keystore.location=/path/to/keystore/server-1.jks
ssl.keystore.password=123456
```
In some cases, an additional password is used to protect the private key. Any such password can be set using the `ssl.key.password` property.

Kafka is able to use keys signed by certification authorities as well as self-signed keys. Using keys signed by certification authorities should always be the preferred method. In order to allow clients to verify the identity of the Kafka broker they are connecting to, the certificate should always contain the advertised hostname(s) as its Common Name (CN) or in the Subject Alternative Names (SAN).

It is possible to use different SSL configurations for different listeners. All options starting with `ssl.` can be prefixed with `listener.name.<NameOfTheListener>`, where the name of the listener has to be always in lower case. This will override the default SSL configuration for that specific listener. The following example shows how to use different SSL configurations for different listeners:

```plaintext
listeners=INT1://:9092,INT2://:9093,REPLICATION://:9094
listener.security.protocol.map=INT1:SSL,INT2:SSL,REPLICATION:SSL

# Default configuration - will be used for listeners INT1 and INT2
ssl.keystore.location=/path/to/keystore/server-1.jks
ssl.keystore.password=123456

# Different configuration for listener REPLICATION
listener.name.replication.ssl.keystore.location=/path/to/keystore/server-1.jks
listener.name.replication.ssl.keystore.password=123456
```

**Additional TLS configuration options**

In addition to the main TLS configuration options described above, Kafka supports many options for fine-tuning the TLS configuration. For example, to enable or disable TLS / SSL protocols or cipher suites:

- `ssl.cipher.suites`  
  List of enabled cipher suites. Each cipher suite is a combination of authentication, encryption, MAC and key exchange algorithms used for the TLS connection. By default, all available cipher suites are enabled.

- `ssl.enabled.protocols`  

For a complete list of supported Kafka broker configuration options, see [Appendix A, Broker configuration parameters](#).

### 4.9.3. Enabling TLS encryption

This procedure describes how to enable encryption in Kafka brokers.

**Prerequisites**

- AMQ Streams is **installed** on all hosts which will be used as Kafka brokers.

**Procedure**

1. Generate TLS certificates for all Kafka brokers in your cluster. The certificates should have their advertised and bootstrap addresses in their Common Name or Subject Alternative Name.
2. Edit the `/opt/kafka/config/server.properties` Kafka configuration file on all cluster nodes for the following:

   - Change the `listener.security.protocol.map` field to specify the SSL protocol for the listener where you want to use TLS encryption.

   - Set the `ssl.keystore.location` option to the path to the JKS keystore with the broker certificate.

   - Set the `ssl.keystore.password` option to the password you used to protect the keystore. For example:

     ```
     listeners=UNENCRYPTED://:9092,ENCRYPTED://:9093,REPLICATION://:9094
     listener.security.protocol.map=UNENCRYPTED:PLAINTEXT,ENCRYPTED:SSL,REPLICATION:PLAINTEXT
     ssl.keystore.location=/path/to/keystore/server-1.jks
     ssl.keystore.password=123456
     ```

3. (Re)start the Kafka brokers

Additional resources

- For more information about configuring AMQ Streams, see Section 2.8, “Configuring AMQ Streams”.

- For more information about running a Kafka cluster, see Section 4.5, “Running a multi-node Kafka cluster”.

- For more information about configuring TLS encryption in clients, see:
  - Appendix D, Producer configuration parameters
  - Appendix C, Consumer configuration parameters

4.9.4. Authentication

Kafka supports two methods of authentication. On all connections, authentication using one of the supported SASL (Simple Authentication and Security Layer) mechanisms can be used. On encrypted connections, TLS client authentication based on X.509 certificates can be used.

4.9.4.1. TLS client authentication

TLS client authentication can be used only on connections which are already using TLS encryption. To use TLS client authentication, a truststore with public keys can be provided to the broker. These keys can be used to authenticate clients connecting to the broker. The truststore should be provided in Java Keystore (JKS) format and should contain public keys of the certification authorities. All clients with public and private keys signed by one of the certification authorities included in the truststore will be authenticated. The location of the truststore is set using field `ssl.truststore.location`. In case the truststore is password protected, the password should be set in the `ssl.truststore.password` property. For example:

```
ssl.truststore.location=/path/to/keystore/server-1.jks
ssl.truststore.password=123456
```
Once the truststore is configured, TLS client authentication has to be enabled using the `ssl.client.auth` property. This property can be set to one of three different values:

**none**
- TLS client authentication is switched off. (Default value)

**requested**
- TLS client authentication is optional. Clients will be asked to authenticate using TLS client certificate but they can choose not to.

**required**
- Clients are required to authenticate using TLS client certificate.

When a client authenticates using TLS client authentication, the authenticated principal name is the distinguished name from the authenticated client certificate. For example, a user with a certificate which has a distinguished name `CN=someuser` will be authenticated with the following principal `CN=someuser,OU=Unknown,O=Unknown,L=Unknown,ST=Unknown,C=Unknown`. When TLS client authentication is not used and SASL is disabled, the principal name will be `ANONYMOUS`.

### 4.9.4.2. SASL authentication

SASL authentication is configured using Java Authentication and Authorization Service (JAAS). JAAS is also used for authentication of connections between Kafka and Zookeeper. JAAS uses its own configuration file. The recommended location for this file is `/opt/kafka/config/jaas.conf`. The file has to be readable by the `kafka` user. When running Kafka, the location of this file is specified using Java system property `java.security.auth.login.config`. This property has to be passed to Kafka when starting the broker nodes:

```
KAFKA_OPTS="-Djava.security.auth.login.config=/path/to/my/jaas.config"; bin/kafka-server-start.sh
```

SASL authentication is supported both through plain unencrypted connections as well as through TLS connections. SASL can be enabled individually for each listener. To enable it, the security protocol in `listener.security.protocol.map` has to be either `SASL_PLAINTEXT` or `SASL_SSL`.

SASL authentication in Kafka supports several different mechanisms:

**PLAIN**
- Implements authentication based on username and passwords. Usernames and passwords are stored locally in Kafka configuration.

**SCRAM-SHA-256 and SCRAM-SHA-512**
- Implements authentication using Salted Challenge Response Authentication Mechanism (SCRAM). SCRAM credentials are stored centrally in Zookeeper. SCRAM can be used in situations where Zookeeper cluster nodes are running isolated in a private network.

**GSSAPI**
- Implements authentication against a Kerberos server.
The SASL mechanisms are configured via the JAAS configuration file. Kafka uses the JAAS context named KafkaServer. After they are configured in JAAS, the SASL mechanisms have to be enabled in the Kafka configuration. This is done using the sasl.enabled.mechanisms property. This property contains a comma-separated list of enabled mechanisms:

```plaintext
sasl.enabled.mechanisms=PLAIN,SCRAM-SHA-256,SCRAM-SHA-512
```

In case the listener used for inter-broker communication is using SASL, the property sasl.mechanism.inter.broker.protocol has to be used to specify the SASL mechanism which it should use. For example:

```plaintext
sasl.mechanism.inter.broker.protocol=PLAIN
```

The username and password which will be used for the inter-broker communication has to be specified in the KafkaServer JAAS context using the field username and password.

**SASL PLAIN**

To use the PLAIN mechanism, the usernames and password which are allowed to connect are specified directly in the JAAS context. The following example shows the context configured for SASL PLAIN authentication. The example configures three different users:

- admin
- user1
- user2

```plaintext
KafkaServer {
  org.apache.kafka.common.security.plain.PlainLoginModule required
  user_admin="123456"
  user_user1="123456"
  user_user2="123456";
};
```

The JAAS configuration file with the user database should be kept in sync on all Kafka brokers.

When SASL PLAIN is also used for inter-broker authentication, the username and password properties should be included in the JAAS context:

```plaintext
KafkaServer {
  org.apache.kafka.common.security.plain.PlainLoginModule required
  username="admin"
  password="123456"
};
```
SASL SCRAM

SCRAM authentication in Kafka consists of two mechanisms: **SCRAM-SHA-256** and **SCRAM-SHA-512**. These mechanisms differ only in the hashing algorithm used - SHA-256 versus stronger SHA-512. To enable SCRAM authentication, the JAAS configuration file has to include the following configuration:

```java
KafkaServer {
    org.apache.kafka.common.security.scram.ScramLoginModule required;
};
```

When enabling SASL authentication in the Kafka configuration file, both SCRAM mechanisms can be listed. However, only one of them can be chosen for the inter-broker communication. For example:

```java
sasl.enabled.mechanisms=SCRAM-SHA-256,SCRAM-SHA-512
sasl.mechanism.inter.broker.protocol=SCRAM-SHA-512
```

User credentials for the SCRAM mechanism are stored in Zookeeper. The `kafka-configs.sh` tool can be used to manage them. For example, run the following command to add user user1 with password 123456:

```bash
bin/kafka-configs.sh --zookeeper zoo1.my-domain.com:2181 --alter --add-config 'SCRAM-SHA-256=[password=123456],SCRAM-SHA-512=[password=123456]' --entity-type users --entity-name user1
```

To delete a user credential use:

```bash
bin/kafka-configs.sh --zookeeper zoo1.my-domain.com:2181 --alter --delete-config 'SCRAM-SHA-512' --entity-type users --entity-name user1
```

SASL GSSAPI

The SASL mechanism used for authentication using Kerberos is called **GSSAPI**. To configure Kerberos SASL authentication, the following configuration should be added to the JAAS configuration file:

```java
KafkaServer {
    com.sun.security.auth.module.Krb5LoginModule required
    useKeyTab=true
    storeKey=true
    keyTab="/etc/security/keytabs/kafka_server.keytab"
    principal="kafka/kafka1.hostname.com@EXAMPLE.COM";
};
```

The domain name in the Kerberos principal has to be always in upper case.

In addition to the JAAS configuration, the Kerberos service name needs to be specified in the `sasl.kerberos.service.name` property in the Kafka configuration:

```java
sasl.enabled.mechanisms=GSSAPI
sasl.mechanism.inter.broker.protocol=GSSAPI
sasl.kerberos.service.name=kafka
```
Multiple SASL mechanisms

Kafka can use multiple SASL mechanisms at the same time. The different JAAS configurations can be all added to the same context:

```
KafkaServer {
    org.apache.kafka.common.security.plain.PlainLoginModule required
    user_admin="123456"
    user_user1="123456"
    user_user2="123456";

    com.sun.security.auth.module.Krb5LoginModule required
    useKeyTab=true
    storeKey=true
    keyTab="/etc/security/keytabs/kafka_server.keytab"
    principal="kafka/kafka1.hostname.com@EXAMPLE.COM";

    org.apache.kafka.common.security.scram.ScramLoginModule required;
};
```

When multiple mechanisms are enabled, clients will be able to choose the mechanism which they want to use.

4.9.5. Enabling TLS client authentication

This procedure describes how to enable TLS client authentication in Kafka brokers.

Prerequisites

- AMQ Streams is installed on all hosts which will be used as Kafka brokers.
- TLS encryption is enabled.

Procedure

1. Prepare a JKS truststore containing the public key of the certification authority used to sign the user certificates.

2. Edit the `/opt/kafka/config/server.properties` Kafka configuration file on all cluster nodes for the following:
   - Set the `ssl.truststore.location` option to the path to the JKS truststore with the certification authority of the user certificates.
   - Set the `ssl.truststore.password` option to the password you used to protect the truststore.
   - Set the `ssl.client.auth` option to `required`.
     For example:

     ```
     ssl.truststore.location=/path/to/truststore.jks
     ssl.truststore.password=123456
     ssl.client.auth=required
     ```

3. (Re)start the Kafka brokers
Additional resources

- For more information about configuring AMQ Streams, see Section 2.8, “Configuring AMQ Streams”.
- For more information about running a Kafka cluster, see Section 4.5, “Running a multi-node Kafka cluster”.
- For more information about configuring TLS encryption in clients, see:
  - Appendix D, Producer configuration parameters
  - Appendix C, Consumer configuration parameters

4.9.6. Enabling SASL PLAIN authentication

This procedure describes how to enable SASL PLAIN authentication in Kafka brokers.

Prerequisites

- AMQ Streams is installed on all hosts which will be used as Kafka brokers.

Procedure

1. Edit or create the `/opt/kafka/config/jaas.conf` JAAS configuration file. This file should contain all your users and their passwords. Make sure this file is the same on all Kafka brokers. For example:

   ```
   KafkaServer {
     org.apache.kafka.common.security.plain.PlainLoginModule required
     user_admin="123456"
     user_user1="123456"
     user_user2="123456";
   };
   ```

2. Edit the `/opt/kafka/config/server.properties` Kafka configuration file on all cluster nodes for the following:

   - Change the `listener.security.protocol.map` field to specify the `SASL_PLAINTEXT` or `SASL_SSL` protocol for the listener where you want to use SASL PLAIN authentication.
   - Set the `sasl.enabled.mechanisms` option to `PLAIN`. For example:

     ```
     listeners=INSECURE://:9092,AUTHENTICATED://:9093,REPLICATION://:9094
     listener.security.protocol.map=INSECURE:PLAINTEXT,AUTHENTICATED:SASL_PLAINTEXT,REPLICATION:PLAINTEXT
     sasl.enabled.mechanisms=PLAIN
     ```

3. (Re)start the Kafka brokers using the KAFKA_OPTS environment variable to pass the JAAS configuration to Kafka brokers.

   ```
   su - kafka
   export KAFKA_OPTS=-Djava.security.auth.login.config=/opt/kafka/config/jaas.conf;
   /opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server.properties
   ```
4.9.7. Enabling SASL SCRAM authentication

This procedure describes how to enable SASL SCRAM authentication in Kafka brokers.

Prerequisites

- AMQ Streams is installed on all hosts which will be used as Kafka brokers.

Procedure

1. Edit or create the `/opt/kafka/config/jaas.conf` JAAS configuration file. Enable the `ScramLoginModule` for the `KafkaServer` context. Make sure this file is the same on all Kafka brokers. For example:

   KafkaServer {
       org.apache.kafka.common.security.scram.ScramLoginModule required;
   };

2. Edit the `/opt/kafka/config/server.properties` Kafka configuration file on all cluster nodes for the following:

   - Change the `listener.security.protocol.map` field to specify the `SASL_PLAINTEXT` or `SASL_SSL` protocol for the listener where you want to use SASL SCRAM authentication.

   - Set the `sasl.enabled.mechanisms` option to `SCRAM-SHA-256` or `SCRAM-SHA-512`. For example:

     listeners=INSECURE://:9092,AUTHENTICATED://:9093,REPLICATION://:9094
     listen\er.security.protocol.map=INSECURE:PLAINTEXT,AUTHENTICATED:SASL_PLAINTEXT,REPLICATION:PLAINTEXT
     sasl.enabled.mechanisms=SCRAM-SHA-512

3. (Re)start the Kafka brokers using the KAFKA_OPTS environment variable to pass the JAAS configuration to Kafka brokers.

   su - kafka
   export KAFKA_OPTS="-Djava.security.auth.login.config=/opt/kafka/config/jaas.conf";
   /opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server.properties
Additional resources

- For more information about configuring AMQ Streams, see Section 2.8, “Configuring AMQ Streams”.
- For more information about running a Kafka cluster, see Section 4.5, “Running a multi-node Kafka cluster”.
- For more information about adding SASL SCRAM users, see Section 4.9.8, “Adding SASL SCRAM users”.
- For more information about deleting SASL SCRAM users, see Section 4.9.9, “Deleting SASL SCRAM users”.
- For more information about configuring SASL SCRAM authentication in clients, see:
  - Appendix D, Producer configuration parameters
  - Appendix C, Consumer configuration parameters

4.9.8. Adding SASL SCRAM users

This procedure describes how to add new users for authentication using SASL SCRAM.

Prerequisites

- AMQ Streams is installed on all hosts which will be used as Kafka brokers.
- SASL SCRAM authentication is enabled.

Procedure

- Use the `kafka-configs.sh` tool to add new SASL SCRAM users.

```
bin/kafka-configs.sh --zookeeper <ZookeeperAddress> --alter --add-config 'SCRAM-SHA-512=[password=<Password>]' --entity-type users --entity-name <Username>
```

For example:

```
bin/kafka-configs.sh --zookeeper zoo1.my-domain.com:2181 --alter --add-config 'SCRAM-SHA-512=[password=123456]' --entity-type users --entity-name user1
```

Additional resources

- For more information about configuring SASL SCRAM authentication in clients, see:
  - Appendix D, Producer configuration parameters
  - Appendix C, Consumer configuration parameters

4.9.9. Deleting SASL SCRAM users

This procedure describes how to remove users when using SASL SCRAM authentication.

Prerequisites
AMQ Streams is installed on all hosts which will be used as Kafka brokers.

SASL SCRAM authentication is enabled.

Procedure

- Use the `kafka-configs.sh` tool to delete SASL SCRAM users.

  ```
  bin/kafka-configs.sh --zookeeper <ZookeeperAddress> --alter --delete-config 'SCRAM-SHA-512' --entity-type users --entity-name <Username>
  ```

  For example:

  ```
  bin/kafka-configs.sh --zookeeper zoo1.my-domain.com:2181 --alter --delete-config 'SCRAM-SHA-512' --entity-type users --entity-name user1
  ```

Additional resources

- For more information about configuring SASL SCRAM authentication in clients, see:
  - Appendix D, Producer configuration parameters
  - Appendix C, Consumer configuration parameters

4.10. USING OAUTH 2.0 TOKEN BASED AUTHENTICATION

AMQ Streams supports the use of OAuth 2.0 authentication using the SASL OAUTHBEARER mechanism.

OAuth 2.0 enables standardized token based authentication and authorization between applications, using a central authorization server to issue tokens that grant limited access to resources.

OAuth 2.0 is currently only supported for authentication, with no authorization support. However, OAuth 2.0 authentication can be used in conjunction with ACL-based Kafka authorization.

Using OAuth 2.0 token based authentication, application clients can access resources on application servers (called ‘resource servers’) without exposing account credentials. The client passes an access token as a means of authenticating, which application servers can also use to find more information about the level of access granted. The authorization server handles the granting of access and inquiries about access.

In the context of AMQ Streams:

- Kafka brokers act as resource servers
- Kafka clients act as resource clients

The brokers and clients communicate with the OAuth 2.0 authorization server, as necessary, to obtain or validate access tokens.

For a deployment of AMQ Streams, OAuth 2.0 integration provides:

- Server-side OAuth 2.0 support for Kafka brokers
- Client-side OAuth 2.0 support for Kafka Mirror Maker, Kafka Connect and the Kafka Bridge
Additional resources

- OAuth 2.0 site

4.10.1. OAuth 2.0 authentication mechanism

Support for OAuth 2.0 is based on the Kafka SASL OAUTHBEARER mechanism, which is used to establish authenticated sessions with a Kafka broker.

A Kafka client initiates a session with the Kafka broker using the SASL OAUTHBEARER mechanism for credentials exchange, where credentials take the form of an access token.

Kafka brokers and clients need to be configured to use OAuth 2.0.

Kafka broker configuration

The Kafka broker must be configured to validate the token received during session initiation. The recommended approach is to create a client definition in an authorization server with:

- Client ID of `kafka-broker`
- Client ID and secret as the authentication mechanism

Kafka client configuration

A Kafka client is configured with either:

- Credentials required to obtain a valid access token from an authorization server
- A valid long-lived access token, obtained using tools provided by an authorization server

Credentials are never sent to the Kafka broker. The only information ever sent to the Kafka broker is an access token. When a client obtains an access token, no further communication with the authorization server is needed.

The simplest mechanism, which requires no additional usage of authorization server tools, is authentication with a client ID and secret. Using a long-lived access token, or a long-lived refresh token, is more complex.

NOTE

If you are using long-lived access tokens, you can set policy in the authorization server to increase the maximum lifetime of the token.

If the Kafka client is not configured with an access token directly, the client exchanges credentials for an access token during Kafka session initiation by contacting the authorization server. The Kafka client uses one of two mechanisms:

- Client id and secret
- Client id, refresh token, and (optionally) a secret

4.10.2. OAuth 2.0 client authentication flow
In this section, we explain and visualize the communication flow between Kafka client, Kafka broker, and authorization server during Kafka session initiation. The flow depends on the client and server configuration.

When a Kafka client sends an access token as credentials to a Kafka broker, the token needs to be validated.

Depending on the authorization server used, and the configuration options available, you may prefer to use:

- Fast local token validation based on JWT signature checking and local token introspection, without contacting the authorization server
- An OAuth 2.0 introspection endpoint provided by the authorization server

Using fast local token validation requires the authorization server to provide a JWKS endpoint with public certificates that are used to validate signatures on the tokens.

**NOTE**

An authorization server might only allow the use of opaque access tokens, which means that local token validation is not possible.

Another option is to use an OAuth 2.0 introspection endpoint on the authorization server. Each time a Kafka broker connection is established, the broker sends the access token it receives to the authorization server, and a response confirming whether or not the token is valid is returned.

Kafka client credentials can also be configured for:

- Direct local access using a previously generated long-lived access token
- Contact with the authorization server for a new access token to be issued and sent to the Kafka broker

### 4.10.2.1. Example client authentication flows

Here you can see the communication flows, for different configurations of Kafka clients and brokers, during Kafka session authentication.

- **Client using client ID and secret, with broker delegating validation to authorization server**
- **Client using client ID and secret, with broker performing fast local token validation**
- **Client using long-lived access token, with broker delegating validation to authorization server**
- **Client using long-lived access token, with broker performing fast local validation**

**Client using client ID and secret, with broker delegating validation to authorization server**
1. Kafka client requests access token from authorization server, using client ID and secret, and optionally a refresh token.

2. Authorization server generates a new access token.

3. Kafka client authenticates with the Kafka broker using the SASL OAUTHBEARER mechanism to pass the access token.

4. Kafka broker validates the access token by calling a token introspection endpoint on authorization server, using its own client ID and secret.

5. Kafka client session is established if the token is valid.

**Client using client ID and secret, with broker performing fast local token validation**

1. Kafka client authenticates with authorization server from the token endpoint, using a client ID and secret, and optionally a refresh token.

2. Authorization server generates a new access token.

3. Kafka client authenticates with the Kafka broker using the SASL OAUTHBEARER mechanism to pass the access token.

4. Kafka broker validates the access token locally using a JWT token signature check, and local token introspection.

**Client using long-lived access token, with broker delegating validation to authorization server**
1. Kafka client authenticates with the Kafka broker using the SASL OAUTHBEARER mechanism to pass the long-lived access token.

2. Kafka broker validates the access token by calling a token introspection endpoint on authorization server, using its own client ID and secret.

3. Kafka client session is established if the token is valid.

Client using long-lived access token, with broker performing fast local validation

1. Kafka client authenticates with the Kafka broker using the SASL OAUTHBEARER mechanism to pass the long-lived access token.

2. Kafka broker validates the access token locally using JWT token signature check, and local token introspection.

**WARNING**

Fast local JWT token signature validation is suitable only for short-lived tokens as there is no check with the authorization server if a token has been revoked. Token expiration is written into the token, but revocation can happen at any time, so cannot be accounted for without contacting the authorization server. Any issued token would be considered valid until it expires.

### 4.10.3. Configuring OAuth 2.0 authentication

OAuth 2.0 is used for interaction between Kafka clients and AMQ Streams components.

In order to use OAuth 2.0 for AMQ Streams, you must:
1. Deploy an authorization server and configure the deployment to integrate with AMQ Streams
2. Deploy or update the Kafka cluster with Kafka broker listeners configured to use OAuth 2.0
3. Update your Java-based Kafka clients to use OAuth 2.0

4.10.3.1. Configuring Red Hat Single Sign-On as an OAuth 2.0 authorization server

This procedure describes how to deploy Red Hat Single Sign-On as an authorization server and configure it for integration with AMQ Streams.

The authorization server provides a central point for authentication and authorization, and management of users, clients, and permissions. Red Hat Single Sign-On has a concept of realms where a **realm** represents a separate set of users, clients, permissions, and other configuration. You can use a default **master realm**, or create a new one. Each realm exposes its own OAuth 2.0 endpoints, which means that application clients and application servers all need to use the same realm.

To use OAuth 2.0 with AMQ Streams, you need a deployment of an authorization server to be able to create and manage authentication realms.

**NOTE**

If you already have Red Hat Single Sign-On deployed, you can skip the deployment step and use your current deployment.

**Before you begin**

You will need to be familiar with using Red Hat Single Sign-On.

For installation and administration instructions, see:

- Server Installation and Configuration Guide
- Server Administration Guide

**Prerequisites**

- AMQ Streams and Kafka are running

For the Red Hat Single Sign-On deployment:

- Check the Red Hat Single Sign-On Supported Configurations

**Procedure**

1. Install Red Hat Single Sign-On.
   
   You can install from a ZIP file or by using an RPM.

2. Log in to the Red Hat Single Sign-On Admin Console to create the OAuth 2.0 policies for AMQ Streams.
   
   Login details are provided when you deploy Red Hat Single Sign-On.

3. Create and enable a realm.
   
   You can use an existing master realm.

4. Adjust the session and token timeouts for the realm, if required.
5. Create a client called **kafka-broker**.

6. From the **Settings** tab, set:
   - **Access Type** to **Confidential**
   - **Standard Flow Enabled** to **OFF** to disable web login for this client
   - **Service Accounts Enabled** to **ON** to allow this client to authenticate in its own name

7. Click **Save** before continuing.

8. From the **Credentials** tab, take a note of the secret for using in your AMQ Streams Kafka cluster configuration.

9. Repeat the client creation steps for any application client that will connect to your Kafka brokers.
   Create a definition for each new client.
   You will use the names as client IDs in your configuration.

**What to do next**

After deploying and configuring the authorization server, configure the Kafka brokers to use OAuth 2.0.

4.10.3.2. Configuring OAuth 2.0 support for Kafka brokers

This procedure describes how to configure Kafka brokers so that the broker listeners are enabled to use OAuth 2.0 authentication using an authorization server.

**Before you start**

For more information on the configuration and authentication of Kafka broker listeners, see:

- **Listeners**
- **Encryption and authentication**

**Prerequisites**

- AMQ Streams and Kafka are running
- An OAuth 2.0 authorization server is deployed

**Procedure**

1. Check you have the following JAR files in your Kafka **libs** directory.

```
strimzi-kafka-oauth-common-*.jar
strimzi-kafka-oauth-server-*.jar
strimzi-kafka-oauth-client-*.jar
keycloak-common-*.jar
keycloak-core-*.jar
bcpovt-*.jar
```

If they are not already present, the files are available from the installation archive.
2. Update the Kafka `server.properties` file.

```properties
sasl.enabled.mechanisms=OAUTHBEARER
listeners=CLIENTS://kafka:9092
listener.security.protocol.map=CLIENTS:SASL_PLAINTEXT

listener.name.clients.oauthbearer.sasl.jaas.config=org.apache.kafka.common.security.oauthbearer.OAuthBearerLoginModule required;
listener.name.clients.oauthbearer.sasl.login.callback.handler.class=io.strimzi.kafka.oauth.client.JaasClientOauthLoginCallbackHandler
listener.name.clients.oauthbearer.sasl.server.callback.handler.class=io.strimzi.kafka.oauth.server.JaasServerOauthValidatorCallbackHandler
```

1. Enables the `OAUTHBEARER` as SASL mechanism for credentials exchange over SASL.
2. Configures a listener for client applications, replacing `kafka` with a valid hostname, resolvable by clients.
3. Specifies the channel protocol for the listener. `SASL_PLAINTEXT` means unencrypted connection (no TLS), so there is risk of eavesdropping and interception at the TCP connection layer.
4. The three listener properties enable OAuth 2.0 for AMQ Streams.

3. To further configure OAuth 2.0 support, use one of the following connection options.

- **OPTION 1**: Add environment variables to enable local token validation using a JWKS endpoint configuration.

```bash
export OAUTH_JWKS_ENDPOINT_URI=https://<authorization-server-address>/jwks
export OAUTH_JWKS_REFRESH_SECONDS=300
export OAUTH_JWKS_EXPIRY_SECONDS=360
```

1. The JWKS endpoint URL. For example, `https://<authorization-server-address>/auth/realms/master/protocol/openid-connect/certs`.
2. The period between endpoint refreshes (default 300).
3. The certificate’s expiry time (default 360). If you specify a longer time, consider the risk of allowing access to revoked certificates.

- **OPTION 2**: Add environment variables to enable delegating token validation to the authorization server through the OAuth 2.0 introspection endpoint.

```bash
export OAUTH_INTROSPECTION_ENDPOINT_URI=https://<authorization-server-address>/introspection
```

1. The OAuth 2.0 introspection endpoint URL. For example, `https://<authorization-server-address>/auth/realms/master/protocol/openid-connect/token/introspect`.
4. If required, configure access to the authorization server.
   This step is normally required for a production environment, unless a technology like service mesh is used to configure secure channels outside containers.

   a. Provide a custom truststore for connecting to the authorization server. SSL is always required for access to the authorization server.
      Set environment variables to configure a truststore for connecting to a secured authorization server:

      For example:

      ```
      export OAUTH_SSL_TRUSTSTORE_LOCATION=\</path/to/truststore.p12>  
      export OAUTH_SSL_TRUSTSTORE_PASSWORD=\<my-password> 
      export OAUTH_SSL_TRUSTSTORE_TYPE=\pkcs12 
      ```

      1. Location of the truststore file in PKCS format.
      2. Password to access the truststore.
      3. Truststore type in PKCS12 format.

   b. If the certificate hostname does not match the access URL hostname, you can turn off certificate hostname validation:

      ```
      export OAUTH_SSL_ENDPOINT_IDENTIFICATION_ALGORITHM= "" 
      ```

      The check ensures that client connection to the authorization server is authentic. You may wish to turn off the validation in a non-production environment.

5. Configure the following environment variables according to your chosen authentication flow.

   ```
   export OAUTH_TOKEN_ENDPOINT_URI=https://\<authorization-server-address>/token 
   export OAUTH_VALID_ISSUER_URI=https://\<authorization-server-address> 
   export OAUTH_CLIENT_ID=kafka-broker 
   export OAUTH_CLIENT_SECRET=kafka-broker-secret 
   export OAUTH_REFRESH_TOKEN=\<my-refresh-token-for-kafka-brokers> 
   export OAUTH_ACCESS_TOKEN=\<my-access-token-for-kafka-brokers> 
   ```

   1. The OAuth 2.0 token endpoint URL to your authorization server. For production, always use HTTPs.
   2. A valid issuer URI. Only access tokens issued by this issuer will be accepted.
   3. The configured client ID of the Kafka broker, which is the same for all brokers. This is the client registered with the authorization server as kafka-broker.
   4. The configured secret for Kafka broker, which is the same for all brokers.
   5. (Optional) A long-lived refresh token for Kafka brokers.
   6. (Optional) A long-lived access token for Kafka brokers.
What to do next

- Configure your Kafka clients to use OAuth 2.0

### 4.10.3.3. Configuring Kafka Java clients to use OAuth 2.0

This procedure describes how to configure Kafka producer and consumer APIs to use OAuth 2.0 for interaction with Kafka brokers.

Add a client callback plugin to your `pom.xml` file, and configure the system properties.

**Prerequisites**

- AMQ Streams and Kafka are running
- An OAuth 2.0 authorization server is deployed and configured for OAuth access to Kafka brokers
- Kafka brokers are configured for OAuth 2.0

**Procedure**

1. Add the client library with OAuth 2.0 support to the `pom.xml` file for the Kafka client:

   ```xml
   <dependency>
   <groupId>io.strimzi</groupId>
   <artifactId>kafka-oauth-client</artifactId>
   <version>0.1.0.redhat-00002</version>
   </dependency>
   ```

2. Configure the system properties for the callback:
   For example:
   ```java
   System.setProperty(ClientConfig.OAUTH_TOKEN_ENDPOINT_URI, "https://{authorization-server-address}/auth/realms/master/protocol/openid-connect/token");
   System.setProperty(ClientConfig.OAUTH_CLIENT_ID, "<client-name>");
   System.setProperty(ClientConfig.OAUTH_CLIENT_SECRET, "<client-secret>");
   ```
   
   1. URI of the authorization server token endpoint.
   2. Client ID, which is the name used when creating the `client` in the authorization server.
   3. Client secret created when creating the `client` in the authorization server.

3. Enable the `SASL OAUTHBEARER` mechanism on a TLS encrypted connection in the Kafka client configuration:
   For example:
   ```java
   props.put("sasl.jaas.config", "org.apache.kafka.common.security.oauthbearer.OAuthBearerLoginModule required;");
   props.put("security.protocol", "SASL_SSL");
   ```
1. Here we use **SASL_SSL** for use over TLS connections. Use **SASL_PLAINTEXT** over unencrypted connections.

4. Verify that the Kafka client can access the Kafka brokers.

### 4.11. LOGGING

Kafka brokers use Log4j as their logging infrastructure. Logging configuration is by default read from the **log4j.properties** configuration file which should be placed either in the `/opt/kafka/config/` directory or on the classpath. The location and name of the configuration file can be changed using the Java property **log4j.configuration** which can be passed to Kafka using the **KAFKA_LOG4J_OPTS** environment variable:

```bash
su - kafka
export KAFKA_LOG4J_OPTS=-Dlog4j.configuration=file:/my/path/to/log4j.config;
/opt/kafka/bin/kafka-server-start.sh /opt/kafka/config/server.properties
```

For more information about Log4j configurations, see [Log4j manual](#).
CHAPTER 5. TOPICS

Messages in Kafka are always sent to or received from a topic. This chapter describes how to configure and manage Kafka topics.

5.1. PARTITIONS AND REPLICA

Messages in Kafka are always sent to or received from a topic. A topic is always split into one or more partitions. Partitions act as shards. That means that every message sent by a producer is always written only into a single partition. Thanks to the sharding of messages into different partitions, topics are easy to scale horizontally.

Each partition can have one or more replicas, which will be stored on different brokers in the cluster. When creating a topic you can configure the number of replicas using the replication factor. Replication factor defines the number of copies which will be held within the cluster. One of the replicas for given partition will be elected as a leader. The leader replica will be used by the producers to send new messages and by the consumers to consume messages. The other replicas will be follower replicas. The followers replicate the leader.

If the leader fails, one of the followers will automatically become the new leader. Each server acts as a leader for some of its partitions and a follower for others so the load is well balanced within the cluster.

NOTE

The replication factor determines the number of replicas including the leader and the followers. For example, if you set the replication factor to 3, then there will one leader and two follower replicas.

5.2. MESSAGE RETENTION

The message retention policy defines how long the messages will be stored on the Kafka brokers. It can be defined based on time, partition size or both.

For example, you can define that the messages should be kept:

- For 7 days
- Until the partition has 1GB of messages. Once the limit is reached, the oldest messages will be removed.
- For 7 days or until the 1GB limit has been reached. Whatever limit comes first will be used.

WARNING

Kafka brokers store messages in log segments. The messages which are past their retention policy will be deleted only when a new log segment is created. New log segments are created when the previous log segment exceeds the configured log segment size. Additionally, users can request new segments to be created periodically.
Additionally, Kafka brokers support a compacting policy.

For a topic with the compacted policy, the broker will always keep only the last message for each key. The older messages with the same key will be removed from the partition. Because compacting is a periodically executed action, it does not happen immediately when the new message with the same key are sent to the partition. Instead it might take some time until the older messages are removed.

For more information about the message retention configuration options, see Section 5.5, “Topic configuration”.

5.3. TOPIC AUTO-CREATION

When a producer or consumer tries to send to or receive from a topic which does not exist, Kafka will, by default, automatically create that topic. This behavior is controlled by the auto.create.topics.enable configuration property which is set to true by default.

To disable it, set auto.create.topics.enable to false in the Kafka broker configuration file:

```yaml
auto.create.topics.enable=false
```

5.4. TOPIC DELETION

Kafka offers the possibility to disable deletion of topics. This is configured through the delete.topic.enable property, which is set to true by default (that is, deleting topics is possible). When this property is set to false it will be not possible to delete topics and all attempts to delete topic will return success but the topic will not be deleted.

```yaml
delete.topic.enable=false
```

5.5. TOPIC CONFIGURATION

Auto-created topics will use the default topic configuration which can be specified in the broker properties file. However, when creating topics manually, their configuration can be specified at creation time. It is also possible to change a topic’s configuration after it has been created. The main topic configuration options for manually created topics are:

**cleanup.policy**

Configures the retention policy to delete or compact. The delete policy will delete old records. The compact policy will enable log compaction. The default value is delete. For more information about log compaction, see Kafka website.

**compression.type**

Specifies the compression which is used for stored messages. Valid values are gzip, snappy, lz4, uncompressed (no compression) and producer (retain the compression codec used by the producer). The default value is producer.

**max.message.bytes**

The maximum size of a batch of messages allowed by the Kafka broker, in bytes. The default value is 1000012.

**min.insync.replicas**

The minimum number of replicas which must be in sync for a write to be considered successful. The default value is 1.

**retention.ms**
Maximum number of milliseconds for which log segments will be retained. Log segments older than this value will be deleted. The default value is 604800000 (7 days).

**retention.bytes**

The maximum number of bytes a partition will retain. Once the partition size grows over this limit, the oldest log segments will be deleted. Value of -1 indicates no limit. The default value is -1.

**segment.bytes**

The maximum file size of a single commit log segment file in bytes. When the segment reaches its size, a new segment will be started. The default value is 1073741824 bytes (1 gibibyte).

For list of all supported topic configuration options, see Appendix B, Topic configuration parameters.

The defaults for auto-created topics can be specified in the Kafka broker configuration using similar options:

**log.cleanup.policy**

See cleanup.policy above.

**compression.type**

See compression.type above.

**message.max.bytes**

See max.message.bytes above.

**min.insync.replicas**

See min.insync.replicas above.

**log.retention.ms**

See retention.ms above.

**log.retention.bytes**

See retention.bytes above.

**log.segment.bytes**

See segment.bytes above.

**default.replication.factor**

Default replication factor for automatically created topics. Default value is 1.

**num.partitions**

Default number of partitions for automatically created topics. Default value is 1.

For list of all supported Kafka broker configuration options, see Appendix A, Broker configuration parameters.

### 5.6. INTERNAL TOPICS

Internal topics are created and used internally by the Kafka brokers and clients. Kafka has several internal topics. These are used to store consumer offsets (__consumer_offsets) or transaction state (__transaction_state). These topics can be configured using dedicated Kafka broker configuration options starting with prefix offsets.topic and transaction.state.log. The most important configuration options are:

**offsets.topic.replication.factor**

Number of replicas for __consumer_offsets topic. The default value is 3.

**offsets.topic.num.partitions**
Number of partitions for _consumer_offsets_ topic. The default value is **50**.

**transaction.state.log.replication.factor**

Number of replicas for _transaction_state_ topic. The default value is **3**.

**transaction.state.log.num.partitions**

Number of partitions for _transaction_state_ topic. The default value is **50**.

**transaction.state.log.min.isr**

Minimum number of replicas that must acknowledge a write to _transaction_state_ topic to be considered successful. If this minimum cannot be met, then the producer will fail with an exception. The default value is **2**.

### 5.7. CREATING A TOPIC

The _kafka-topics.sh_ tool can be used to manage topics. _kafka-topics.sh_ is part of the AMQ Streams distribution and can be found in the **bin** directory.

**Prerequisites**

- AMQ Streams cluster is installed and running

**Creating a topic**

1. Create a topic using the _kafka-topics.sh_ utility and specify the following: Zookeeper URL in the **--zookeeper** option. The new topic to be created in the **--create** option. Topic name in the **--topic** option. The number of partitions in the **--partitions** option. Replication factor in the **--replication-factor** option.

   You can also override some of the default topic configuration options using the option **--config**. This option can be used multiple times to override different options.

   ```bash
   bin/kafka-topics.sh --zookeeper <ZookeeperAddress> --create --topic <TopicName> --partitions <NumberOfPartitions> --replication-factor <ReplicationFactor> --config <Option1>=<Value1> --config <Option2>=<Value2>
   ```

   **Example of the command to create a topic named mytopic**

   ```bash
   bin/kafka-topics.sh --zookeeper zoo1.my-domain.com:2181 --create --topic mytopic --partitions 50 --replication-factor 3 --config cleanup.policy=compact --config min.insync.replicas=2
   ```

2. Verify that the topic exists using _kafka-topics.sh_.

   ```bash
   bin/kafka-topics.sh --zookeeper <ZookeeperAddress> --describe --topic <TopicName>
   ```

   **Example of the command to describe a topic named mytopic**

   ```bash
   bin/kafka-topics.sh --zookeeper zoo1.my-domain.com:2181 --describe --topic mytopic
   ```

**Additional resources**

- For more information about topic configuration, see Section 5.5, “Topic configuration”.
5.8. LISTING AND DESCRIBING TOPICS

The *kafka-topics.sh* tool can be used to list and describe topics. *kafka-topics.sh* is part of the AMQ Streams distribution and can be found in the *bin* directory.

Prerequisites

- AMQ Streams cluster is installed and running
- Topic *mytopic* exists

Describing a topic

1. Describe a topic using the *kafka-topics.sh* utility.
   - Specify the Zookeeper URL in the *--zookeeper* option.
   - Use *--describe* option to specify that you want to describe a topic.
   - Topic name has to be specified in the *--topic* option.
   - When the *--topic* option is omitted, it will describe all available topics.

```
bin/kafka-topics.sh --zookeeper <ZookeeperAddress> --describe --topic <TopicName>
```

Example of the command to describe a topic named *mytopic*

```
bin/kafka-topics.sh --zookeeper zoo1.my-domain.com:2181 --describe --topic mytopic
```

The describe command will list all partitions and replicas which belong to this topic. It will also list all topic configuration options.

Additional resources

- For more information about topic configuration, see Section 5.5, “Topic configuration”.
- For more information about creating topics, see Section 5.7, “Creating a topic”.

5.9. MODIFYING A TOPIC CONFIGURATION

The *kafka-configs.sh* tool can be used to modify topic configurations. *kafka-configs.sh* is part of the AMQ Streams distribution and can be found in the *bin* directory.

Prerequisites

- AMQ Streams cluster is installed and running
- Topic *mytopic* exists

Modify topic configuration
1. Use the `kafka-configs.sh` tool to get the current configuration.
   - Specify the Zookeeper URL in the `--zookeeper` option.
   - Set the `--entity-type` as `topic` and `--entity-name` to the name of your topic.
   - Use `--describe` option to get the current configuration.

   ```bash
   bin/kafka-configs.sh --zookeeper <ZookeeperAddress> --entity-type topics --entity-name <TopicName> --describe
   
   Example of the command to get configuration of a topic named mytopic
   ```

   ```bash
   bin/kafka-configs.sh --zookeeper zoo1.my-domain.com:2181 --entity-type topics --entity-name mytopic --describe
   ```

2. Use the `kafka-configs.sh` tool to change the configuration.
   - Specify the Zookeeper URL in the `--zookeeper` options.
   - Set the `--entity-type` as `topic` and `--entity-name` to the name of your topic.
   - Use `--alter` option to modify the current configuration.
   - Specify the options you want to add or change in the option `--add-config`.

   ```bash
   bin/kafka-configs.sh --zookeeper <ZookeeperAddress> --entity-type topics --entity-name <TopicName> --alter --add-config <Option>=<Value>
   
   Example of the command to change configuration of a topic named mytopic
   ```

   ```bash
   bin/kafka-configs.sh --zookeeper zoo1.my-domain.com:2181 --entity-type topics --entity-name mytopic --alter --add-config min.insync.replicas=1
   ```

3. Use the `kafka-configs.sh` tool to delete an existing configuration option.
   - Specify the Zookeeper URL in the `--zookeeper` options.
   - Set the `--entity-type` as `topic` and `--entity-name` to the name of your topic.
   - Use `--delete-config` option to remove existing configuration option.
   - Specify the options you want to remove in the option `--remove-config`.

   ```bash
   bin/kafka-configs.sh --zookeeper <ZookeeperAddress> --entity-type topics --entity-name <TopicName> --alter --delete-config <Option>
   
   Example of the command to change configuration of a topic named mytopic
   ```

   ```bash
   bin/kafka-configs.sh --zookeeper zoo1.my-domain.com:2181 --entity-type topics --entity-name mytopic --alter --delete-config min.insync.replicas
   ```

Additional resources
5.10. DELETING A TOPIC

The `kafka-topics.sh` tool can be used to manage topics. `kafka-topics.sh` is part of the AMQ Streams distribution and can be found in the `bin` directory.

**Prerequisites**

- AMQ Streams cluster is installed and running
- Topic `mytopic` exists

**Deleting a topic**

1. Delete a topic using the `kafka-topics.sh` utility.
   - Specify the Zookeeper URL in the `--zookeeper` option.
   - Use `--delete` option to specify that an existing topic should be deleted.
   - Topic name has to be specified in the `--topic` option.

   ```bash
   bin/kafka-topics.sh --zookeeper <ZookeeperAddress> --delete --topic <TopicName>
   
   Example of the command to create a topic named `mytopic`
   ```
   ```bash
   bin/kafka-topics.sh --zookeeper zoo1.my-domain.com:2181 --delete --topic mytopic
   ```

2. Verify that the topic was deleted using `kafka-topics.sh`.

   ```bash
   bin/kafka-topics.sh --zookeeper <ZookeeperAddress> --list
   
   Example of the command to list all topics
   ```
   ```bash
   bin/kafka-topics.sh --zookeeper zoo1.my-domain.com:2181 --list
   ```

**Additional resources**

- For more information about creating topics, see Section 5.7, “Creating a topic”.
6.1. SCALING KAFKA CLUSTERS

6.1.1. Adding brokers to a cluster

The primary way of increasing throughput for a topic is to increase the number of partitions for that topic. That works because the partitions allow the load for that topic to be shared between the brokers in the cluster. When the brokers are all constrained by some resource (typically I/O), then using more partitions will not yield an increase in throughput. Instead, you must add brokers to the cluster.

When you add an extra broker to the cluster, AMQ Streams does not assign any partitions to it automatically. You have to decide which partitions to move from the existing brokers to the new broker.

Once the partitions have been redistributed between all brokers, each broker should have a lower resource utilization.

6.1.2. Removing brokers from the cluster

Before you remove a broker from a cluster, you must ensure that it is not assigned to any partitions. You should decide which remaining brokers will be responsible for each of the partitions on the broker being decommissioned. Once the broker has no assigned partitions, you can stop it.

6.2. REASSIGNMENT OF PARTITIONS

The `kafka-reassign-partitions.sh` utility is used to reassign partitions to different brokers.

It has three different modes:

--generate

Takes a set of topics and brokers and generates a reassignment JSON file which will result in the partitions of those topics being assigned to those brokers. It is an easy way to generate a reassignment JSON file, but it operates on whole topics, so its use is not always appropriate.

--execute

Takes a reassignment JSON file and applies it to the partitions and brokers in the cluster. Brokers which are gaining partitions will become followers of the partition leader. For a given partition, once the new broker has caught up and joined the ISR the old broker will stop being a follower and will delete its replica.

--verify

Using the same reassignment JSON file as the --execute step, --verify checks whether all of the partitions in the file have been moved to their intended brokers. If the reassignment is complete it will also remove any throttles which are in effect. Unless removed, throttles will continue to affect the cluster even after the reassignment has finished.

It is only possible to have one reassignment running in the cluster at any given time, and it is not possible to cancel a running reassignment. If you need to cancel a reassignment you have to wait for it to complete and then perform another reassignment to revert the effects of the first one. The `kafka-reassign-partitions.sh` will print the reassignment JSON for this reversion as part of its output. Very large reassignments should be broken down into a number of smaller reassignments in case there is a need to stop in-progress reassignment.
6.2.1. Reassignment JSON file

The reassignment JSON file has a specific structure:

```json
{
    "version": 1,
    "partitions": [
        <PartitionObjects>
    ]
}
```

Where `<PartitionObjects>` is a comma-separated list of objects like:

```json
{
    "topic": "<TopicName>",
    "partition": "<Partition>",
    "replicas": [ "<AssignedBrokerIds>" ],
    "log_dirs": [ "<LogDirs>" ]
}
```

The "log_dirs" property is optional and is used to move the partition to a specific log directory.

The following is an example reassignment JSON file that assigns topic `topic-a`, partition 4 to brokers 2, 4 and 7, and topic `topic-b` partition 2 to brokers 1, 5 and 7:

```json
{
    "version": 1,
    "partitions": [
        {
            "topic": "topic-a",
            "partition": 4,
            "replicas": [2,4,7]
        },
        {
            "topic": "topic-b",
            "partition": 2,
            "replicas": [1,5,7]
        }
    ]
}
```

Partitions not included in the JSON are not changed.

6.2.2. Generating reassignment JSON files

The easiest way to assign all the partitions for a given set of topics to a given set of brokers is to generate a reassignment JSON file using the `kafka-reassign-partitions.sh --generate` command.

```bash
bin/kafka-reassign-partitions.sh --zookeeper <Zookeeper> --topics-to-move-json-file <TopicsFile> --broker-list <BrokerList> --generate
```

The `<TopicsFile>` is a JSON file which lists the topics to move. It has the following structure:

```json
{
}
```
where `<TopicObjects>` is a comma-separated list of objects like:

```json
{
  "topic": `<TopicName>`
}
```

For example to move all the partitions of `topic-a` and `topic-b` to brokers 4 and 7:

```
bin/kafka-reassign-partitions.sh --zookeeper localhost:2181 --topics-to-move-json-file topics-to-be-moved.json --broker-list 4,7 --generate
```

where `topics-to-be-moved.json` has contents:

```json
{
  "version": 1,
  "topics": [
    { "topic": "topic-a"},
    { "topic": "topic-b"}
  ]
}
```

### 6.2.3. Creating reassignment JSON files manually

You can manually create the reassignment JSON file if you want to move specific partitions.

### 6.3. REASSIGNMENT THROTTLES

Reassigning partitions can be a slow process because it can require moving lots of data between brokers. To avoid this having a detrimental impact on clients it is possible to throttle the reassignment. Using a throttle can mean the reassignment takes longer. If the throttle is too low then the newly assigned brokers will not be able to keep up with records being published and the reassignment will never complete. If the throttle is too high then clients will be impacted. For example, for producers, this could manifest as higher than normal latency waiting for acknowledgement. For consumers, this could manifest as a drop in throughput caused by higher latency between polls.

### 6.4. SCALING UP A KAFKA CLUSTER

This procedure describes how to increase the number of brokers in a Kafka cluster.

**Prerequisites**

- An existing Kafka cluster.
- A new machine with the AMQ broker installed.
- A reassignment JSON file of how partitions should be reassigned to brokers in the enlarged cluster.
Procedure

1. Create a configuration file for the new broker using the same settings as for the other brokers in your cluster, except for broker.id which should be a number that is not already used by any of the other brokers.

2. Start the new Kafka broker passing the configuration file you created in the previous step as the argument to the kafka-server-start.sh script:

   su - kafka
   /opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server.properties

3. Verify that the Kafka broker is running.

   jcmd | grep Kafka

4. Repeat the above steps for each new broker.

5. Execute the partition reassignment using the kafka-reassign-partitions.sh command line tool.

   kafka-reassign-partitions.sh --zookeeper <ZookeeperHostAndPort> --reassignment-json-file <ReassignmentJsonFile> --execute

   If you are going to throttle replication you can also pass the --throttle option with an inter-broker throttled rate in bytes per second. For example:

   kafka-reassign-partitions.sh --zookeeper zookeeper1:2181 --reassignment-json-file reassignment.json --throttle 5000000 --execute

   This command will print out two reassignment JSON objects. The first records the current assignment for the partitions being moved. You should save this to a file in case you need to revert the reassignment later on. The second JSON object is the target reassignment you have passed in your reassignment JSON file.

6. If you need to change the throttle during reassignment you can use the same command line with a different throttled rate. For example:

   kafka-reassign-partitions.sh --zookeeper zookeeper1:2181 --reassignment-json-file reassignment.json --throttle 10000000 --execute

7. Periodically verify whether the reassignment has completed using the kafka-reassign-partitions.sh command line tool. This is the same command as the previous step but with the --verify option instead of the --execute option.

   kafka-reassign-partitions.sh --zookeeper <ZookeeperHostAndPort> --reassignment-json-file <ReassignmentJsonFile> --verify

   For example:

   kafka-reassign-partitions.sh --zookeeper zookeeper1:2181 --reassignment-json-file reassignment.json --verify

8. The reassignment has finished when the --verify command reports each of the partitions being moved as completed successfully. This final --verify will also have the effect of removing any
reassignment throttles. You can now delete the revert file if you saved the JSON for reverting the assignment to their original brokers.

6.5. SCALING DOWN A KAFKA CLUSTER

Additional resources

This procedure describes how to decrease the number of brokers in a Kafka cluster.

Prerequisites

- An existing Kafka cluster.
- A reassignment JSON file of how partitions should be reassigned to brokers in the cluster once the broker(s) have been removed.

Procedure

1. Execute the partition reassignment using the `kafka-reassign-partitions.sh` command line tool.

   ```bash
   kafka-reassign-partitions.sh --zookeeper <ZookeeperHostAndPort> --reassignment-json-file <ReassignmentJsonFile> --execute
   ```

   If you are going to throttle replication you can also pass the `--throttle` option with an inter-broker throttled rate in bytes per second. For example:

   ```bash
   kafka-reassign-partitions.sh --zookeeper zookeeper1:2181 --reassignment-json-file reassignment.json --throttle 5000000 --execute
   ```

   This command will print out two reassignment JSON objects. The first records the current assignment for the partitions being moved. You should save this to a file in case you need to revert the reassignment later on. The second JSON object is the target reassignment you have passed in your reassignment JSON file.

2. If you need to change the throttle during reassignment you can use the same command line with a different throttled rate. For example:

   ```bash
   kafka-reassign-partitions.sh --zookeeper zookeeper1:2181 --reassignment-json-file reassignment.json --throttle 10000000 --execute
   ```

3. Periodically verify whether the reassignment has completed using the `kafka-reassign-partitions.sh` command line tool. This is the same command as the previous step but with the `--verify` option instead of the `--execute` option.

   ```bash
   kafka-reassign-partitions.sh --zookeeper <ZookeeperHostAndPort> --reassignment-json-file <ReassignmentJsonFile> --verify
   ```

   For example:

   ```bash
   kafka-reassign-partitions.sh --zookeeper zookeeper1:2181 --reassignment-json-file reassignment.json --verify
   ```

4. The reassignment has finished when the `--verify` command reports each of the partitions being
moved as completed successfully. This final --verify will also have the effect of removing any reassignment throttles. You can now delete the revert file if you saved the JSON for reverting the assignment to their original brokers.

5. Once all the partition reassignments have finished, the broker being removed should not have responsibility for any of the partitions in the cluster. You can verify this by checking each of the directories given in the broker's log.dirs configuration parameters. If any of the log directories on the broker contains a directory that does not match the extended regular expression \([a-z0-9]-delete\)$ then the broker still has live partitions and it should not be stopped.

You can check this by executing the command:

```
ls -l <LogDir> | grep -E '^d' | grep -vE '[a-zA-Z0-9.-]+[a-z0-9]+-delete$
```

If the above command prints any output then the broker still has live partitions. In this case, either the reassignment has not finished, or the reassignment JSON file was incorrect.

6. Once you have confirmed that the broker has no live partitions you can stop it.

```
su - kafka
/opt/kafka/bin/kafka-server-stop.sh
```

7. Confirm that the Kafka broker is stopped.

```
jcmd | grep kafka
```
CHAPTER 7. MONITORING YOUR CLUSTER USING JMX

Zookeeper, the Kafka broker, Kafka Connect, and the Kafka clients all expose management information using Java Management Extensions (JMX). Most management information is in the form of metrics that are useful for monitoring the condition and performance of your Kafka cluster. Like other Java applications, Kafka provides this management information through managed beans or MBeans.

JMX works at the level of the JVM (Java Virtual Machine). To obtain management information, external tools can connect to the JVM that is running Zookeeper, the Kafka broker, and so on. By default, only tools on the same machine and running as the same user as the JVM are able to connect.

NOTE

Management information for Zookeeper is not documented here. You can view Zookeeper metrics in JConsole. For more information, see Monitoring using JConsole.

7.1. JMX CONFIGURATION OPTIONS

You configure JMX using JVM system properties. The scripts provided with AMQ Streams (bin/kafka-server-start.sh and bin/connect-distributed.sh, and so on) use the KAFKA_JMX_OPTS environment variable to set these system properties. The system properties for configuring JMX are the same, even though Kafka producer, consumer, and streams applications typically start the JVM in different ways.

7.2. DISABLING THE JMX AGENT

You can prevent local JMX tools from connecting to the JVM (for example, for compliance reasons) by disabling the JMX agent for an AMQ Streams component. The following procedure explains how to disable the JMX agent for a Kafka broker.

Procedure

1. Use the KAFKA_JMX_OPTS environment variable to set com.sun.management.jmxremote to false.

   export KAFKA_JMX_OPTS=-Dcom.sun.management.jmxremote=false
   bin/kafka-server-start.sh

2. Start the JVM.

7.3. CONNECTING TO THE JVM FROM A DIFFERENT MACHINE

You can connect to the JVM from a different machine by configuring the port that the JMX agent listens on. This is insecure because it allows JMX tools to connect from anywhere, with no authentication.

Procedure

1. Use the KAFKA_JMX_OPTS environment variable to set -Dcom.sun.management.jmxremote.port=<port>. For <port>, enter the name of the port on which you want the Kafka broker to listen for JMX connections.

   export KAFKA_JMX_OPTS=-Dcom.sun.management.jmxremote=true
   -Dcom.sun.management.jmxremote.port=<port>
2. Start the JVM.

**IMPORTANT**

It is recommended that you configure authentication and SSL to ensure that the remote JMX connection is secure. For more information about the system properties needed to do this, see the JMX documentation.

### 7.4. MONITORING USING JCONSOLE

The JConsole tool is distributed with the Java Development Kit (JDK). You can use JConsole to connect to a local or remote JVM and discover and display management information from Java applications. If using JConsole to connect to a local JVM, the names of the JVM processes corresponding to the different components of AMQ Streams are as follows:

<table>
<thead>
<tr>
<th>AMQ Streams component</th>
<th>JVM process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zookeeper</td>
<td>org.apache.zookeeper.server.quorum.QuorumPeerMain</td>
</tr>
<tr>
<td>Kafka broker</td>
<td>kafka.Kafka</td>
</tr>
<tr>
<td>Kafka Connect standalone</td>
<td>org.apache.kafka.connect.cli.ConnectStandalone</td>
</tr>
<tr>
<td>Kafka Connect distributed</td>
<td>org.apache.kafka.connect.cli.ConnectDistributed</td>
</tr>
<tr>
<td>A Kafka producer, consumer, or Streams application</td>
<td>The name of the class containing the main method for the application.</td>
</tr>
</tbody>
</table>

When using JConsole to connect to a remote JVM, use the appropriate host name and JMX port.

Many other tools and monitoring products can be used to fetch the metrics using JMX and provide monitoring and alerting based on those metrics. Refer to the product documentation for those tools.

### 7.5. IMPORTANT KAFKA BROKER METRICS

Kafka provides many MBeans for monitoring the performance of the brokers in your Kafka cluster. These apply to an individual broker rather than the entire cluster.

The following tables present a selection of these broker-level MBeans organized into server, network, logging, and controller metrics.

#### 7.5.1. Kafka server metrics

The following table shows a selection of metrics that report information about the Kafka server.
<table>
<thead>
<tr>
<th>Metric</th>
<th>MBean</th>
<th>Description</th>
<th>Expected value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Messages in per second</td>
<td>kafka.server:type=BrokerTopicMetrics,name=MessagesInPerSec</td>
<td>The rate at which individual messages are consumed by the broker.</td>
<td>Approximately the same as the other brokers in the cluster.</td>
</tr>
<tr>
<td>Bytes in per second</td>
<td>kafka.server:type=BrokerTopicMetrics,name=BytesInPerSec</td>
<td>The rate at which data sent from producers is consumed by the broker.</td>
<td>Approximately the same as the other brokers in the cluster.</td>
</tr>
<tr>
<td>Replication bytes in per second</td>
<td>kafka.server:type=BrokerTopicMetrics,name=ReplicationBytesInPerSec</td>
<td>The rate at which data sent from other brokers is consumed by the follower broker.</td>
<td>N/A</td>
</tr>
<tr>
<td>Bytes out per second</td>
<td>kafka.server:type=BrokerTopicMetrics,name=BytesOutPerSec</td>
<td>The rate at which data is fetched and read from the broker by consumers.</td>
<td>N/A</td>
</tr>
<tr>
<td>Replication bytes out per second</td>
<td>kafka.server:type=BrokerTopicMetrics,name=ReplicationBytesOutPerSec</td>
<td>The rate at which data is sent from the broker to other brokers. This metric is useful to monitor if the broker is a leader for a group of partitions.</td>
<td>N/A</td>
</tr>
<tr>
<td>Under-replicated partitions</td>
<td>kafka.server:type=ReplicaManager,name=UnderReplicatedPartitions</td>
<td>The number of partitions that have not been fully replicated in the follower replicas.</td>
<td>Zero</td>
</tr>
<tr>
<td>Under minimum ISR partition count</td>
<td>kafka.server:type=ReplicaManager,name=UnderMinIsrPartitionCount</td>
<td>The number of partitions under the minimum In-Sync Replica (ISR) count. The ISR count indicates the set of replicas that are up-to-date with the leader.</td>
<td>Zero</td>
</tr>
<tr>
<td>Partition count</td>
<td>kafka.server:type=ReplicaManager,name=PartitionCount</td>
<td>The number of partitions in the broker.</td>
<td>Approximately even when compared with the other brokers.</td>
</tr>
<tr>
<td>Leader count</td>
<td>kafka.server:type=ReplicaManager,name=LeaderCount</td>
<td>The number of replicas for which this broker is the leader.</td>
<td>Approximately the same as the other brokers in the cluster.</td>
</tr>
</tbody>
</table>
## Kafka network metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>MBean</th>
<th>Description</th>
<th>Expected value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISR shrinks per second</td>
<td>kafka.server:type=ReplicaManager,name=IsrShrinksPerSec</td>
<td>The rate at which the number of ISRs in the broker decreases</td>
<td>Zero</td>
</tr>
<tr>
<td>ISR expands per second</td>
<td>kafka.server:type=ReplicaManager,name=IsrExpandsPerSec</td>
<td>The rate at which the number of ISRs in the broker increases.</td>
<td>Zero</td>
</tr>
<tr>
<td>Maximum lag</td>
<td>kafka.server:type=ReplicaFetcherManager,name=MaxLag,clientId=Replica</td>
<td>The maximum lag between the time that messages are received by the leader replica and by the follower replicas.</td>
<td>Proportional to the maximum batch size of a produce request.</td>
</tr>
<tr>
<td>Requests in producer purgatory</td>
<td>kafka.server:type=DelayedOperationPurgatory,name=PurgatorySize,delayedOperation=Produce</td>
<td>The number of send requests in the producer purgatory.</td>
<td>N/A</td>
</tr>
<tr>
<td>Requests in fetch purgatory</td>
<td>kafka.server:type=DelayedOperationPurgatory,name=PurgatorySize,delayedOperation=Fetch</td>
<td>The number of fetch requests in the fetch purgatory.</td>
<td>N/A</td>
</tr>
<tr>
<td>Request handler average idle percent</td>
<td>kafka.server:type=KafkaRequestHandlerPool,name=RequestHandlerAvglIdlePercent</td>
<td>Indicates the percentage of time that the request handler (IO) threads are not in use.</td>
<td>A lower value indicates that the workload of the broker is high.</td>
</tr>
<tr>
<td>Request (Requests exempt from throttling)</td>
<td>kafka.server:type=Request</td>
<td>The number of requests that are exempt from throttling.</td>
<td>N/A</td>
</tr>
<tr>
<td>Zookeeper request latency in milliseconds</td>
<td>kafka.server:type=ZooKeeperClientMetric,name=ZooKeeperRequestLatencyMs</td>
<td>The latency for ZooKeeper requests from the broker, in milliseconds.</td>
<td>N/A</td>
</tr>
<tr>
<td>Zookeeper session state</td>
<td>kafka.server:type=SessionExpireListener,name=SessionState</td>
<td>The status of the broker’s connection to Zookeeper.</td>
<td>CONNECTED</td>
</tr>
</tbody>
</table>

7.5.2. Kafka network metrics
The following table shows a selection of metrics that report information about requests.

<table>
<thead>
<tr>
<th>Metric</th>
<th>MBean</th>
<th>Description</th>
<th>Expected value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requests per second</td>
<td>kafka.network:type=RequestMetrics,name=RequestsPerSec,requests={Produce</td>
<td>FetchConsumer</td>
<td>FetchFollower}</td>
</tr>
<tr>
<td>Request bytes (request size in bytes)</td>
<td>kafka.network:type=RequestMetrics,name=RequestBytes,requests=[-\w]+</td>
<td>The size of requests, in bytes, made for the request type identified by the request property of the MBean name. Separate MBeans for all available request types are listed under the RequestBytes node.</td>
<td>N/A</td>
</tr>
<tr>
<td>Temporary memory size in bytes</td>
<td>kafka.network:type=RequestMetrics,name=TemporaryMemoryBytes,requests={Produce</td>
<td>Fetch}</td>
<td>The amount of temporary memory used for converting message formats and decompressing messages.</td>
</tr>
<tr>
<td>Message conversions time</td>
<td>kafka.network:type=RequestMetrics,name=MessageConversionsTimeMs,requests={Produce</td>
<td>Fetch}</td>
<td>Time, in milliseconds, spent on converting message formats.</td>
</tr>
<tr>
<td>Total request time in milliseconds</td>
<td>kafka.network:type=RequestMetrics,name=TotalTimeMs,requests={Produce</td>
<td>FetchConsumer</td>
<td>FetchFollower}</td>
</tr>
<tr>
<td>Request queue time in milliseconds</td>
<td>kafka.network:type=RequestMetrics,name=RequestQueueTimeMs,requests={Produce</td>
<td>FetchConsumer</td>
<td>FetchFollower}</td>
</tr>
</tbody>
</table>
### 7.5.3. Kafka log metrics

The following table shows a selection of metrics that report information about logging.

<table>
<thead>
<tr>
<th>Metric</th>
<th>MBean</th>
<th>Description</th>
<th>Expected Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log flush rate and time in milliseconds</td>
<td>kafka.log:type=LogFlushStats,name=LogFlushRateAndTimeMs</td>
<td>The rate at which log data is written to disk, in milliseconds.</td>
<td>N/A</td>
</tr>
</tbody>
</table>
7.5.4. Kafka controller metrics

The following table shows a selection of metrics that report information about the controller of the cluster.

<table>
<thead>
<tr>
<th>Metric</th>
<th>MBean</th>
<th>Description</th>
<th>Expected Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offline log directory count</td>
<td>kafka.log:type=LogManager,name=OfflineLogDirectoryCount</td>
<td>The number of offline log directories (for example, after a hardware failure).</td>
<td>Zero</td>
</tr>
<tr>
<td>Active controller count</td>
<td>kafka.controller:type=KafkaController,name=ActiveControllerCount</td>
<td>The number of brokers designated as controllers.</td>
<td>One</td>
</tr>
<tr>
<td>Leader election rate and time in milliseconds</td>
<td>kafka.controller:type=ControllerStats,name=LeaderElectionRateAndTimeMs</td>
<td>The rate at which new leader replicas are elected.</td>
<td>Zero</td>
</tr>
</tbody>
</table>

7.5.5. Yammer metrics

Metrics that express a rate or unit of time are provided as Yammer metrics. The class name of an MBean that uses Yammer metrics is prefixed with `com.yammer.metrics`.

Yammer rate metrics have the following attributes for monitoring requests:

- Count
- EventType (Bytes)
- FifteenMinuteRate
- RateUnit (Seconds)
- MeanRate
- OneMinuteRate
- FiveMinuteRate

Yammer time metrics have the following attributes for monitoring requests:

- Max
- Min
• Mean
• StdDev
• 75/95/98/99/99.9th Percentile

### 7.6. PRODUCER MBEANS

The following MBeans will exist in Kafka producer applications, including Kafka Streams applications and Kafka Connect with source connectors.

#### 7.6.1. MBeans matching `kafka.producer:type=producer-metrics,client-id=*`

These are metrics at the producer level.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>batch-size-avg</td>
<td>The average number of bytes sent per partition per-request.</td>
</tr>
<tr>
<td>batch-size-max</td>
<td>The max number of bytes sent per partition per-request.</td>
</tr>
<tr>
<td>batch-split-rate</td>
<td>The average number of batch splits per second.</td>
</tr>
<tr>
<td>batch-split-total</td>
<td>The total number of batch splits.</td>
</tr>
<tr>
<td>buffer-available-bytes</td>
<td>The total amount of buffer memory that is not being used (either unallocated or in the free list).</td>
</tr>
<tr>
<td>buffer-total-bytes</td>
<td>The maximum amount of buffer memory the client can use (whether or not it is currently used).</td>
</tr>
<tr>
<td>bufferpool-wait-time</td>
<td>The fraction of time an appender waits for space allocation.</td>
</tr>
<tr>
<td>compression-rate-avg</td>
<td>The average compression rate of record batches.</td>
</tr>
<tr>
<td>connection-close-rate</td>
<td>Connections closed per second in the window.</td>
</tr>
<tr>
<td>connection-count</td>
<td>The current number of active connections.</td>
</tr>
<tr>
<td>connection-creation-rate</td>
<td>New connections established per second in the window.</td>
</tr>
<tr>
<td>failed-authentication-rate</td>
<td>Connections that failed authentication.</td>
</tr>
<tr>
<td>incoming-byte-rate</td>
<td>Bytes/second read off all sockets.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>io-ratio</td>
<td>The fraction of time the I/O thread spent doing I/O.</td>
</tr>
<tr>
<td>io-time-ns-avg</td>
<td>The average length of time for I/O per select call in nanoseconds.</td>
</tr>
<tr>
<td>io-wait-ratio</td>
<td>The fraction of time the I/O thread spent waiting.</td>
</tr>
<tr>
<td>io-wait-time-ns-avg</td>
<td>The average length of time the I/O thread spent waiting for a socket ready for reads or writes in nanoseconds.</td>
</tr>
<tr>
<td>metadata-age</td>
<td>The age in seconds of the current producer metadata being used.</td>
</tr>
<tr>
<td>network-io-rate</td>
<td>The average number of network operations (reads or writes) on all connections per second.</td>
</tr>
<tr>
<td>outgoing-byte-rate</td>
<td>The average number of outgoing bytes sent per second to all servers.</td>
</tr>
<tr>
<td>produce-throttle-time-avg</td>
<td>The average time in ms a request was throttled by a broker.</td>
</tr>
<tr>
<td>produce-throttle-time-max</td>
<td>The maximum time in ms a request was throttled by a broker.</td>
</tr>
<tr>
<td>record-error-rate</td>
<td>The average per-second number of record sends that resulted in errors.</td>
</tr>
<tr>
<td>record-error-total</td>
<td>The total number of record sends that resulted in errors.</td>
</tr>
<tr>
<td>record-queue-time-avg</td>
<td>The average time in ms record batches spent in the send buffer.</td>
</tr>
<tr>
<td>record-queue-time-max</td>
<td>The maximum time in ms record batches spent in the send buffer.</td>
</tr>
<tr>
<td>record-retry-rate</td>
<td>The average per-second number of retried record sends.</td>
</tr>
<tr>
<td>record-retry-total</td>
<td>The total number of retried record sends.</td>
</tr>
<tr>
<td>record-send-rate</td>
<td>The average number of records sent per second.</td>
</tr>
<tr>
<td>record-send-total</td>
<td>The total number of records sent.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>record-size-avg</td>
<td>The average record size.</td>
</tr>
<tr>
<td>record-size-max</td>
<td>The maximum record size.</td>
</tr>
<tr>
<td>records-per-request-avg</td>
<td>The average number of records per request.</td>
</tr>
<tr>
<td>request-latency-avg</td>
<td>The average request latency in ms.</td>
</tr>
<tr>
<td>request-latency-max</td>
<td>The maximum request latency in ms.</td>
</tr>
<tr>
<td>request-rate</td>
<td>The average number of requests sent per second.</td>
</tr>
<tr>
<td>request-size-avg</td>
<td>The average size of all requests in the window.</td>
</tr>
<tr>
<td>request-size-max</td>
<td>The maximum size of any request sent in the window.</td>
</tr>
<tr>
<td>requests-in-flight</td>
<td>The current number of in-flight requests awaiting a response.</td>
</tr>
<tr>
<td>response-rate</td>
<td>Responses received sent per second.</td>
</tr>
<tr>
<td>select-rate</td>
<td>Number of times the I/O layer checked for new I/O to perform per second.</td>
</tr>
<tr>
<td>successful-authentication-rate</td>
<td>Connections that were successfully authenticated using SASL or SSL.</td>
</tr>
<tr>
<td>waiting-threads</td>
<td>The number of user threads blocked waiting for buffer memory to enqueue their records.</td>
</tr>
</tbody>
</table>

### 7.6.2. MBsena matching `kafka.producer:type=producer-metrics,client-id=*,node-id=*`

These are metrics at the producer level about connection to each broker.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>incoming-byte-rate</td>
<td>The average number of responses received per second for a node.</td>
</tr>
<tr>
<td>outgoing-byte-rate</td>
<td>The average number of outgoing bytes sent per second for a node.</td>
</tr>
<tr>
<td>request-latency-avg</td>
<td>The average request latency in ms for a node.</td>
</tr>
</tbody>
</table>
### Attribute Description

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>request-latency-max</td>
<td>The maximum request latency in ms for a node.</td>
</tr>
<tr>
<td>request-rate</td>
<td>The average number of requests sent per second for a node.</td>
</tr>
<tr>
<td>request-size-avg</td>
<td>The average size of all requests in the window for a node.</td>
</tr>
<tr>
<td>request-size-max</td>
<td>The maximum size of any request sent in the window for a node.</td>
</tr>
<tr>
<td>response-rate</td>
<td>Responses received sent per second for a node.</td>
</tr>
</tbody>
</table>

#### 7.6.3. MBeans matching kafka.producer:type=producer-topic-metrics,client-id=*,topic=*

These are metrics at the topic level about topics the producer is sending messages to.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>byte-rate</td>
<td>The average number of bytes sent per second for a topic.</td>
</tr>
<tr>
<td>byte-total</td>
<td>The total number of bytes sent for a topic.</td>
</tr>
<tr>
<td>compression-rate</td>
<td>The average compression rate of record batches for a topic.</td>
</tr>
<tr>
<td>record-error-rate</td>
<td>The average per-second number of record sends that resulted in errors for a topic.</td>
</tr>
<tr>
<td>record-error-total</td>
<td>The total number of record sends that resulted in errors for a topic.</td>
</tr>
<tr>
<td>record-retry-rate</td>
<td>The average per-second number of retried record sends for a topic.</td>
</tr>
<tr>
<td>record-retry-total</td>
<td>The total number of retried record sends for a topic.</td>
</tr>
<tr>
<td>record-send-rate</td>
<td>The average number of records sent per second for a topic.</td>
</tr>
<tr>
<td>record-send-total</td>
<td>The total number of records sent for a topic.</td>
</tr>
</tbody>
</table>

#### 7.7. CONSUMER MBEANS
The following MBeans will exist in Kafka consumer applications, including Kafka Streams applications and Kafka Connect with sink connectors.

### 7.7.1. MBeans matching kafka.consumer:type=consumer-metrics,client-id=* 

These are metrics at the consumer level.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>connection-close-rate</td>
<td>Connections closed per second in the window.</td>
</tr>
<tr>
<td>connection-count</td>
<td>The current number of active connections.</td>
</tr>
<tr>
<td>connection-creation-rate</td>
<td>New connections established per second in the window.</td>
</tr>
<tr>
<td>failed-authentication-rate</td>
<td>Connections that failed authentication.</td>
</tr>
<tr>
<td>incoming-byte-rate</td>
<td>Bytes/second read off all sockets.</td>
</tr>
<tr>
<td>io-ratio</td>
<td>The fraction of time the I/O thread spent doing I/O.</td>
</tr>
<tr>
<td>io-time-ns-avg</td>
<td>The average length of time for I/O per select call in nanoseconds.</td>
</tr>
<tr>
<td>io-wait-ratio</td>
<td>The fraction of time the I/O thread spent waiting.</td>
</tr>
<tr>
<td>io-wait-time-ns-avg</td>
<td>The average length of time the I/O thread spent waiting for a socket ready for reads or writes in nanoseconds.</td>
</tr>
<tr>
<td>network-io-rate</td>
<td>The average number of network operations (reads or writes) on all connections per second.</td>
</tr>
<tr>
<td>outgoing-byte-rate</td>
<td>The average number of outgoing bytes sent per second to all servers.</td>
</tr>
<tr>
<td>request-rate</td>
<td>The average number of requests sent per second.</td>
</tr>
<tr>
<td>request-size-avg</td>
<td>The average size of all requests in the window.</td>
</tr>
<tr>
<td>request-size-max</td>
<td>The maximum size of any request sent in the window.</td>
</tr>
<tr>
<td>response-rate</td>
<td>Responses received sent per second.</td>
</tr>
<tr>
<td>select-rate</td>
<td>Number of times the I/O layer checked for new I/O to perform per second.</td>
</tr>
</tbody>
</table>
### 7.7.2. MBeans matching `kafka.consumer:type=consumer-metrics,client-id=*,node-id=*`

These are metrics at the consumer level about connection to each broker.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>incoming-byte-rate</td>
<td>The average number of responses received per second for a node.</td>
</tr>
<tr>
<td>outgoing-byte-rate</td>
<td>The average number of outgoing bytes sent per second for a node.</td>
</tr>
<tr>
<td>request-latency-avg</td>
<td>The average request latency in ms for a node.</td>
</tr>
<tr>
<td>request-latency-max</td>
<td>The maximum request latency in ms for a node.</td>
</tr>
<tr>
<td>request-rate</td>
<td>The average number of requests sent per second for a node.</td>
</tr>
<tr>
<td>request-size-avg</td>
<td>The average size of all requests in the window for a node.</td>
</tr>
<tr>
<td>request-size-max</td>
<td>The maximum size of any request sent in the window for a node.</td>
</tr>
<tr>
<td>response-rate</td>
<td>Responses received sent per second for a node.</td>
</tr>
</tbody>
</table>

### 7.7.3. MBeans matching `kafka.consumer:type=consumer-coordinator-metrics,client-id=*`

These are metrics at the consumer level about the consumer group.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>assigned-partitions</td>
<td>The number of partitions currently assigned to this consumer.</td>
</tr>
<tr>
<td>commit-latency-avg</td>
<td>The average time taken for a commit request.</td>
</tr>
<tr>
<td>commit-latency-max</td>
<td>The max time taken for a commit request.</td>
</tr>
<tr>
<td>commit-rate</td>
<td>The number of commit calls per second.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>heartbeat-rate</td>
<td>The average number of heartbeats per second.</td>
</tr>
<tr>
<td>heartbeat-response-time-max</td>
<td>The max time taken to receive a response to a heartbeat request.</td>
</tr>
<tr>
<td>join-rate</td>
<td>The number of group joins per second.</td>
</tr>
<tr>
<td>join-time-avg</td>
<td>The average time taken for a group rejoin.</td>
</tr>
<tr>
<td>join-time-max</td>
<td>The max time taken for a group rejoin.</td>
</tr>
<tr>
<td>last-heartbeat-seconds-ago</td>
<td>The number of seconds since the last controller heartbeat.</td>
</tr>
<tr>
<td>sync-rate</td>
<td>The number of group syncs per second.</td>
</tr>
<tr>
<td>sync-time-avg</td>
<td>The average time taken for a group sync.</td>
</tr>
<tr>
<td>sync-time-max</td>
<td>The max time taken for a group sync.</td>
</tr>
</tbody>
</table>

### 7.7.4. MBeans matching kafka.consumer:type=consumer-fetch-manager-metrics,client-id=*  

These are metrics at the consumer level about the consumer’s fetcher.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bytes-consumed-rate</td>
<td>The average number of bytes consumed per second.</td>
</tr>
<tr>
<td>bytes-consumed-total</td>
<td>The total number of bytes consumed.</td>
</tr>
<tr>
<td>fetch-latency-avg</td>
<td>The average time taken for a fetch request.</td>
</tr>
<tr>
<td>fetch-latency-max</td>
<td>The max time taken for any fetch request.</td>
</tr>
<tr>
<td>fetch-rate</td>
<td>The number of fetch requests per second.</td>
</tr>
<tr>
<td>fetch-size-avg</td>
<td>The average number of bytes fetched per request.</td>
</tr>
<tr>
<td>fetch-size-max</td>
<td>The maximum number of bytes fetched per request.</td>
</tr>
<tr>
<td>fetch-throttle-time-avg</td>
<td>The average throttle time in ms.</td>
</tr>
<tr>
<td>fetch-throttle-time-max</td>
<td>The maximum throttle time in ms.</td>
</tr>
</tbody>
</table>
### Attribute | Description
--- | ---
fetch-total | The total number of fetch requests.
records-consumed-rate | The average number of records consumed per second.
records-consumed-total | The total number of records consumed.
records-lag-max | The maximum lag in terms of number of records for any partition in this window.
records-lead-min | The minimum lead in terms of number of records for any partition in this window.
records-per-request-avg | The average number of records in each request.

**7.7.5. MBeans matching kafka.consumer:type=consumer-fetch-manager-metrics,client-id=*,topic=***

These are metrics at the topic level about the consumer’s fetcher.

### Attribute | Description
--- | ---
bytes-consumed-rate | The average number of bytes consumed per second for a topic.
bytes-consumed-total | The total number of bytes consumed for a topic.
fetch-size-avg | The average number of bytes fetched per request for a topic.
fetch-size-max | The maximum number of bytes fetched per request for a topic.
records-consumed-rate | The average number of records consumed per second for a topic.
records-consumed-total | The total number of records consumed for a topic.
records-per-request-avg | The average number of records in each request for a topic.

**7.7.6. MBeans matching kafka.consumer:type=consumer-fetch-manager-metrics,client-id=*,topic=*,partition=***

These are metrics at the partition level about the consumer’s fetcher.
### 7.8. Kafka Connect MBeans

**NOTE**

Kafka Connect will contain the producer MBeans for source connectors and consumer MBeans for sink connectors in addition to those documented here.

#### 7.8.1. MBeans matching `kafka.connect:type=connect-metrics,client-id=*`

These are metrics at the connect level.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>records-lag</td>
<td>The latest lag of the partition.</td>
</tr>
<tr>
<td>records-lag-avg</td>
<td>The average lag of the partition.</td>
</tr>
<tr>
<td>records-lag-max</td>
<td>The max lag of the partition.</td>
</tr>
<tr>
<td>records-lead</td>
<td>The latest lead of the partition.</td>
</tr>
<tr>
<td>records-lead-avg</td>
<td>The average lead of the partition.</td>
</tr>
<tr>
<td>records-lead-min</td>
<td>The min lead of the partition.</td>
</tr>
<tr>
<td>connection-close-rate</td>
<td>Connections closed per second in the window.</td>
</tr>
<tr>
<td>connection-count</td>
<td>The current number of active connections.</td>
</tr>
<tr>
<td>connection-creation-rate</td>
<td>New connections established per second in the window.</td>
</tr>
<tr>
<td>failed-authentication-rate</td>
<td>Connections that failed authentication.</td>
</tr>
<tr>
<td>incoming-byte-rate</td>
<td>Bytes/second read off all sockets.</td>
</tr>
<tr>
<td>io-ratio</td>
<td>The fraction of time the I/O thread spent doing I/O.</td>
</tr>
<tr>
<td>io-time-ns-avg</td>
<td>The average length of time for I/O per select call in nanoseconds.</td>
</tr>
<tr>
<td>io-wait-ratio</td>
<td>The fraction of time the I/O thread spent waiting.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>io-wait-time-ns-avg</td>
<td>The average length of time the I/O thread spent waiting for a socket ready for reads or writes in nanoseconds.</td>
</tr>
<tr>
<td>network-io-rate</td>
<td>The average number of network operations (reads or writes) on all connections per second.</td>
</tr>
<tr>
<td>outgoing-byte-rate</td>
<td>The average number of outgoing bytes sent per second to all servers.</td>
</tr>
<tr>
<td>request-rate</td>
<td>The average number of requests sent per second.</td>
</tr>
<tr>
<td>request-size-avg</td>
<td>The average size of all requests in the window.</td>
</tr>
<tr>
<td>request-size-max</td>
<td>The maximum size of any request sent in the window.</td>
</tr>
<tr>
<td>response-rate</td>
<td>Responses received sent per second.</td>
</tr>
<tr>
<td>select-rate</td>
<td>Number of times the I/O layer checked for new I/O to perform per second.</td>
</tr>
<tr>
<td>successful-authentication-rate</td>
<td>Connections that were successfully authenticated using SASL or SSL.</td>
</tr>
</tbody>
</table>

### 7.8.2. MBeans matching `kafka.connect:type=connect-metrics,client-id=*,node-id=*`  
These are metrics at the connect level about connection to each broker.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>incoming-byte-rate</td>
<td>The average number of responses received per second for a node.</td>
</tr>
<tr>
<td>outgoing-byte-rate</td>
<td>The average number of outgoing bytes sent per second for a node.</td>
</tr>
<tr>
<td>request-latency-avg</td>
<td>The average request latency in ms for a node.</td>
</tr>
<tr>
<td>request-latency-max</td>
<td>The maximum request latency in ms for a node.</td>
</tr>
<tr>
<td>request-rate</td>
<td>The average number of requests sent per second for a node.</td>
</tr>
</tbody>
</table>
### Attribute Description

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>request-size-avg</td>
<td>The average size of all requests in the window for a node.</td>
</tr>
<tr>
<td>request-size-max</td>
<td>The maximum size of any request sent in the window for a node.</td>
</tr>
<tr>
<td>response-rate</td>
<td>Responses received sent per second for a node.</td>
</tr>
</tbody>
</table>

### 7.8.3. MBeans matching `kafka.connect:type=connect-worker-metrics`

These are metrics at the connect level.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>connector-count</td>
<td>The number of connectors run in this worker.</td>
</tr>
<tr>
<td>connector-startup-attempts-total</td>
<td>The total number of connector startups that this worker has attempted.</td>
</tr>
<tr>
<td>connector-startup-failure-percentage</td>
<td>The average percentage of this worker's connectors starts that failed.</td>
</tr>
<tr>
<td>connector-startup-failure-total</td>
<td>The total number of connector starts that failed.</td>
</tr>
<tr>
<td>connector-startup-success-percentage</td>
<td>The average percentage of this worker's connectors starts that succeeded.</td>
</tr>
<tr>
<td>connector-startup-success-total</td>
<td>The total number of connector starts that succeeded.</td>
</tr>
<tr>
<td>task-count</td>
<td>The number of tasks run in this worker.</td>
</tr>
<tr>
<td>task-startup-attempts-total</td>
<td>The total number of task startups that this worker has attempted.</td>
</tr>
<tr>
<td>task-startup-failure-percentage</td>
<td>The average percentage of this worker's tasks starts that failed.</td>
</tr>
<tr>
<td>task-startup-failure-total</td>
<td>The total number of task starts that failed.</td>
</tr>
<tr>
<td>task-startup-success-percentage</td>
<td>The average percentage of this worker's tasks starts that succeeded.</td>
</tr>
<tr>
<td>task-startup-success-total</td>
<td>The total number of task starts that succeeded.</td>
</tr>
</tbody>
</table>
### 7.8.4. MBeans matching `kafka.connect:type=connect-worker-rebalance-metrics`

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>completed-rebalances-total</td>
<td>The total number of rebalances completed by this worker.</td>
</tr>
<tr>
<td>epoch</td>
<td>The epoch or generation number of this worker.</td>
</tr>
<tr>
<td>leader-name</td>
<td>The name of the group leader.</td>
</tr>
<tr>
<td>rebalance-avg-time-ms</td>
<td>The average time in milliseconds spent by this worker to rebalance.</td>
</tr>
<tr>
<td>rebalance-max-time-ms</td>
<td>The maximum time in milliseconds spent by this worker to rebalance.</td>
</tr>
<tr>
<td>rebalancing</td>
<td>Whether this worker is currently rebalancing.</td>
</tr>
<tr>
<td>time-since-last-rebalance-ms</td>
<td>The time in milliseconds since this worker completed the most recent rebalance.</td>
</tr>
</tbody>
</table>

### 7.8.5. MBeans matching `kafka.connect:type=connector-metrics,connector=*`

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>connector-class</td>
<td>The name of the connector class.</td>
</tr>
<tr>
<td>connector-type</td>
<td>The type of the connector. One of ‘source’ or ‘sink’.</td>
</tr>
<tr>
<td>connector-version</td>
<td>The version of the connector class, as reported by the connector.</td>
</tr>
</tbody>
</table>

### 7.8.6. MBeans matching `kafka.connect:type=connector-task-metrics,connector=*,task=*`

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>batch-size-avg</td>
<td>The average size of the batches processed by the connector.</td>
</tr>
<tr>
<td>batch-size-max</td>
<td>The maximum size of the batches processed by the connector.</td>
</tr>
</tbody>
</table>
### Attribute Description

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>offset-commit-avg-time-ms</td>
<td>The average time in milliseconds taken by this task to commit offsets.</td>
</tr>
<tr>
<td>offset-commit-failure-percentage</td>
<td>The average percentage of this task’s offset commit attempts that failed.</td>
</tr>
<tr>
<td>offset-commit-max-time-ms</td>
<td>The maximum time in milliseconds taken by this task to commit offsets.</td>
</tr>
<tr>
<td>offset-commit-success-percentage</td>
<td>The average percentage of this task’s offset commit attempts that succeeded.</td>
</tr>
<tr>
<td>pause-ratio</td>
<td>The fraction of time this task has spent in the pause state.</td>
</tr>
<tr>
<td>running-ratio</td>
<td>The fraction of time this task has spent in the running state.</td>
</tr>
</tbody>
</table>

#### 7.8.7. MBeans matching kafka.connect:type=sink-task-metrics,connector=*,task=*  

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>offset-commit-completion-rate</td>
<td>The average per-second number of offset commit completions that were completed successfully.</td>
</tr>
<tr>
<td>offset-commit-completion-total</td>
<td>The total number of offset commit completions that were completed successfully.</td>
</tr>
<tr>
<td>offset-commit-seq-no</td>
<td>The current sequence number for offset commits.</td>
</tr>
<tr>
<td>offset-commit-skip-rate</td>
<td>The average per-second number of offset commit completions that were received too late and skipped/ignored.</td>
</tr>
<tr>
<td>offset-commit-skip-total</td>
<td>The total number of offset commit completions that were received too late and skipped/ignored.</td>
</tr>
<tr>
<td>partition-count</td>
<td>The number of topic partitions assigned to this task belonging to the named sink connector in this worker.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>put-batch-avg-time-ms</td>
<td>The average time taken by this task to put a batch of sinks records.</td>
</tr>
<tr>
<td>put-batch-max-time-ms</td>
<td>The maximum time taken by this task to put a batch of sinks records.</td>
</tr>
<tr>
<td>sink-record-active-count</td>
<td>The number of records that have been read from Kafka but not yet completely committed/flushed/acknowledged by the sink task.</td>
</tr>
<tr>
<td>sink-record-active-count-avg</td>
<td>The average number of records that have been read from Kafka but not yet completely committed/flushed/acknowledged by the sink task.</td>
</tr>
<tr>
<td>sink-record-active-count-max</td>
<td>The maximum number of records that have been read from Kafka but not yet completely committed/flushed/acknowledged by the sink task.</td>
</tr>
<tr>
<td>sink-record-lag-max</td>
<td>The maximum lag in terms of number of records that the sink task is behind the consumer’s position for any topic partitions.</td>
</tr>
<tr>
<td>sink-record-read-rate</td>
<td>The average per-second number of records read from Kafka for this task belonging to the named sink connector in this worker. This is before transformations are applied.</td>
</tr>
<tr>
<td>sink-record-read-total</td>
<td>The total number of records read from Kafka by this task belonging to the named sink connector in this worker, since the task was last restarted.</td>
</tr>
<tr>
<td>sink-record-send-rate</td>
<td>The average per-second number of records output from the transformations and sent/put to this task belonging to the named sink connector in this worker. This is after transformations are applied and excludes any records filtered out by the transformations.</td>
</tr>
<tr>
<td>sink-record-send-total</td>
<td>The total number of records output from the transformations and sent/put to this task belonging to the named sink connector in this worker, since the task was last restarted.</td>
</tr>
</tbody>
</table>

### 7.8.8. MBeans matching kafka.connect:type=source-task-metrics,connector=*,task=*:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
</table>

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<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>poll-batch-avg-time-ms</td>
<td>The average time in milliseconds taken by this task to poll for a batch of source records.</td>
</tr>
<tr>
<td>poll-batch-max-time-ms</td>
<td>The maximum time in milliseconds taken by this task to poll for a batch of source records.</td>
</tr>
<tr>
<td>source-record-active-count</td>
<td>The number of records that have been produced by this task but not yet completely written to Kafka.</td>
</tr>
<tr>
<td>source-record-active-count-avg</td>
<td>The average number of records that have been produced by this task but not yet completely written to Kafka.</td>
</tr>
<tr>
<td>source-record-active-count-max</td>
<td>The maximum number of records that have been produced by this task but not yet completely written to Kafka.</td>
</tr>
<tr>
<td>source-record-poll-rate</td>
<td>The average per-second number of records produced/polled (before transformation) by this task belonging to the named source connector in this worker.</td>
</tr>
<tr>
<td>source-record-poll-total</td>
<td>The total number of records produced/polled (before transformation) by this task belonging to the named source connector in this worker.</td>
</tr>
<tr>
<td>source-record-write-rate</td>
<td>The average per-second number of records output from the transformations and written to Kafka for this task belonging to the named source connector in this worker. This is after transformations are applied and excludes any records filtered out by the transformations.</td>
</tr>
<tr>
<td>source-record-write-total</td>
<td>The number of records output from the transformations and written to Kafka for this task belonging to the named source connector in this worker, since the task was last restarted.</td>
</tr>
</tbody>
</table>

### 7.8.9. MBeans matching `kafka.connect:type=task-error-metrics,connector=*,task=*`

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>deadletterqueue-produce-failures</td>
<td>The number of failed writes to the dead letter queue.</td>
</tr>
<tr>
<td>deadletterqueue-produce-requests</td>
<td>The number of attempted writes to the dead letter queue.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>last-error-timestamp</td>
<td>The epoch timestamp when this task last encountered an error.</td>
</tr>
<tr>
<td>total-errors-logged</td>
<td>The number of errors that were logged.</td>
</tr>
<tr>
<td>total-record-errors</td>
<td>The number of record processing errors in this task.</td>
</tr>
<tr>
<td>total-record-failures</td>
<td>The number of record processing failures in this task.</td>
</tr>
<tr>
<td>total-records-skipped</td>
<td>The number of records skipped due to errors.</td>
</tr>
<tr>
<td>total-retries</td>
<td>The number of operations retried.</td>
</tr>
</tbody>
</table>

### 7.9. KAFKA STREAMS MBEANS

**NOTE**

A Streams application will contain the `producer` and `consumer` MBeans in addition to those documented here.

#### 7.9.1. MBeans matching kafka.streams:type=stream-metrics,client-id=* 

These metrics are collected when the `metrics.recording.level` configuration parameter is `info` or `debug`.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>commit-latency-avg</td>
<td>The average execution time in ms for committing, across all running tasks of this thread.</td>
</tr>
<tr>
<td>commit-latency-max</td>
<td>The maximum execution time in ms for committing across all running tasks of this thread.</td>
</tr>
<tr>
<td>commit-rate</td>
<td>The average number of commits per second.</td>
</tr>
<tr>
<td>commit-total</td>
<td>The total number of commit calls across all tasks.</td>
</tr>
<tr>
<td>poll-latency-avg</td>
<td>The average execution time in ms for polling, across all running tasks of this thread.</td>
</tr>
<tr>
<td>poll-latency-max</td>
<td>The maximum execution time in ms for polling across all running tasks of this thread.</td>
</tr>
<tr>
<td>poll-rate</td>
<td>The average number of polls per second.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>poll-total</td>
<td>The total number of poll calls across all tasks.</td>
</tr>
<tr>
<td>process-latency-avg</td>
<td>The average execution time in ms for processing, across all running tasks of this thread.</td>
</tr>
<tr>
<td>process-latency-max</td>
<td>The maximum execution time in ms for processing, across all running tasks of this thread.</td>
</tr>
<tr>
<td>process-rate</td>
<td>The average number of process calls per second.</td>
</tr>
<tr>
<td>process-total</td>
<td>The total number of process calls across all tasks.</td>
</tr>
<tr>
<td>punctuate-latency-avg</td>
<td>The average execution time in ms for punctuating, across all running tasks of this thread.</td>
</tr>
<tr>
<td>punctuate-latency-max</td>
<td>The maximum execution time in ms for punctuating, across all running tasks of this thread.</td>
</tr>
<tr>
<td>punctuate-rate</td>
<td>The average number of punctuates per second.</td>
</tr>
<tr>
<td>punctuate-total</td>
<td>The total number of punctuate calls across all tasks.</td>
</tr>
<tr>
<td>skipped-records-rate</td>
<td>The average number of skipped records per second.</td>
</tr>
<tr>
<td>skipped-records-total</td>
<td>The total number of skipped records.</td>
</tr>
<tr>
<td>task-closed-rate</td>
<td>The average number of tasks closed per second.</td>
</tr>
<tr>
<td>task-closed-total</td>
<td>The total number of tasks closed.</td>
</tr>
<tr>
<td>task-created-rate</td>
<td>The average number of newly created tasks per second.</td>
</tr>
<tr>
<td>task-created-total</td>
<td>The total number of tasks created.</td>
</tr>
</tbody>
</table>

**7.9.2. MBeans matching kafka.streams:type=stream-task-metrics,client-id=*,task-id=***

Task metrics.

These metrics are collected when the `metrics.recording.level` configuration parameter is `debug`.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>commit-latency-avg</td>
<td>The average commit time in ns for this task.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>commit-latency-max</td>
<td>The maximum commit time in ns for this task.</td>
</tr>
<tr>
<td>commit-rate</td>
<td>The average number of commit calls per second.</td>
</tr>
<tr>
<td>commit-total</td>
<td>The total number of commit calls.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>create-latency-avg</td>
<td>The average create execution time in ns.</td>
</tr>
<tr>
<td>create-latency-max</td>
<td>The maximum create execution time in ns.</td>
</tr>
<tr>
<td>create-rate</td>
<td>The average number of create operations per second.</td>
</tr>
<tr>
<td>create-total</td>
<td>The total number of create operations called.</td>
</tr>
<tr>
<td>destroy-latency-avg</td>
<td>The average destroy execution time in ns.</td>
</tr>
<tr>
<td>destroy-latency-max</td>
<td>The maximum destroy execution time in ns.</td>
</tr>
<tr>
<td>destroy-rate</td>
<td>The average number of destroy operations per second.</td>
</tr>
<tr>
<td>destroy-total</td>
<td>The total number of destroy operations called.</td>
</tr>
<tr>
<td>forward-rate</td>
<td>The average rate of records being forwarded downstream, from source nodes only, per second.</td>
</tr>
<tr>
<td>forward-total</td>
<td>The total number of of records being forwarded downstream, from source nodes only.</td>
</tr>
<tr>
<td>process-latency-avg</td>
<td>The average process execution time in ns.</td>
</tr>
<tr>
<td>process-latency-max</td>
<td>The maximum process execution time in ns.</td>
</tr>
<tr>
<td>process-rate</td>
<td>The average number of process operations per second.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>process-total</td>
<td>The total number of process operations called.</td>
</tr>
<tr>
<td>punctuate-latency-avg</td>
<td>The average punctuate execution time in ns.</td>
</tr>
<tr>
<td>punctuate-latency-max</td>
<td>The maximum punctuate execution time in ns.</td>
</tr>
<tr>
<td>punctuate-rate</td>
<td>The average number of punctuate operations per second.</td>
</tr>
<tr>
<td>punctuate-total</td>
<td>The total number of punctuate operations called.</td>
</tr>
</tbody>
</table>

### 7.9.4. MBeans matching `kafka.streams:type=stream-[store-scope]-metrics,client-id=*,task-id=*,[store-scope]-id=*`  

State store metrics.

These metrics are collected when the `metrics.recording.level` configuration parameter is `debug`.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>all-latency-avg</td>
<td>The average all operation execution time in ns.</td>
</tr>
<tr>
<td>all-latency-max</td>
<td>The maximum all operation execution time in ns.</td>
</tr>
<tr>
<td>all-rate</td>
<td>The average all operation rate for this store.</td>
</tr>
<tr>
<td>all-total</td>
<td>The total number of all operation calls for this store.</td>
</tr>
<tr>
<td>delete-latency-avg</td>
<td>The average delete execution time in ns.</td>
</tr>
<tr>
<td>delete-latency-max</td>
<td>The maximum delete execution time in ns.</td>
</tr>
<tr>
<td>delete-rate</td>
<td>The average delete rate for this store.</td>
</tr>
<tr>
<td>delete-total</td>
<td>The total number of delete calls for this store.</td>
</tr>
<tr>
<td>flush-latency-avg</td>
<td>The average flush execution time in ns.</td>
</tr>
<tr>
<td>flush-latency-max</td>
<td>The maximum flush execution time in ns.</td>
</tr>
<tr>
<td>flush-rate</td>
<td>The average flush rate for this store.</td>
</tr>
<tr>
<td>flush-total</td>
<td>The total number of flush calls for this store.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>get-latency-avg</td>
<td>The average get execution time in ns.</td>
</tr>
<tr>
<td>get-latency-max</td>
<td>The maximum get execution time in ns.</td>
</tr>
<tr>
<td>get-rate</td>
<td>The average get rate for this store.</td>
</tr>
<tr>
<td>get-total</td>
<td>The total number of get calls for this store.</td>
</tr>
<tr>
<td>put-all-latency-avg</td>
<td>The average put-all execution time in ns.</td>
</tr>
<tr>
<td>put-all-latency-max</td>
<td>The maximum put-all execution time in ns.</td>
</tr>
<tr>
<td>put-all-rate</td>
<td>The average put-all rate for this store.</td>
</tr>
<tr>
<td>put-all-total</td>
<td>The total number of put-all calls for this store.</td>
</tr>
<tr>
<td>put-if-absent-latency-avg</td>
<td>The average put-if-absent execution time in ns.</td>
</tr>
<tr>
<td>put-if-absent-latency-max</td>
<td>The maximum put-if-absent execution time in ns.</td>
</tr>
<tr>
<td>put-if-absent-rate</td>
<td>The average put-if-absent rate for this store.</td>
</tr>
<tr>
<td>put-if-absent-total</td>
<td>The total number of put-if-absent calls for this store.</td>
</tr>
<tr>
<td>put-latency-avg</td>
<td>The average put execution time in ns.</td>
</tr>
<tr>
<td>put-latency-max</td>
<td>The maximum put execution time in ns.</td>
</tr>
<tr>
<td>put-rate</td>
<td>The average put rate for this store.</td>
</tr>
<tr>
<td>put-total</td>
<td>The total number of put calls for this store.</td>
</tr>
<tr>
<td>range-latency-avg</td>
<td>The average range execution time in ns.</td>
</tr>
<tr>
<td>range-latency-max</td>
<td>The maximum range execution time in ns.</td>
</tr>
<tr>
<td>range-rate</td>
<td>The average range rate for this store.</td>
</tr>
<tr>
<td>range-total</td>
<td>The total number of range calls for this store.</td>
</tr>
<tr>
<td>restore-latency-avg</td>
<td>The average restore execution time in ns.</td>
</tr>
<tr>
<td>restore-latency-max</td>
<td>The maximum restore execution time in ns.</td>
</tr>
<tr>
<td>restore-rate</td>
<td>The average restore rate for this store.</td>
</tr>
</tbody>
</table>
### Attribute Description

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>restore-total</td>
<td>The total number of restore calls for this store.</td>
</tr>
</tbody>
</table>

#### 7.9.5. MBeans matching kafka.streams:type=stream-record-cache-metrics,client-id=*,task-id=*,record-cache-id=*

Record cache metrics.

These metrics are collected when the `metrics.recording.level` configuration parameter is **debug**.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hitRatio-avg</td>
<td>The average cache hit ratio defined as the ratio of cache read hits over the total cache read requests.</td>
</tr>
<tr>
<td>hitRatio-max</td>
<td>The maximum cache hit ratio.</td>
</tr>
<tr>
<td>hitRatio-min</td>
<td>The minimum cache hit ratio.</td>
</tr>
</tbody>
</table>
CHAPTER 8. KAFKA CONNECT

Kafka Connect is a tool for streaming data between Apache Kafka and external systems. It provides a framework for moving large amounts of data while maintaining scalability and reliability. Kafka Connect is typically used to integrate Kafka with database, storage, and messaging systems that are external to your Kafka cluster.

Kafka Connect uses connector plug-ins that implement connectivity for different types of external systems. There are two types of connector plug-ins: sink and source. Sink connectors stream data from Kafka to external systems. Source connectors stream data from external systems into Kafka.

Kafka Connect can run in standalone or distributed modes.

Standalone mode
In standalone mode, Kafka Connect runs on a single node with user-defined configuration read from a properties file.

Distributed mode
In distributed mode, Kafka Connect runs across one or more worker nodes and the workloads are distributed among them. You manage connectors and their configuration using an HTTP REST interface.

8.1. KAFKA CONNECT IN STANDALONE MODE

In standalone mode, Kafka Connect runs as a single process, on a single node. You manage the configuration of standalone mode using properties files.

8.1.1. Configuring Kafka Connect in standalone mode

To configure Kafka Connect in standalone mode, edit the `config/connect-standalone.properties` configuration file. The following options are the most important.

**bootstrap.servers**
A list of Kafka broker addresses used as bootstrap connections to Kafka. For example, `kafka0.my-domain.com:9092,kafka1.my-domain.com:9092,kafka2.my-domain.com:9092`.

**key.converter**
The class used to convert message keys to and from Kafka format. For example, `org.apache.kafka.connect.json.JsonConverter`.

**value.converter**
The class used to convert message payloads to and from Kafka format. For example, `org.apache.kafka.connect.json.JsonConverter`.

**offset.storage.file.filename**
Specifies the file in which the offset data is stored.

An example configuration file is provided in the installation directory at `config/connect-standalone.properties`. For a complete list of all supported Kafka Connect configuration options, see [kafka-connect-configuration-parameters-str].

Connector plug-ins open client connections to the Kafka brokers using the bootstrap address. To configure these connections, use the standard Kafka producer and consumer configuration options prefixed by `producer` or `consumer`.

For more information on configuring Kafka producers and consumers, see:
8.1.2. Configuring connectors in Kafka Connect in standalone mode

You can configure connector plug-ins for Kafka Connect in standalone mode using properties files. Most configuration options are specific to each connector. The following options apply to all connectors:

**name**
- The name of the connector, which must be unique within the current Kafka Connect instance.

**connector.class**
- The class of the connector plug-in. For example, `org.apache.kafka.connect.file.FileStreamSinkConnector`.

**tasks.max**
- The maximum number of tasks that the specified connector can use. Tasks enable the connector to perform work in parallel. The connector might create fewer tasks than specified.

**key.converter**
- The class used to convert message keys to and from Kafka format. This overrides the default value set by the Kafka Connect configuration. For example, `org.apache.kafka.connect.json.JsonConverter`.

**value.converter**
- The class used to convert message payloads to and from Kafka format. This overrides the default value set by the Kafka Connect configuration. For example, `org.apache.kafka.connect.json.JsonConverter`.

Additionally, you must set at least one of the following options for sink connectors:

**topics**
- A comma-separated list of topics used as input.

**topics.regex**
- A Java regular expression of topics used as input.

For all other options, see the documentation for the available connectors.

AMQ Streams includes example connector configuration files – see `config/connect-file-sink.properties` and `config/connect-file-source.properties` in the AMQ Streams installation directory.

8.1.3. Running Kafka Connect in standalone mode

This procedure describes how to configure and run Kafka Connect in standalone mode.

**Prerequisites**
- An installed and running AMQ Streams cluster.

**Procedure**

1. Edit the `/opt/kafka/config/connect-standalone.properties` Kafka Connect configuration file and set `bootstrap.server` to point to your Kafka brokers. For example:
2. Start Kafka Connect with the configuration file and specify one or more connector configurations.

```bash
su - kafka
/opt/kafka/bin/connect-standalone.sh /opt/kafka/config/connect-standalone.properties
connector1.properties
[connector2.properties ...]
```

3. Verify that Kafka Connect is running.

```bash
jcmd | grep ConnectStandalone
```

Additional resources

- For more information on installing AMQ Streams, see Section 2.3, “Installing AMQ Streams”.
- For more information on configuring AMQ Streams, see Section 2.8, “Configuring AMQ Streams”.
- For a complete list of supported Kafka Connect configuration options, see Appendix F, Kafka Connect configuration parameters.

### 8.2. KAFKA CONNECT IN DISTRIBUTED MODE

In distributed mode, Kafka Connect runs across one or more worker nodes and the workloads are distributed among them. You manage connector plug-ins and their configuration using the HTTP REST interface.

#### 8.2.1. Configuring Kafka Connect in distributed mode

To configure Kafka Connect in distributed mode, edit the `config/connect-distributed.properties` configuration file. The following options are the most important.

- **bootstrap.servers**
  
  A list of Kafka broker addresses used as bootstrap connections to Kafka. For example, `kafka0.my-domain.com:9092,kafka1.my-domain.com:9092,kafka2.my-domain.com:9092`.

- **key.converter**
  
  The class used to convert message keys to and from Kafka format. For example, `org.apache.kafka.connect.json.JsonConverter`.

- **value.converter**
  
  The class used to convert message payloads to and from Kafka format. For example, `org.apache.kafka.connect.json.JsonConverter`.

- **group.id**
  
  The name of the distributed Kafka Connect cluster. This must be unique and must not conflict with another consumer group ID. The default value is `connect-cluster`.

- **config.storage.topic**
  
  The Kafka topic used to store connector configurations. The default value is `connect-configs`. 

---

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offset.storage.topic
- The Kafka topic used to store offsets. The default value is connect-offset.

status.storage.topic
- The Kafka topic used for worker node statuses. The default value is connect-status.

AMQ Streams includes an example configuration file for Kafka Connect in distributed mode – see config/connect-distributed.properties in the AMQ Streams installation directory.

For a complete list of all supported Kafka Connect configuration options, see Appendix F, Kafka Connect configuration parameters.

Connector plug-ins open client connections to the Kafka brokers using the bootstrap address. To configure these connections, use the standard Kafka producer and consumer configuration options prefixed by producer. or consumer..

For more information on configuring Kafka producers and consumers, see:
- Appendix D, Producer configuration parameters
- Appendix C, Consumer configuration parameters

8.2.2. Configuring connectors in distributed Kafka Connect

HTTP REST Interface
Connectors for distributed Kafka Connect are configured using HTTP REST interface. The REST interface listens on port 8083 by default. It supports following endpoints:

GET /connectors
- Return a list of existing connectors.

POST /connectors
- Create a connector. The request body has to be a JSON object with the connector configuration.

GET /connectors/<name>
- Get information about a specific connector.

GET /connectors/<name>/config
- Get configuration of a specific connector.

PUT /connectors/<name>/config
- Update the configuration of a specific connector.

GET /connectors/<name>/status
- Get the status of a specific connector.

PUT /connectors/<name>/pause
- Pause the connector and all its tasks. The connector will stop processing any messages.

PUT /connectors/<name>/resume
- Resume a paused connector.

POST /connectors/<name>/restart
- Restart a connector in case it has failed.

DELETE /connectors/<name>
- Delete a connector.
GET /connector-plugins

Get a list of all supported connector plugins.

Connector configuration

Most configuration options are connector specific and included in the documentation for the connectors. The following fields are common for all connectors.

name

Name of the connector. Must be unique within a given Kafka Connect instance.

class

Class of the connector plugin. For example, `org.apache.kafka.connect.file.FileStreamSinkConnector`.

tasks.max

The maximum number of tasks used by this connector. Tasks are used by the connector to parallelise its work. Connectors may create fewer tasks than specified.

key.converter

Class used to convert message keys to and from Kafka format. This overrides the default value set by the Kafka Connect configuration. For example, `org.apache.kafka.connect.json.JsonConverter`.

value.converter

Class used to convert message payloads to and from Kafka format. This overrides the default value set by the Kafka Connect configuration. For example, `org.apache.kafka.connect.json.JsonConverter`.

Additionally, one of the following options must be set for sink connectors:

topics

A comma-separated list of topics used as input.

topics.regex

A Java regular expression of topics used as input.

For all other options, see the documentation for the specific connector.

AMQ Streams includes example connector configuration files. They can be found in `config/connect-file-sink.properties` and `config/connect-file-source.properties` in the AMQ Streams installation directory.

8.2.3. Running distributed Kafka Connect

This procedure describes how to configure and run Kafka Connect in distributed mode.

Prerequisites

- An installed and running AMQ Streams cluster.

Running the cluster

1. Edit the `/opt/kafka/config/connect-distributed.properties` Kafka Connect configuration file on all Kafka Connect worker nodes.
   - Set the `bootstrap.server` option to point to your Kafka brokers.
• Set the `group.id` option.
• Set the `config.storage.topic` option.
• Set the `offset.storage.topic` option.
• Set the `status.storage.topic` option.

For example:

```
bootstrap.servers=kafka0.my-domain.com:9092,kafka1.my-domain.com:9092,kafka2.my-domain.com:9092
group.id=my-group-id
cfg.storage.topic=my-group-id-configs
offset.storage.topic=my-group-id-offsets
status.storage.topic=my-group-id-status
```

2. Start the Kafka Connect workers with the `/opt/kafka/config/connect-distributed.properties` configuration file on all Kafka Connect nodes.

```
su - kafka
/opt/kafka/bin/connect-distributed.sh /opt/kafka/config/connect-distributed.properties
```

3. Verify that Kafka Connect is running.

```
jcmd | grep ConnectDistributed
```

Additional resources

• For more information about installing AMQ Streams, see Section 2.3, “Installing AMQ Streams”.

• For more information about configuring AMQ Streams, see Section 2.8, “Configuring AMQ Streams”.

• For a complete list of supported Kafka Connect configuration options, see Appendix F, Kafka Connect configuration parameters.

### 8.2.4. Creating connectors

This procedure describes how to use the Kafka Connect REST API to create a connector plug-in for use with Kafka Connect in distributed mode.

**Prerequisites**

• A Kafka Connect installation running in distributed mode.

**Procedure**

1. Prepare a JSON payload with the connector configuration. For example:

```
{
  "name": "my-connector",
  "config": {
    "connector.class": "org.apache.kafka.connect.file.FileStreamSinkConnector",
    "tasks.max": "1",
  }
```


2. Send a POST request to `<KafkaConnectAddress>:8083/connectors` to create the connector. The following example uses `curl`:

```bash
curl -X POST -H "Content-Type: application/json" --data @sink-connector.json http://connect0.my-domain.com:8083/connectors
```

3. Verify that the connector was deployed by sending a GET request to `<KafkaConnectAddress>:8083/connectors`. The following example uses `curl`:

```bash
curl http://connect0.my-domain.com:8083/connectors
```

### 8.2.5. Deleting connectors

This procedure describes how to use the Kafka Connect REST API to delete a connector plug-in from Kafka Connect in distributed mode.

**Prerequisites**

- A Kafka Connect installation running in distributed mode.

**Deleting connectors**

1. Verify that the connector exists by sending a `GET` request to `<KafkaConnectAddress>:8083/connectors/<ConnectorName>`. The following example uses `curl`:

```bash
curl http://connect0.my-domain.com:8083/connectors
```

2. To delete the connector, send a `DELETE` request to `<KafkaConnectAddress>:8083/connectors`. The following example uses `curl`:

```bash
curl -X DELETE http://connect0.my-domain.com:8083/connectors/my-connector
```

3. Verify that the connector was deleted by sending a GET request to `<KafkaConnectAddress>:8083/connectors`. The following example uses `curl`:

```bash
curl http://connect0.my-domain.com:8083/connectors
```

### 8.3. CONNECTOR PLUG-INS

The following connector plug-ins are included with AMQ Streams.

**FileStreamSink** Reads data from Kafka topics and writes the data to a file.

**FileStreamSource** Reads data from a file and sends the data to Kafka topics.
You can add more connector plug-ins if needed. Kafka Connect searches for and runs additional connector plug-ins at startup. To define the path that kafka Connect searches for plug-ins, set the `plugin.path` configuration option:

```
plugin.path=/opt/kafka/connector-plugins,/opt/connectors
```

The `plugin.path` configuration option can contain a comma-separated list of paths.

When running Kafka Connect in distributed mode, plug-ins must be made available on all worker nodes.

### 8.4. ADDING CONNECTOR PLUGINS

This procedure shows you how to add additional connector plug-ins.

**Prerequisites**

- An installed and running AMQ Streams cluster.

**Procedure**

1. Create the `/opt/kafka/connector-plugins` directory.

   ```
su - kafka
mkdir /opt/kafka/connector-plugins
   ```

2. Edit the `/opt/kafka/config/connect-standalone.properties` or `/opt/kafka/config/connect-distributed.properties` Kafka Connect configuration file, and set the `plugin.path` option to `/opt/kafka/connector-plugins`. For example:

   ```
plugin.path=/opt/kafka/connector-plugins
   ```

3. Copy your connector plug-ins to `/opt/kafka/connector-plugins`.

4. Start or restart the Kafka Connect workers.

**Additional resources**

- For more information on installing AMQ Streams, see Section 2.3, “Installing AMQ Streams”.
- For more information on configuring AMQ Streams, see Section 2.8, “Configuring AMQ Streams”.
- For more information on running Kafka Connect in standalone mode, see Section 8.1.3, “Running Kafka Connect in standalone mode”.
- For more information on running Kafka Connect in distributed mode, see Section 8.2.3, “Running distributed Kafka Connect”.
- For a complete list of supported Kafka Connect configuration options, see Appendix F, Kafka Connect configuration parameters.
CHAPTER 9. KAFKA CLIENTS

The `kafka-clients` JAR file contains the Kafka Producer and Consumer APIs together with the Kafka AdminClient API.

- The Producer API allows applications to send data to a Kafka broker.
- The Consumer API allows applications to consume data from a Kafka broker.
- The AdminClient API provides functionality for managing Kafka clusters, including topics, brokers, and other components.

9.1. ADDING KAFKA CLIENTS AS A DEPENDENCY TO YOUR MAVEN PROJECT

This procedure shows you how to add the AMQ Streams Java clients as a dependency to your Maven project.

Prerequisites

- A Maven project with an existing `pom.xml`.

Procedure

1. Add the Red Hat Maven repository to the `<repositories>` section of your `pom.xml` file.

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

2. Add the clients to the `<dependencies>` section of your `pom.xml` file.

```xml
<dependencies>
  ...  
</dependencies>
```
3. Build your Maven project.
CHAPTER 10. KAFKA STREAMS API OVERVIEW

The Kafka Streams API allows applications to receive data from one or more input streams, execute complex operations like mapping, filtering or joining, and write the results into one or more output streams. It is part of the kafka-streams JAR package that is available in the Red Hat Maven repository.

10.1. ADDING THE KAFKA STREAMS API AS A DEPENDENCY TO YOUR MAVEN PROJECT

This procedure shows you how to add the AMQ Streams Java clients as a dependency to your Maven project.

Prerequisites

- A Maven project with an existing pom.xml.

Procedure

1. Add the Red Hat Maven repository to the <repositories> section of your pom.xml file.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
    http://maven.apache.org/xsd/maven-4.0.0.xsd">
    <!-- ... -->
    <repositories>
        <repository>
            <id>redhat-maven</id>
            <url>https://maven.repository.redhat.com/ga/</url>
        </repository>
    </repositories>
    <!-- ... -->
</project>
```

2. Add kafka-streams to the <dependencies> section of your pom.xml file.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
    http://maven.apache.org/xsd/maven-4.0.0.xsd">
    <!-- ... -->
    <dependencies>
        <dependency>
            <groupId>org.apache.kafka</groupId>
            <artifactId>kafka-streams</artifactId>
            <version>2.3.0.redhat-00003</version>
        </dependency>
    </dependencies>
    <!-- ... -->
</project>
```
3. Build your Maven project.
CHAPTER 11. KAFKA BRIDGE

This chapter provides an overview of the AMQ Streams Kafka Bridge on Red Hat Enterprise Linux and helps you get started using its REST API to interact with AMQ Streams. To try out the Kafka Bridge in your local environment, see the Section 11.2, “Kafka Bridge quickstart” later in this chapter.

Additional resources

- To view the API documentation, including example requests and responses, see the Kafka Bridge API reference.

11.1. KAFKA BRIDGE OVERVIEW

The AMQ Streams Kafka Bridge provides an API for integrating HTTP-based clients with a Kafka cluster running on Red Hat Enterprise Linux. The API enables such clients to produce and consume messages without the requirement to use the native Kafka protocol.

The API has two main resources—consumers and topics—that are exposed and made accessible through endpoints to interact with consumers and producers in your Kafka cluster. The resources relate only to the Kafka Bridge, not the consumers and producers connected directly to Kafka.

You can:

- Send messages to a topic.
- Create and delete consumers.
- Subscribe consumers to topics, so that they start receiving messages from those topics.
- Retrieve a list of the topics to which a consumer is subscribed.
- Unsubscribe consumers from topics.
- Assign partitions to consumers.
- Retrieve messages from topics.
- Commit a list of consumer offsets.
- Seek on a partition, so that a consumer starts receiving messages from the first or last offset position, or a given offset position.

Similar to an AMQ Streams installation, you can download the Kafka Bridge files for installation on Red Hat Enterprise Linux. See Section 11.1.4, “Downloading a Kafka Bridge archive”.

For more information on configuring the host and port for the KafkaBridge resource, see Section 11.1.5, “Configuring Kafka Bridge properties”.

11.1.1. Requests to the Kafka Bridge

11.1.1.1. Authentication and encryption

Authentication and encryption between HTTP clients and the Kafka Bridge is not yet supported. This means that requests sent from clients to the Kafka Bridge are:
• Not encrypted, and must use HTTP rather than HTTPS
• Sent without authentication

You can configure **TLS or SASL-based authentication** between the Kafka Bridge and your Kafka cluster.

You configure the Kafka Bridge for authentication through its **properties file**.

11.1.1.2. Data formats and headers

Specify data formats and HTTP headers to ensure valid requests are submitted to the Kafka Bridge.

API request and response bodies are always encoded as JSON.

11.1.1.2.1. Content Type headers

A **Content-Type** header must be submitted for all requests (apart from the exception described below).

Consumer operations (**/consumers** endpoints) and producer operations (**/topics** endpoints) require different **Content-Type** headers.

**Content-Type headers for consumer operations**

Regardless of the embedded data format, **POST** requests for consumer operations must provide the following **Content-Type** header if the request body contains data:

```
Content-Type: application/vnd.kafka.v2+json
```

Do not send a **Content-Type** header if the **POST** request body is empty, or the request will fail.

**Content-Type headers for producer operations**

When performing producer operations, **POST** requests must provide the following **Content-Type** header specifying the desired embedded data format, either **json** or **binary**, as shown in the following table.

<table>
<thead>
<tr>
<th>Embedded data format</th>
<th>Content-Type header</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>JSON</strong></td>
<td><strong>Content-Type:</strong> application/vnd.kafka.json.v2+json</td>
</tr>
<tr>
<td><strong>Binary</strong></td>
<td><strong>Content-Type:</strong> application/vnd.kafka.binary.v2+json</td>
</tr>
</tbody>
</table>

You set the embedded data format when creating a consumer using the **consumers/groupid** endpoint — for more information, see the next section.

The **Content-Type** must not be set if the **POST** request has an empty body. An empty body can be used to create a consumer with the default values.

11.1.1.2.2. Embedded data format
The embedded data format is the format of the Kafka messages that are transmitted, over HTTP, from a producer to a consumer using the Kafka Bridge. Two embedded data formats are supported: JSON or binary.

When creating a consumer using the `/consumers/groupid` endpoint, the **POST** request body must specify an embedded data format of either JSON or binary. This is specified in the **format** field in the request body, for example:

```
{
 "name": "my-consumer",
 "format": "binary",
...
}
```

A binary embedded data format.

If an embedded data format for the consumer is not specified, then a binary format is set.

The embedded data format specified when creating a consumer must match the data format of the Kafka messages it will consume.

If you choose to specify a binary embedded data format, subsequent producer requests must provide the binary data in the request body as Base64-encoded strings. For example, when sending messages by making **POST** requests to the `/topics/topicname` endpoint, the **value** must be encoded in Base64:

```
{
 "records": [
 {  
  "key": "my-key",
  "value": "ZWR3YXJkdGhldGhyZWVsZWRjYXQ="
 },
 ]
}
```

Producer requests must also provide a **Content-Type** header that corresponds to the embedded data format, for example, **Content-Type: application/vnd.kafka.binary.v2+json**.

**11.1.1.2.3. Accept headers**

After creating a consumer, all subsequent GET requests must provide an **Accept** header in the following format:

```
Accept: application/vnd.kafka.embedded-data-format.v2+json
```

The **embedded-data-format** is either **json** or **binary**.

For example, when retrieving records for a subscribed consumer using an embedded data format of JSON, include this Accept header:

```
Accept: application/vnd.kafka.json.v2+json
```

**11.1.2. Configuring loggers for the Kafka Bridge**
The AMQ Streams Kafka bridge allows you to set a different log level for each operation that is defined by the related OpenAPI specification.

Each operation has a corresponding API endpoint through which the bridge receives requests from HTTP clients. You can change the log level on each endpoint to produce more or less fine-grained logging information about the incoming and outgoing HTTP requests.

Loggers are defined in the `log4j.properties` file, which has the following default configuration for healthy and ready endpoints:

```properties
log4j.logger.http.openapi.operation.healthy=WARN, out
log4j.additivity.http.openapi.operation.healthy=false
log4j.logger.http.openapi.operation.ready=WARN, out
log4j.additivity.http.openapi.operation.ready=false
```

The log level of all other operations is set to `INFO` by default. Loggers are formatted as follows:

```properties
log4j.logger.http.openapi.operation.<operation-id>
```

Where `<operation-id>` is the identifier of the specific operation. Following is the list of operations defined by the OpenAPI specification:

- createConsumer
- deleteConsumer
- subscribe
- unsubscribe
- poll
- assign
- commit
- send
- sendToPartition
- seekToBeginning
- seekToEnd
- seek
- healthy
- ready
- openapi

11.1.3. Kafka Bridge API resources

For the full list of REST API endpoints and descriptions, including example requests and responses, see the Kafka Bridge API reference.
11.1.4. Downloading a Kafka Bridge archive

A zipped distribution of the AMQ Streams Kafka Bridge is available for download from the Red Hat website.

Procedure

- Download the latest version of the Red Hat AMQ Streams Kafka Bridge archive from the Customer Portal.

11.1.5. Configuring Kafka Bridge properties

This procedure describes how to configure the properties used by the AMQ Streams Kafka Bridge.

You configure the Kafka Bridge, as any other Kafka client, using appropriate prefixes for Kafka-related properties.

- **kafka.** for general configuration that applies to producers and consumers, such as server connection and security.
- **kafka.consumer.** for consumer-specific configuration passed only to the consumer.
- **kafka.producer.** for producer-specific configuration passed only to the producer.

Prerequisites

- AMQ Streams is installed on the host
- The Kafka Bridge installation archive is downloaded

Procedure

1. Edit the `application.properties` file provided with the AMQ Streams Kafka Bridge installation archive.
   Use the properties file to specify Kafka and HTTP-related properties.

   a. Configure standard Kafka-related properties, including properties specific to the Kafka consumers and producers.
      Use:
      
      - **kafka.bootstrap.servers** to define the host/port connections to the Kafka cluster
      - **kafka.producer.acks** to provide acknowledgments to the HTTP client
      - **kafka.consumer.auto.offset.reset** to determine how to manage reset of the offset in Kafka
      
      For more information on configuration of Kafka properties, see the Apache Kafka website

   b. Configure HTTP-related properties to enable HTTP access to the Kafka cluster.

      ```
      http.enabled=true
      http.host=0.0.0.0
      http.port=8080
      ```
11.1.6. Installing the Kafka Bridge

Follow this procedure to install the AMQ Streams Kafka Bridge on Red Hat Enterprise Linux.

Prerequisites

- AMQ Streams is installed on the host
- The Kafka Bridge installation archive is downloaded
- The Kafka Bridge configuration properties are set

Procedure

1. If you have not already done so, unzip the AMQ Streams Kafka Bridge installation archive to any directory.

2. Run the Kafka Bridge script using the configuration properties as a parameter:
   For example:
   ```bash
   /bin/kafka_bridge_run.sh --config-file=../configfile.properties
   ```

3. Check to see that the installation was successful in the log.

   HTTP-Kafka Bridge started and listening on port 8080
   HTTP-Kafka Bridge bootstrap servers localhost:9092

11.2. KAFKA BRIDGE QUICKSTART

Use this quickstart to try out the AMQ Streams Kafka Bridge on Red Hat Enterprise Linux. You will learn how to:

- Install the Kafka Bridge
- Produce messages to topics and partitions in your Kafka cluster
- Create a Kafka Bridge consumer
- Perform basic consumer operations, such as subscribing the consumer to topics and retrieving the messages that you produced

In this quickstart, HTTP requests are formatted as curl commands that you can copy and paste to your terminal.

Ensure you have the prerequisites and then follow the tasks in the order provided in this chapter.

About data formats

In this quickstart, you will produce and consume messages in JSON format, not binary. For more information on the data formats and HTTP headers used in the example requests, see Section 11.1.1, “Requests to the Kafka Bridge”.

Prerequisites for the quickstart

- AMQ Streams is installed on the host
11.2.1. Deploying the Kafka Bridge locally

Deploy an instance of the AMQ Streams Kafka Bridge to the host. Use the application.properties file provided with the installation archive to apply the default configuration settings.

Procedure

1. Open the application.properties file and check that the default HTTP related settings are defined:

   ```
   http.enabled=true
   http.host=0.0.0.0
   http.port=8080
   ```

   This configures the Kafka Bridge to listen for requests on port 8080.

2. Run the Kafka Bridge script using the configuration properties as a parameter:

   ```
   ./bin/kafka_bridge_run.sh --config-file=<path>/application.properties
   ```

What to do next

- Produce messages to topics and partitions.

11.2.2. Producing messages to topics and partitions

Produce messages to a topic in JSON format by using the topics endpoint.

You can specify destination partitions for messages in the request body, as shown below. The partitions endpoint provides an alternative method for specifying a single destination partition for all messages as a path parameter.

Procedure

1. Create a Kafka topic using the kafka-topics.sh utility:

   ```
   bin/kafka-topics.sh --zookeeper localhost:2181 --create --topic bridge-quickstart-topic --partitions 3 --replication-factor 1 --config retention.ms=7200000 --config segment.bytes=1073741824
   ```

   Specify three partitions.

2. Verify that the topic was created:

   ```
   bin/kafka-topics.sh --zookeeper localhost:2181 --describe --topic bridge-quickstart-topic
   ```

3. Using the Kafka Bridge, produce three messages to the topic you created:

   ```
   curl -X POST \
   ```
sales-lead-0001 is sent to a partition based on the hash of the key.

sales-lead-0002 is sent directly to partition 2.

sales-lead-0003 is sent to a partition in the bridge-quickstart-topic topic using a round-robin method.

4. If the request is successful, the Kafka Bridge returns an offsets array, along with a 200 (OK) code and a content-type header of application/vnd.kafka.v2+json. For each message, the offsets array describes:

- The partition that the message was sent to
- The current message offset of the partition

Example response

```
http://localhost:8080/topics/bridge-quickstart-topic \
-H 'content-type: application/vnd.kafka.v2+json' \
-d '{
"records": [
  {
   "key": "my-key",
   "value": "sales-lead-0001"
  },
  {
   "value": "sales-lead-0002",
   "partition": 2
  },
  {"value": "sales-lead-0003"
   }
  ]
}'
```

What to do next

After producing messages to topics and partitions, create a Kafka Bridge consumer.
11.2.3. Creating a Kafka Bridge consumer

Before you can perform any consumer operations on the Kafka cluster, you must first create a consumer by using the `consumers` endpoint. The consumer is referred to as a Kafka Bridge consumer.

Procedure

1. Create a Kafka Bridge consumer in a new consumer group named `bridge-quickstart-consumer-group`:

   curl -X POST http://localhost:8080/consumers/bridge-quickstart-consumer-group
   -H 'content-type: application/vnd.kafka.v2+json'
   -d '{
     "name": "bridge-quickstart-consumer",
     "auto.offset.reset": "earliest",
     "format": "json",
     "enable.auto.commit": false,
     "fetch.min.bytes": 512,
     "consumer.request.timeout.ms": 30000
   }'

   - The consumer is named `bridge-quickstart-consumer` and the embedded data format is set as `json`.
   - The consumer will not commit offsets to the log automatically because the `enable.auto.commit` setting is `false`. You will commit the offsets manually later in this quickstart.

   **NOTE**

   The Kafka Bridge generates a random consumer name if you do not specify a consumer name in the request body.

If the request is successful, the Kafka Bridge returns the consumer ID (`instance_id`) and base URL (`base_uri`) in the response body, along with a 200 (OK) code.

Example response

```json
{
  "instance_id": "bridge-quickstart-consumer",
  "base_uri": "http://<bridge-name>-bridge-service:8080/consumers/bridge-quickstart-consumer-group/instances/bridge-quickstart-consumer"
}
```

2. Copy the base URL (`base_uri`) to use in the other consumer operations in this quickstart.

**What to do next**
Now that you have created a Kafka Bridge consumer, you can subscribe it to topics.

Additional resources

- POST /consumers/{groupid} in the API reference documentation.

11.2.4. Subscribing a Kafka Bridge consumer to topics

Subscribe the Kafka Bridge consumer to one or more topics by using the subscription endpoint. Once subscribed, the consumer starts receiving all messages that are produced to the topic.

Procedure

- Subscribe the consumer to the bridge-quickstart-topic topic that you created earlier, in Producing messages to topics and partitions:

```bash
```

The topics array can contain a single topic (as shown above) or multiple topics. If you want to subscribe the consumer to multiple topics that match a regular expression, you can use the topic_pattern string instead of the topics array.

If the request is successful, the Kafka Bridge returns a 204 No Content code only.

What to do next

After subscribing a Kafka Bridge consumer to topics, you can retrieve messages from the consumer.

Additional resources

- POST /consumers/{groupid}/instances/{name}/subscription in the API reference documentation.

11.2.5. Retrieving the latest messages from a Kafka Bridge consumer

Retrieve the latest messages from the Kafka Bridge consumer by requesting data from the records endpoint. In production, HTTP clients can call this endpoint repeatedly (in a loop).

Procedure

1. Produce additional messages to the Kafka Bridge consumer, as described in Producing messages to topics and partitions.

2. Submit a GET request to the records endpoint:

```bash
```
After creating and subscribing to a Kafka Bridge consumer, a first GET request will return an empty response because the poll operation triggers a rebalancing process to assign partitions.

3. Repeat step two to retrieve messages from the Kafka Bridge consumer. The Kafka Bridge returns an array of messages — describing the topic name, key, value, partition, and offset — in the response body, along with a 200 (OK) code. Messages are retrieved from the latest offset by default.

```plaintext
HTTP/1.1 200 OK
content-type: application/vnd.kafka.json.v2+json
#
[
  {
    "topic":"bridge-quickstart-topic",
    "key":"my-key",
    "value":"sales-lead-0001",
    "partition":0,
    "offset":0
  },
  {
    "topic":"bridge-quickstart-topic",
    "key":null,
    "value":"sales-lead-0003",
    "partition":0,
    "offset":1
  }
]
#...
```

**NOTE**

If an empty response is returned, produce more records to the consumer as described in Producing messages to topics and partitions, and then try retrieving messages again.

**What to do next**

After retrieving messages from a Kafka Bridge consumer, try committing offsets to the log.

**Additional resources**

- GET /consumers/{groupid}/instances/{name}/records in the API reference documentation.

**11.2.6. Commiting offsets to the log**

Use the offsets endpoint to manually commit offsets to the log for all messages received by the Kafka Bridge consumer. This is required because the Kafka Bridge consumer that you created earlier, in Creating a Kafka Bridge consumer, was configured with the enable.auto.commit setting as false.

**Procedure**

- Commit offsets to the log for the bridge-quickstart-consumer:
Because no request body is submitted, offsets are committed for all the records that have been received by the consumer. Alternatively, the request body can contain an array (OffsetCommitSeekList) that specifies the topics and partitions that you want to commit offsets for.

If the request is successful, the Kafka Bridge returns a 204 No Content code only.

What to do next

After committing offsets to the log, try out the endpoints for seeking to offsets.

Additional resources

- POST /consumers/{groupid}/instances/{name}/offsets in the API reference documentation.

11.2.7. Seeking to offsets for a partition

Use the positions endpoints to configure the Kafka Bridge consumer to retrieve messages for a partition from a specific offset, and then from the latest offset. This is referred to in Apache Kafka as a seek operation.

Procedure

1. Seek to a specific offset for partition 0 of the quickstart-bridge-topic topic:

```bash
curl -X POST http://localhost:8080/consumers/bridge-quickstart-consumer-group/instances/bridge-quickstart-consumer/positions \
    -H 'content-type: application/vnd.kafka-v2+json' \
    -d '{
        "offsets": [
            {
                "topic": "bridge-quickstart-topic",
                "partition": 0,
                "offset": 2
            }
        ]
    }
```

If the request is successful, the Kafka Bridge returns a 204 No Content code only.

2. Submit a GET request to the records endpoint:

```bash
curl -X GET http://localhost:8080/consumers/bridge-quickstart-consumer-group/instances/bridge-quickstart-consumer/records \
    -H 'accept: application/vnd.kafka.json.v2+json'
```

The Kafka Bridge returns messages from the offset that you sought to.

3. Restore the default message retrieval behavior by seeking to the last offset for the same partition. This time, use the positions/end endpoint.

```bash
```

The Kafka Bridge returns the latest offset for the partition.
If the request is successful, the Kafka Bridge returns another **204 No Content** code.

**NOTE**

You can also use the `positions/beginning` endpoint to seek to the first offset for one or more partitions.

### What to do next

In this quickstart, you have used the AMQ Streams Kafka Bridge to perform several common operations on a Kafka cluster. You can now **delete the Kafka Bridge consumer** that you created earlier.

**Additional resources**

- POST `/consumers/{groupid}/instances/{name}/positions` in the API reference documentation.
- POST `/consumers/{groupid}/instances/{name}/positions/beginning` in the API reference documentation.
- POST `/consumers/{groupid}/instances/{name}/positions/end` in the API reference documentation.

#### 11.2.8. Deleting a Kafka Bridge consumer

Finally, delete the Kafka Bridge consumer that you used throughout this quickstart.

**Procedure**

- Delete the Kafka Bridge consumer by sending a **DELETE** request to the `instances` endpoint.

```bash
```

If the request is successful, the Kafka Bridge returns a **204 No Content** code only.

**Additional resources**

- **DELETE /consumers/{groupid}/instances/{name}** in the API reference documentation.
Kafka Exporter is an open source project to enhance monitoring of Apache Kafka brokers and clients. Kafka Exporter is provided with AMQ Streams for deployment with a Kafka cluster to extract additional metrics data from Kafka brokers related to offsets, consumer groups, consumer lag, and topics. The metrics data is used, for example, to help identify slow consumers. Lag data is exposed as Prometheus metrics, which can then be presented in Grafana for analysis. If you are already using Prometheus and Grafana for monitoring of built-in Kafka metrics, you can configure Prometheus to also scrape the Kafka Exporter Prometheus endpoint.

Additional resources
Kafka exposes metrics through JMX, which can then be exported as Prometheus metrics.

- Chapter 7, Monitoring your cluster using JMX

12.1. CONSUMER LAG

Consumer lag indicates the difference in the rate of production and consumption of messages. Specifically, consumer lag for a given consumer group indicates the delay between the last message in the partition and the message being currently picked up by that consumer. The lag reflects the position of the consumer offset in relation to the end of the partition log.

This difference is sometimes referred to as the delta between the producer offset and consumer offset, the read and write positions in the Kafka broker topic partitions.

Suppose a topic streams 100 messages a second. A lag of 1000 messages between the producer offset (the topic partition head) and the last offset the consumer has read means a 10-second delay.

The importance of monitoring consumer lag

For applications that rely on the processing of (near) real-time data, it is critical to monitor consumer lag to check that it does not become too big. The greater the lag becomes, the further the process moves from the real-time processing objective.

Consumer lag, for example, might be a result of consuming too much old data that has not been purged, or through unplanned shutdowns.

Reducing consumer lag

Typical actions to reduce lag include:

- Scaling-up consumer groups by adding new consumers
- Increasing the retention time for a message to remain in a topic
- Adding more disk capacity to increase the message buffer

Actions to reduce consumer lag depend on the underlying infrastructure and the use cases AMQ Streams is supporting. For instance, a lagging consumer is less likely to benefit from the broker being able to service a fetch request from its disk cache. And in certain cases, it might be acceptable to automatically drop messages until a consumer has caught up.
12.2. KAFKA EXPORTER ALERTING RULE EXAMPLES

The sample alert notification rules specific to Kafka Exporter are as follows:

**UnderReplicatedPartition**

An alert to warn that a topic is under-replicated and the broker is not replicating enough partitions. The default configuration is for an alert if there are one or more under-replicated partitions for a topic. The alert might signify that a Kafka instance is down or the Kafka cluster is overloaded. A planned restart of the Kafka broker may be required to restart the replication process.

**TooLargeConsumerGroupLag**

An alert to warn that the lag on a consumer group is too large for a specific topic partition. The default configuration is 1000 records. A large lag might indicate that consumers are too slow and are falling behind the producers.

**NoMessageForTooLong**

An alert to warn that a topic has not received messages for a period of time. The default configuration for the time period is 10 minutes. The delay might be a result of a configuration issue preventing a producer from publishing messages to the topic.

You can adapt alerting rules according to your specific needs.

**Additional resources**

For more information about setting up alerting rules, see Configuration in the Prometheus documentation.

12.3. KAFKA EXPORTER METRICS

Lag information is exposed by Kafka Exporter as Prometheus metrics for presentation in Grafana.

Kafka Exporter exposes metrics data for brokers, topics, and consumer groups.

The data extracted is described here.

**Table 12.1. Broker metrics output**

<table>
<thead>
<tr>
<th>Name</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>kafka_brokers</td>
<td>Number of brokers in the Kafka cluster</td>
</tr>
</tbody>
</table>

**Table 12.2. Topic metrics output**

<table>
<thead>
<tr>
<th>Name</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>kafka_topic_partitions</td>
<td>Number of partitions for a topic</td>
</tr>
<tr>
<td>kafka_topic_partition_current_offset</td>
<td>Current topic partition offset for a broker</td>
</tr>
<tr>
<td>kafka_topic_partition_oldest_offset</td>
<td>Oldest topic partition offset for a broker</td>
</tr>
<tr>
<td>kafka_topic_partition_in_sync_replica</td>
<td>Number of in-sync replicas for a topic partition</td>
</tr>
</tbody>
</table>
Table 12.3. Consumer group metrics output

<table>
<thead>
<tr>
<th>Name</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>kafka_consumergroup_current_offset</td>
<td>Current topic partition offset for a consumer group</td>
</tr>
<tr>
<td>kafka_consumergroup_lag</td>
<td>Current approximate lag for a consumer group at a topic partition</td>
</tr>
</tbody>
</table>

12.4. RUNNING KAFKA EXPORTER

Kafka Exporter is provided with the download archive used for [Installing AMQ Streams](#).

You can run it to expose Prometheus metrics for presentation in a Grafana dashboard.

**Prerequisites**

- AMQ Streams is installed on the host

This procedure assumes you already have access to a Grafana user interface and Prometheus is deployed and added as a data source.

**Procedure**

1. Run the Kafka Exporter script using appropriate configuration parameter values.

   ```bash
   ./bin/kafka_exporter --kafka.server=<kafka-bootstrap-address>:9092 --kafka.version=2.3.0 -- <my-other-parameters>
   ```

   The parameters require a double-hyphen convention, such as `--kafka.server`.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>kafka.server</td>
<td>Host/post address of the Kafka server.</td>
<td>kafka:9092</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
<td>Default</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>kafka.version</td>
<td>Kafka broker version.</td>
<td>1.0.0</td>
</tr>
<tr>
<td>group.filter</td>
<td>A regular expression to specify the consumer groups to include in the metrics.</td>
<td>.* (all)</td>
</tr>
<tr>
<td>topic.filter</td>
<td>A regular expression to specify the topics to include in the metrics.</td>
<td>.* (all)</td>
</tr>
<tr>
<td>sasl.&lt;parameter&gt;</td>
<td>Parameters to enable and connect to the Kafka cluster using SASL/PLAIN authentication, with user name and password.</td>
<td>false</td>
</tr>
<tr>
<td>tls.&lt;parameter&gt;</td>
<td>Parameters to enable connect to the Kafka cluster using TLS authentication, with optional certificate and key.</td>
<td>false</td>
</tr>
<tr>
<td>web.listen-address</td>
<td>Port address to expose the metrics.</td>
<td>:9308</td>
</tr>
<tr>
<td>web.telemetry-path</td>
<td>Path for the exposed metrics.</td>
<td>/metrics</td>
</tr>
<tr>
<td>log.level</td>
<td>Logging configuration, to log messages with a given severity (debug, info, warn, error, fatal) or above.</td>
<td>info</td>
</tr>
<tr>
<td>log.enable-sarama</td>
<td>Boolean to enable Sarama logging, a Go client library used by the Kafka Exporter.</td>
<td>false</td>
</tr>
</tbody>
</table>

You can use `kafka_exporter --help` for information on the properties.

2. Configure Prometheus to monitor the Kafka Exporter metrics.  
   For more information on configuring Prometheus, see the Prometheus documentation.

3. Enable Grafana to present the Kafka Exporter metrics data exposed by Prometheus.  
   For more information, see Presenting Kafka Exporter metrics in Grafana.

### 12.5. PRESENTING KAFKA EXPORTER METRICS IN GRAFANA

Using Kafka Exporter Prometheus metrics as a data source, you can create a dashboard of Grafana charts.

For example, from the metrics you can create the following Grafana charts:
- Message in per second (from topics)
- Message in per minute (from topics)
- Lag by consumer group
- Messages consumed per minute (by consumer groups)

When metrics data has been collected for some time, the Kafka Exporter charts are populated.

Use the Grafana charts to analyze lag and to check if actions to reduce lag are having an impact on an affected consumer group. If, for example, Kafka brokers are adjusted to reduce lag, the dashboard will show the *Lag by consumer group* chart going down and the *Messages consumed per minute* chart going up.

**Additional resources**

- [Example dashboard for Kafka Exporter](#)
- [Grafana documentation](#)
CHAPTER 13. AMQ STREAMS AND KAFKA UPGRADES

AMQ Streams can be upgraded with no cluster downtime. Each version of AMQ Streams supports one or more versions of Apache Kafka: you can upgrade to a higher Kafka version as long as it is supported by your version of AMQ Streams. In some cases, you can also downgrade to a lower supported Kafka version.

Newer versions of AMQ Streams may support newer versions of Kafka, but you need to upgrade AMQ Streams before you can upgrade to a higher supported Kafka version.

13.1. UPGRADE PREREQUISITES

Before you begin the upgrade process, make sure that:

- AMQ Streams is installed. For instructions, see Chapter 2, Getting started.
- You are familiar with any upgrade changes described in the AMQ Streams 1.3 on Red Hat Enterprise Linux Release Notes.

13.2. UPGRADE PROCESS

Upgrading AMQ Streams is a two-stage process. To upgrade brokers and clients without downtime, you must complete the upgrade procedures in the following order:

1. Upgrade to the latest AMQ Streams version.
   - Upgrading to AMQ Streams 1.3

2. Upgrade all Kafka brokers and client applications to the latest Kafka version
   - Upgrading Kafka

13.3. KAFKA VERSIONS

AMQ Streams is based on a specific version of Apache Kafka.

<table>
<thead>
<tr>
<th>AMQ Streams version</th>
<th>Kafka version</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3</td>
<td>2.3.0</td>
</tr>
</tbody>
</table>

Kafka’s log message format version and inter-broker protocol version specify the version of the format of messages appended to broker logs and the version of protocol used between brokers in a cluster. As a result, the upgrade process involves making configuration changes to existing Kafka brokers and code changes to client applications (consumers and producers) to ensure the correct versions are used.

The following table shows the differences between Kafka versions:

<table>
<thead>
<tr>
<th>Kafka version</th>
<th>Interbroker protocol version</th>
<th>Log message format version</th>
<th>Zookeeper version</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.1</td>
<td>2.2</td>
<td>2.2</td>
<td>3.4.14</td>
</tr>
</tbody>
</table>
Although Kafka versions may use the same version of Zookeeper, it is recommended that you update your Zookeeper cluster to use the newest Zookeeper binaries before proceeding with the main AMQ Streams upgrade.

**Message format version**

When a producer sends a message to a Kafka broker, the message is encoded using a specific format. The format can change between Kafka releases, so messages include a version identifying which version of the format they were encoded with. You can configure a Kafka broker to convert messages from newer format versions to a given older format version before the broker appends the message to the log.

In Kafka, there are two different methods for setting the message format version:

- The `message.format.version` property is set on topics.
- The `log.message.format.version` property is set on Kafka brokers.

The default value of `message.format.version` for a topic is defined by the `log.message.format.version` that is set on the Kafka broker. You can manually set the `message.format.version` of a topic by modifying its topic configuration.

The upgrade tasks in this section assume that the message format version is defined at the broker level by the `log.message.format.version`.

### 13.4. UPGRADING TO AMQ STREAMS 1.3

The steps to upgrade your deployment to use AMQ Streams 1.3 are outlined in this section.

The availability of Kafka clusters managed by AMQ Streams is not affected by the upgrade operation.

**NOTE**

Refer to the documentation supporting a specific version of AMQ Streams for information on how to upgrade to that version.

### 13.4.1. Upgrading Zookeeper

This procedure describes how to upgrade Zookeeper on a host machine.

**Prerequisites**

- You are logged in to Red Hat Enterprise Linux as the *kafka* user.

**Procedure**

For each Kafka broker in your AMQ Streams cluster and one at a time:
1. Download the AMQ Streams archive for this release from the Customer Portal.

   **NOTE**
   
   If prompted, log in to your Red Hat account.

2. On the command line, create a temporary directory and extract the contents of the `amq-streams-x.y.z-bin.zip` file:

   ```
   mkdir /tmp/kafka
   unzip amq-streams-x.y.z-bin.zip -d /tmp/kafka
   ```

3. Delete the `libs`, `bin`, and `docs` directories from your existing installation:

   ```
   rm -rf /opt/kafka/libs /opt/kafka/bin /opt/kafka/docs
   ```

4. Copy the `libs`, `bin`, and `docs` directories from the temporary directory:

   ```
   cp -r /tmp/kafka/kafka_y.y-x.x.x/libs /opt/kafka/
   cp -r /tmp/kafka/kafka_y.y-x.x.x/bin /opt/kafka/
   cp -r /tmp/kafka/kafka_y.y-x.x.x/docs /opt/kafka/
   ```

5. Delete the temporary directory:

   ```
   rm -rf /tmp/kafka
   ```

6. Restart Zookeeper:

   ```
   /opt/kafka/bin/zookeeper-server-start.sh -daemon /opt/kafka/config/zookeeper.properties
   ```

### 13.4.2. Upgrading Kafka brokers

This procedure describes how to upgrade Kafka brokers on a host machine.

**Prerequisites**

- You are logged in to Red Hat Enterprise Linux as the `kafka` user.

**Procedure**

For each Kafka broker in your AMQ Streams cluster and one at a time:

1. Download the AMQ Streams archive from the Customer Portal.

   **NOTE**
   
   If prompted, log in to your Red Hat account.

2. On the command line, create a temporary directory and extract the contents of the `amq-streams-x.y.z-bin.zip` file.
3. Delete the **libs**, **bin**, and **docs** directories from your existing installation:

   ```bash
   rm -rf /opt/kafka/libs /opt/kafka/bin /opt/kafka/docs
   ```

4. Copy the **libs**, **bin**, and **docs** directories from the temporary directory:

   ```bash
   cp -r /tmp/kafka/kafka_y.y-x.x.x/libs /opt/kafka/
   cp -r /tmp/kafka/kafka_y.y-x.x.x/bin /opt/kafka/
   cp -r /tmp/kafka/kafka_y.y-x.x.x/docs /opt/kafka/
   ```

5. Delete the temporary directory.

   ```bash
   rm -r /tmp/kafka
   ```

6. In a text editor, open the broker properties file, commonly stored in the `/opt/kafka/config/` directory.

7. Temporarily override the default inter-broker protocol and message format versions for Kafka 2.3.0 by adding or updating the following properties in the file:

   ```bash
   inter.broker.protocol.version=2.2
   log.message.format.version=2.2
   ```

   This configures the Kafka broker to process data using the previous inter-broker protocol (2.2) and message format versions.

8. On the command line, stop the Kafka broker that you modified:

   ```bash
   /opt/kafka/bin/kafka-server-stop.sh
   jcmd | grep kafka
   ```

9. Restart the Kafka broker that you modified:

   ```bash
   /opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server.properties
   ```

   **NOTE**

   The Kafka broker will start using the binaries for the latest Kafka version.

10. Verify that the restarted Kafka broker has caught up with the partition replicas it is following. Use the `kafka-topics.sh` tool to ensure that all replicas contained in the broker are back in sync. For instructions, see [Listing and describing topics](#).

### 13.4.3. Upgrading Kafka Connect

This procedure describes how to upgrade a Kafka Connect cluster on a host machine.

Kafka Connect is a client application and should be included in your chosen strategy for upgrading clients. For more information, see [Strategies for upgrading clients](#).
Prerequisites

- You are logged in to Red Hat Enterprise Linux as the kafka user.

Procedure

For each Kafka broker in your AMQ Streams cluster and one at a time:

1. Download the AMQ Streams archive from the Customer Portal.

   NOTE

   If prompted, log in to your Red Hat account.

2. On the command line, create a temporary directory and extract the contents of the amq-streams-x.y.z-bin.zip file.

   ```
   mkdir /tmp/kafka
   unzip amq-streams-x.y.z-bin.zip -d /tmp/kafka
   ```

3. Delete the libs, bin, and docs directories from your existing installation:

   ```
   rm -rf /opt/kafka/libs /opt/kafka/bin /opt/kafka/docs
   ```

4. Copy the libs, bin, and docs directories from the temporary directory:

   ```
   cp -r /tmp/kafka/kafka_y.y-x.x.x/libs /opt/kafka/
   cp -r /tmp/kafka/kafka_y.y-x.x.x/bin /opt/kafka/
   cp -r /tmp/kafka/kafka_y.y-x.x.x/docs /opt/kafka/
   ```

5. Delete the temporary directory.

   ```
   rm -r /tmp/kafka
   ```

6. Start Kafka Connect in either standalone or distributed mode.

   - To start in standalone mode, run the connect-standalone.sh script. Specify the Kafka Connect standalone configuration file and the configuration files of your Kafka Connect connectors.

     ```
     su - kafka
     /opt/kafka/bin/connect-standalone.sh /opt/kafka/config/connect-standalone.properties
     [connector1.properties ...
     ```

   - To start in distributed mode, start the Kafka Connect workers with the /opt/kafka/config/connect-distributed.properties configuration file on all Kafka Connect nodes:

     ```
     su - kafka
     /opt/kafka/bin/connect-distributed.sh /opt/kafka/config/connect-distributed.properties
     ```

7. Verify that Kafka Connect is running:
In standalone mode:

```
jcmd | grep ConnectStandalone
```

In distributed mode:

```
jcmd | grep ConnectDistributed
```

8. Verify that Kafka Connect is producing and consuming data as expected.

**Additional resources**

- Running Kafka Connect in standalone mode
- Running distributed Kafka Connect
- Strategies for upgrading clients

### 13.5. UPGRAADING KAFKA

After you have upgraded your binaries to use the latest version of AMQ Streams, you can upgrade your brokers and clients to use a higher supported version of Kafka.

Take care to follow the steps in the correct order:

1. **Section 13.5.1, "Upgrading Kafka brokers to use the new inter-broker protocol version"**
2. **Section 13.5.3, "Upgrading client applications to the new Kafka version"**
3. **Section 13.5.4, "Upgrading Kafka brokers to use the new message format version"**

**Additional resources**

- **Section 13.4, "Upgrading to AMQ Streams 1.3"**

### 13.5.1. Upgrading Kafka brokers to use the new inter-broker protocol version

Manually configure and restart all Kafka brokers to use the new inter-broker protocol version. After performing these steps, data is transmitted between the Kafka brokers using the new inter-broker protocol version.

Messages received are still appended to the message logs in the earlier message format version.

**WARNING**

Downgrading AMQ Streams is not possible after completing this procedure.

**Prerequisites**
You have updated the Zookeeper binaries.

You have upgraded all Kafka brokers to AMQ Streams 1.3

You are logged in to Red Hat Enterprise Linux as the **kafka** user.

**Procedure**

For each Kafka broker in your AMQ Streams cluster and one at a time:

1. In a text editor, open the broker properties file for the Kafka broker you want to update. Broker properties files are commonly stored in the `/opt/kafka/config/` directory.

2. Set the **inter.broker.protocol.version** to **2.3**.

```
inter.broker.protocol.version=2.3
```

3. On the command line, stop the Kafka broker that you modified:

```
/opt/kafka/bin/kafka-server-stop.sh
jcmd | grep kafka
```

4. Restart the Kafka broker that you modified:

```
/opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server.properties
```

5. Verify that the restarted Kafka broker has caught up with the partition replicas it is following. Use the **kafka-topics.sh** tool to ensure that all replicas contained in the broker are back in sync. For instructions, see [Listing and describing topics](#).

**13.5.2. Strategies for upgrading clients**

The best approach to upgrading your client applications depends on your particular circumstances. Client applications might include producers, consumers, Kafka Connect, and Kafka MirrorMaker.

Consuming applications need to receive messages in a message format that they understand. You can ensure that this is the case in one of two ways:

- By upgrading all the consumers for a topic before upgrading any of the producers.
- By having the brokers down-convert messages to an older format.

Using broker down-conversion puts extra load on the brokers, so it is not ideal to rely on down-conversion for all topics for a prolonged period of time. For brokers to perform optimally they should not be down converting messages at all.

Broker down-conversion is configured in two ways:

- The topic-level **message.format.version** configures it for a single topic.
- The broker-level **log.message.format.version** is the default for topics that do not have the topic-level **message.format.version** configured.

Another aspect to consider is that once new-version messages have been published to a topic then they will be visible to consumers. This is because brokers perform down-conversion when they receive messages from producers, not when they are sent to consumers.
There are a number of strategies you can use to upgrade your clients:

**Consumers first**

1. Upgrade all the consuming applications.
2. Change the broker-level `log.message.format.version` to the new version.
3. Upgrade all the producing applications.
   This strategy is straightforward, and avoids any broker down-conversion. However, it assumes that all consumers in your organization can be upgraded in a coordinated way, and it does not work for applications that are both consumers and producers. There is also a risk that, if there is a problem with the upgraded clients, new-format messages might get added to the message log so that you cannot revert to the previous consumer version.

**Per-topic consumers first**

For each topic:

1. Upgrade all the consuming applications.
2. Change the topic-level `message.format.version` to the new version.
3. Upgrade all the producing applications.
   This strategy avoids any broker down-conversion, and means you can proceed on a topic-by-topic basis. It does not work for applications that are both consumers and producers of the same topic. Again, it has the risk that, if there is a problem with the upgraded clients, new-format messages might get added to the message log.

**Per-topic consumers first, with down conversion**

For each topic:

1. Change the topic-level `message.format.version` to the old version (or rely on the topic defaulting to the broker-level `log.message.format.version`).
2. Upgrade all the consuming and producing applications.
3. Verify that the upgraded applications function correctly.
4. Change the topic-level `message.format.version` to the new version.
   This strategy requires broker down-conversion, but the load on the brokers is minimized because it is only required for a single topic (or small group of topics) at a time. It also works for applications that are both consumers and producers of the same topic. This approach ensures that the upgraded producers and consumers are working correctly before you commit to using the new message format version.

   The main drawback of this approach is that it can be complicated to manage in a cluster with many topics and applications.

Other strategies for upgrading client applications are also possible.
NOTE

It is also possible to apply multiple strategies. For example, for the first few applications and topics the "per-topic consumers first, with down conversion" strategy can be used. When this has proved successful another, more efficient strategy can be considered acceptable to use instead.

13.5.3. Upgrading client applications to the new Kafka version

This procedure describes one possible approach to upgrading your client applications to the Kafka version used for AMQ Streams 1.3.

The procedure is based on the "per-topic consumers first, with down conversion" approach outlined in Strategies for upgrading clients.

Client applications might include producers, consumers, Kafka Connect, and MirrorMaker.

Prerequisites

- You have updated the Zookeeper binaries.
- You have upgraded all Kafka brokers to AMQ Streams 1.3.
- You have configured Kafka brokers to use the new inter-broker protocol version.
- You are logged in to Red Hat Enterprise Linux as the kafka user.

Procedure

For each topic:

1. On the command line, set the message.format.version configuration option to 2.2.

   bin/kafka-configs.sh --zookeeper <ZookeeperAddress> --entity-type topics --entity-name <TopicName> --alter --add-config message.format.version=2.2

2. Upgrade all the consuming and producing applications for the topic.

3. Verify that the upgraded applications function correctly.

4. Change the topic’s message.format.version configuration option to 2.3.

   bin/kafka-configs.sh --zookeeper <ZookeeperAddress> --entity-type topics --entity-name <TopicName> --alter --add-config message.format.version=2.3

Additional resources

- Strategies for upgrading clients

13.5.4. Upgrading Kafka brokers to use the new message format version

When client applications have been upgraded, you can update the Kafka brokers to use the new message format version.

If you did not modify topic configurations when you upgraded your client applications to use the Kafka brokers, you can now update the Kafka brokers.
version required for AMQ Streams 1.3, the Kafka brokers are now converting messages down to the previous message format version, which can cause a reduction in performance. Therefore, it is important that you update all Kafka brokers to use the new message format version as soon as possible.

**NOTE**

Update and restart the Kafka brokers one-by-one. Before you restart a modified broker, stop the broker you configured and restarted previously.

**Prerequisites**

- You have updated the Zookeeper binaries.
- You have upgraded all Kafka brokers to AMQ Streams 1.3.
- You have configured Kafka brokers to use the new inter-broker protocol version.
- You have upgraded supported client applications that consume messages from topics for which the `message.format.version` property is not explicitly configured at the topic level.
- You are logged in to Red Hat Enterprise Linux as the **kafka** user.

**Procedure**

For each Kafka broker in your AMQ Streams cluster and one at a time:

1. In a text editor, open the broker properties file for the Kafka broker you want to update. Broker properties files are commonly stored in the `/opt/kafka/config/` directory.

2. Set the `log.message.format.version` to **2.3**.

   ```
   log.message.format.version=2.3
   ```

3. On the command line, stop the Kafka broker that you most recently modified and restarted as part of this procedure. If you are modifying the first Kafka broker in this procedure, go to step four.

   ```
   /opt/kafka/bin/kafka-server-stop.sh
   jcmd | grep kafka
   ```

4. Restart the Kafka broker whose configuration you modified in step two:

   ```
   /opt/kafka/bin/kafka-server-start.sh -daemon /opt/kafka/config/server.properties
   ```

5. Verify that the restarted Kafka broker has caught up with the partition replicas it is following. Use the **kafka-topics.sh** tool to ensure that all replicas contained in the broker are back in sync. For instructions, see **Listing and describing topics**.
APPENDIX A. BROKER CONFIGURATION PARAMETERS

zookeeper.connect
Type: string
Importance: high
Dynamic update: read-only
Specifies the ZooKeeper connection string in the form hostname:port where host and port are the host and port of a ZooKeeper server. To allow connecting through other ZooKeeper nodes when that ZooKeeper machine is down you can also specify multiple hosts in the form hostname1:port1,hostname2:port2,hostname3:port3. The server can also have a ZooKeeper chroot path as part of its ZooKeeper connection string which puts its data under some path in the global ZooKeeper namespace. For example to give a chroot path of /chroot/path you would give the connection string as hostname1:port1,hostname2:port2,hostname3:port3/chroot/path.

advertised.host.name
Type: string
Default: null
Importance: high
Dynamic update: read-only
DEPRECATED: only used when advertised.listeners or listeners are not set. Use advertised.listeners instead. Hostname to publish to ZooKeeper for clients to use. In IaaS environments, this may need to be different from the interface to which the broker binds. If this is not set, it will use the value for host.name if configured. Otherwise it will use the value returned from java.net.InetAddress.getCanonicalHostName().

advertised.listeners
Type: string
Default: null
Importance: high
Dynamic update: per-broker
Listeners to publish to ZooKeeper for clients to use, if different than the listeners config property. In IaaS environments, this may need to be different from the interface to which the broker binds. If this is not set, the value for listeners will be used. Unlike listeners it is not valid to advertise the 0.0.0.0 meta-address.

advertised.port
Type: int
Default: null
Importance: high
Dynamic update: read-only
DEPRECATED: only used when advertised.listeners or listeners are not set. Use advertised.listeners instead. The port to publish to ZooKeeper for clients to use. In IaaS environments, this may need to be different from the port to which the broker binds. If this is not set, it will publish the same port that the broker binds to.

auto.create.topics.enable
Type: boolean
Default: true
Importance: high
Dynamic update: read-only
Enable auto creation of topic on the server.
**auto.leader.rebalance.enable**

- **Type:** boolean
- **Default:** true
- **Importance:** high
- **Dynamic update:** read-only

Enables auto leader balancing. A background thread checks and triggers leader balance if required at regular intervals.

**background.threads**

- **Type:** int
- **Default:** 10
- **Valid Values:** [1,…]
- **Importance:** high
- **Dynamic update:** cluster-wide

The number of threads to use for various background processing tasks.

**broker.id**

- **Type:** int
- **Default:** -1
- **Importance:** high
- **Dynamic update:** read-only

The broker id for this server. If unset, a unique broker id will be generated. To avoid conflicts between zookeeper generated broker id’s and user configured broker id’s, generated broker ids start from reserved.broker.max.id + 1.

**compression.type**

- **Type:** string
- **Default:** producer
- **Importance:** high
- **Dynamic update:** cluster-wide

Specify the final compression type for a given topic. This configuration accepts the standard compression codecs (‘gzip’, ‘snappy’, ‘lz4’, ‘zstd’). It additionally accepts ‘uncompressed’ which is equivalent to no compression; and ‘producer’ which means retain the original compression codec set by the producer.

**control.plane.listener.name**

- **Type:** string
- **Default:** null
- **Importance:** high
- **Dynamic update:** read-only

Name of listener used for communication between controller and brokers. Broker will use the control.plane.listener.name to locate the endpoint in listeners list, to listen for connections from the controller. For example, if a broker’s config is : listeners = INTERNAL://192.1.1.8:9092, EXTERNAL://10.1.1.5:9093, CONTROLLER://192.1.1.8:9094 listener.security.protocol.map = INTERNAL:PLAINTEXT, EXTERNAL:SSL, CONTROLLER:SSL control.plane.listener.name = CONTROLLER On startup, the broker will start listening on "192.1.1.8:9094" with security protocol "SSL". On controller side, when it discovers a broker’s published endpoints through zookeeper, it will use the control.plane.listener.name to find the endpoint, which it will use to establish connection to the broker. For example, if the broker’s published endpoints on zookeeper are : “endpoints” : ["INTERNAL://broker1.example.com:9092", "EXTERNAL://broker1.example.com:9093", "CONTROLLER and the controller’s config is : listener.security.protocol.map = INTERNAL:PLAINTEXT, EXTERNAL:SSL, CONTROLLER:SSL control.plane.listener.name = CONTROLLER then controller
will use "broker1.example.com:9094" with security protocol "SSL" to connect to the broker. If not explicitly configured, the default value will be null and there will be no dedicated endpoints for controller connections.

**delete.topic.enable**

- **Type:** boolean
- **Default:** true
- **Importance:** high
- **Dynamic update:** read-only

Enables delete topic. Delete topic through the admin tool will have no effect if this config is turned off.

**host.name**

- **Type:** string
- **Default:** ""
- **Importance:** high
- **Dynamic update:** read-only

DEPRECATED: only used when listeners is not set. Use listeners instead. hostname of broker. If this is set, it will only bind to this address. If this is not set, it will bind to all interfaces.

**leader.imbalance.check.interval.seconds**

- **Type:** long
- **Default:** 300
- **Importance:** high
- **Dynamic update:** read-only

The frequency with which the partition rebalance check is triggered by the controller.

**leader.imbalance.per.broker.percentage**

- **Type:** int
- **Default:** 10
- **Importance:** high
- **Dynamic update:** read-only

The ratio of leader imbalance allowed per broker. The controller would trigger a leader balance if it goes above this value per broker. The value is specified in percentage.

**listeners**

- **Type:** string
- **Default:** null
- **Importance:** high
- **Dynamic update:** per-broker

Listener List - Comma-separated list of URIs we will listen on and the listener names. If the listener name is not a security protocol, listener.security.protocol.map must also be set. Specify hostname as 0.0.0.0 to bind to all interfaces. Leave hostname empty to bind to default interface. Examples of legal listener lists: PLAINTEXT://myhost:9092,SSL://:9091 CLIENT://0.0.0.0:9092,REPLICATION://localhost:9093.

**log.dir**

- **Type:** string
- **Default:** /tmp/kafka-logs
- **Importance:** high
- **Dynamic update:** read-only

The directory in which the log data is kept (supplemental for log.dirs property).
log.dirs
Type: string
Default: null
Importance: high
Dynamic update: read-only
The directories in which the log data is kept. If not set, the value in log.dir is used.

log.flush.interval.messages
Type: long
Default: 9223372036854775807
Valid Values: [1,...]
Importance: high
Dynamic update: cluster-wide
The number of messages accumulated on a log partition before messages are flushed to disk.

log.flush.interval.ms
Type: long
Default: null
Importance: high
Dynamic update: cluster-wide
The maximum time in ms that a message in any topic is kept in memory before flushed to disk. If not set, the value in log.flush.scheduler.interval.ms is used.

log.flush.offset.checkpoint.interval.ms
Type: int
Default: 60000
Valid Values: [0,...]
Importance: high
Dynamic update: read-only
The frequency with which we update the persistent record of the last flush which acts as the log recovery point.

log.flush.scheduler.interval.ms
Type: long
Default: 9223372036854775807
Importance: high
Dynamic update: read-only
The frequency in ms that the log flusher checks whether any log needs to be flushed to disk.

log.flush.start.offset.checkpoint.interval.ms
Type: int
Default: 60000
Valid Values: [0,...]
Importance: high
Dynamic update: read-only
The frequency with which we update the persistent record of log start offset.

log.retention.bytes
Type: long
Default: -1
Importance: high
Dynamic update: cluster-wide
The maximum size of the log before deleting it.

**log.retention.hours**

- Type: int
- Default: 168
- Importance: high
- Dynamic update: read-only
  The number of hours to keep a log file before deleting it (in hours), tertiary to log.retention.ms property.

**log.retention.minutes**

- Type: int
- Default: null
- Importance: high
- Dynamic update: read-only
  The number of minutes to keep a log file before deleting it (in minutes), secondary to log.retention.ms property. If not set, the value in log.retention.hours is used.

**log.retention.ms**

- Type: long
- Default: null
- Importance: high
- Dynamic update: cluster-wide
  The number of milliseconds to keep a log file before deleting it (in milliseconds), If not set, the value in log.retention.minutes is used. If set to -1, no time limit is applied.

**log.roll.hours**

- Type: int
- Default: 168
- Valid Values: [1,…]
- Importance: high
- Dynamic update: read-only
  The maximum time before a new log segment is rolled out (in hours), secondary to log.roll.ms property.

**log.roll.jitter.hours**

- Type: int
- Default: 0
- Valid Values: [0,…]
- Importance: high
- Dynamic update: read-only
  The maximum jitter to subtract from logRollTimeMillis (in hours), secondary to log.roll.jitter.ms property.

**log.roll.jitter.ms**

- Type: long
- Default: null
- Importance: high
- Dynamic update: cluster-wide
  The maximum jitter to subtract from logRollTimeMillis (in milliseconds). If not set, the value in log.roll.jitter.hours is used.
log.roll.ms
  Type: long
  Default: null
  Importance: high
  Dynamic update: cluster-wide
  The maximum time before a new log segment is rolled out (in milliseconds). If not set, the value in log.roll.hours is used.

log.segment.bytes
  Type: int
  Default: 1073741824
  Valid Values: [14,...]
  Importance: high
  Dynamic update: cluster-wide
  The maximum size of a single log file.

log.segment.delete.delay.ms
  Type: long
  Default: 60000
  Valid Values: [0,...]
  Importance: high
  Dynamic update: cluster-wide
  The amount of time to wait before deleting a file from the filesystem.

message.max.bytes
  Type: int
  Default: 1000012
  Valid Values: [0,...]
  Importance: high
  Dynamic update: cluster-wide
  The largest record batch size allowed by Kafka. If this is increased and there are consumers older than 0.10.2, the consumers’ fetch size must also be increased so that the they can fetch record batches this large.

  In the latest message format version, records are always grouped into batches for efficiency. In previous message format versions, uncompressed records are not grouped into batches and this limit only applies to a single record in that case.

  This can be set per topic with the topic level max.message.bytes config.

min.insync.replicas
  Type: int
  Default: 1
  Valid Values: [1,...]
  Importance: high
  Dynamic update: cluster-wide
  When a producer sets acks to "all" (or "-1"), min.insync.replicas specifies the minimum number of replicas that must acknowledge a write for the write to be considered successful. If this minimum cannot be met, then the producer will raise an exception (either NotEnoughReplicas or NotEnoughReplicasAfterAppend). When used together, min.insync.replicas and acks allow you to enforce greater durability guarantees. A typical scenario would be to create a topic with a replication factor of 3, set min.insync.replicas to 2, and produce with acks of "all". This will ensure that the producer raises an exception if a majority of replicas do not receive a write.
num.io.threads
   Type: int
   Default: 8
   Valid Values: [1,...]
   Importance: high
   Dynamic update: cluster-wide
   The number of threads that the server uses for processing requests, which may include disk I/O.

num.network.threads
   Type: int
   Default: 3
   Valid Values: [1,...]
   Importance: high
   Dynamic update: cluster-wide
   The number of threads that the server uses for receiving requests from the network and sending responses to the network.

num.recovery.threads.per.data.dir
   Type: int
   Default: 1
   Valid Values: [1,...]
   Importance: high
   Dynamic update: cluster-wide
   The number of threads per data directory to be used for log recovery at startup and flushing at shutdown.

num.replica.alter.log.dirs.threads
   Type: int
   Default: null
   Importance: high
   Dynamic update: read-only
   The number of threads that can move replicas between log directories, which may include disk I/O.

num.replica.fetchers
   Type: int
   Default: 1
   Importance: high
   Dynamic update: cluster-wide
   Number of fetcher threads used to replicate messages from a source broker. Increasing this value can increase the degree of I/O parallelism in the follower broker.

offset.metadata.max.bytes
   Type: int
   Default: 4096
   Importance: high
   Dynamic update: read-only
   The maximum size for a metadata entry associated with an offset commit.

offsets.commit.required.acks
   Type: short
   Default: -1
Importance: high
Dynamic update: read-only
The required acks before the commit can be accepted. In general, the default (-1) should not be overridden.

**offsets.commit.timeout.ms**

Type: int
Default: 5000
Valid Values: [1,...]
Importance: high
Dynamic update: read-only
Offset commit will be delayed until all replicas for the offsets topic receive the commit or this timeout is reached. This is similar to the producer request timeout.

**offsets.load.buffer.size**

Type: int
Default: 5242880
Valid Values: [1,...]
Importance: high
Dynamic update: read-only
Batch size for reading from the offsets segments when loading offsets into the cache (soft-limit, overridden if records are too large).

**offsets.retention.check.interval.ms**

Type: long
Default: 600000
Valid Values: [1,...]
Importance: high
Dynamic update: read-only
Frequency at which to check for stale offsets.

**offsets.retention.minutes**

Type: int
Default: 10080
Valid Values: [1,...]
Importance: high
Dynamic update: read-only
After a consumer group loses all its consumers (i.e. becomes empty) its offsets will be kept for this retention period before getting discarded. For standalone consumers (using manual assignment), offsets will be expired after the time of last commit plus this retention period.

**offsets.topic.compression.codec**

Type: int
Default: 0
Importance: high
Dynamic update: read-only
Compression codec for the offsets topic - compression may be used to achieve "atomic" commits.

**offsets.topic.num.partitions**

Type: int
Default: 50
Valid Values: [1,...]
Importance: high
Dynamic update: read-only
The number of partitions for the offset commit topic (should not change after deployment).

offsets.topic.replication.factor
Type: short
Default: 3
Valid Values: [1,...]
Importance: high
Dynamic update: read-only
The replication factor for the offsets topic (set higher to ensure availability). Internal topic creation will fail until the cluster size meets this replication factor requirement.

offsets.topic.segment.bytes
Type: int
Default: 104857600
Valid Values: [1,...]
Importance: high
Dynamic update: read-only
The offsets topic segment bytes should be kept relatively small in order to facilitate faster log compaction and cache loads.

port
Type: int
Default: 9092
Importance: high
Dynamic update: read-only
DEPRECATED: only used when listeners is not set. Use listeners instead. the port to listen and accept connections on.

queued.max.requests
Type: int
Default: 500
Valid Values: [1,...]
Importance: high
Dynamic update: read-only
The number of queued requests allowed for data-plane, before blocking the network threads.

quota.consumer.default
Type: long
Default: 9223372036854775807
Valid Values: [1,...]
Importance: high
Dynamic update: read-only
DEPRECATED: Used only when dynamic default quotas are not configured for <user, <client-id> or <user, client-id> in Zookeeper. Any consumer distinguished by clientId/consumer group will get throttled if it fetches more bytes than this value per-second.

quota.producer.default
Type: long
Default: 9223372036854775807
Valid Values: [1,...]
DEPRECATED: Used only when dynamic default quotas are not configured for <user>, <client-id> or <user, client-id> in Zookeeper. Any producer distinguished by clientId will get throttled if it produces more bytes than this value per-second.

**replica.fetch.min.bytes**
- Type: int
- Default: 1
- Importance: high
- Dynamic update: read-only
Minimum bytes expected for each fetch response. If not enough bytes, wait up to replicaMaxWaitTimeMs.

**replica.fetch.wait.max.ms**
- Type: int
- Default: 500
- Importance: high
- Dynamic update: read-only
Max wait time for each fetcher request issued by follower replicas. This value should always be less than the replica.lag.time.max.ms at all times to prevent frequent shrinking of ISR for low throughput topics.

**replica.high.watermark.checkpoint.interval.ms**
- Type: long
- Default: 5000
- Importance: high
- Dynamic update: read-only
The frequency with which the high watermark is saved out to disk.

**replica.lag.time.max.ms**
- Type: long
- Default: 10000
- Importance: high
- Dynamic update: read-only
If a follower hasn’t sent any fetch requests or hasn’t consumed up to the leaders log end offset for at least this time, the leader will remove the follower from isr.

**replica.socket.receive.buffer.bytes**
- Type: int
- Default: 65536
- Importance: high
- Dynamic update: read-only
The socket receive buffer for network requests.

**replica.socket.timeout.ms**
- Type: int
- Default: 30000
- Importance: high
- Dynamic update: read-only
The socket timeout for network requests. Its value should be at least replica.fetch.wait.max.ms.
**request.timeout.ms**

*Type:* int  
*Default:* 30000  
*Importance:* high  
*Dynamic update:* read-only  
The configuration controls the maximum amount of time the client will wait for the response of a request. If the response is not received before the timeout elapses the client will resend the request if necessary or fail the request if retries are exhausted.

**socket.receive.buffer.bytes**

*Type:* int  
*Default:* 102400  
*Importance:* high  
*Dynamic update:* read-only  
The SO_RCVBUF buffer of the socket server sockets. If the value is -1, the OS default will be used.

**socket.request.max.bytes**

*Type:* int  
*Default:* 104857600  
*Valid Values:* [1,...]  
*Importance:* high  
*Dynamic update:* read-only  
The maximum number of bytes in a socket request.

**socket.send.buffer.bytes**

*Type:* int  
*Default:* 102400  
*Importance:* high  
*Dynamic update:* read-only  
The SO_SNDBUF buffer of the socket server sockets. If the value is -1, the OS default will be used.

**transaction.max.timeout.ms**

*Type:* int  
*Default:* 900000  
*Valid Values:* [1,...]  
*Importance:* high  
*Dynamic update:* read-only  
The maximum allowed timeout for transactions. If a client’s requested transaction time exceed this, then the broker will return an error in InitProducerIdRequest. This prevents a client from too large of a timeout, which can stall consumers reading from topics included in the transaction.

**transaction.state.log.load.buffer.size**

*Type:* int  
*Default:* 5242880  
*Valid Values:* [1,...]  
*Importance:* high  
*Dynamic update:* read-only  
Batch size for reading from the transaction log segments when loading producer ids and transactions into the cache (soft-limit, overridden if records are too large).

**transaction.state.log.min.isr**
Type: int
Default: 2
Valid Values: [1,...]
Importance: high
Dynamic update: read-only

Overridden min.insync.replicas config for the transaction topic.

**transaction.state.log.num.partitions**

Type: int
Default: 50
Valid Values: [1,...]
Importance: high
Dynamic update: read-only

The number of partitions for the transaction topic (should not change after deployment).

**transaction.state.log.replication.factor**

Type: short
Default: 3
Valid Values: [1,...]
Importance: high
Dynamic update: read-only

The replication factor for the transaction topic (set higher to ensure availability). Internal topic creation will fail until the cluster size meets this replication factor requirement.

**transaction.state.log.segment.bytes**

Type: int
Default: 104857600
Valid Values: [1,...]
Importance: high
Dynamic update: read-only

The transaction topic segment bytes should be kept relatively small in order to facilitate faster log compaction and cache loads.

**transactional.id.expiration.ms**

Type: int
Default: 604800000
Valid Values: [1,...]
Importance: high
Dynamic update: read-only

The maximum amount of time in ms that the transaction coordinator will wait before proactively expire a producer’s transactional id without receiving any transaction status updates from it.

**unclean.leader.election.enable**

Type: boolean
Default: false
Importance: high
Dynamic update: cluster-wide

Indicates whether to enable replicas not in the ISR set to be elected as leader as a last resort, even though doing so may result in data loss.

**zookeeper.connection.timeout.ms**

Type: int
The max time that the client waits to establish a connection to zookeeper. If not set, the value in zookeeper.session.timeout.ms is used.

**zookeeper.max.in.flight.requests**
- **Type**: int
- **Default**: 10
- **Valid Values**: [1,...]
- **Importance**: high
- **Dynamic update**: read-only
- The maximum number of unacknowledged requests the client will send to Zookeeper before blocking.

**zookeeper.session.timeout.ms**
- **Type**: int
- **Default**: 6000
- **Importance**: high
- **Dynamic update**: read-only
- Zookeeper session timeout.

**zookeeper.set.acl**
- **Type**: boolean
- **Default**: false
- **Importance**: high
- **Dynamic update**: read-only
- Set client to use secure ACLs.

**broker.id.generation.enable**
- **Type**: boolean
- **Default**: true
- **Importance**: medium
- **Dynamic update**: read-only
- Enable automatic broker id generation on the server. When enabled the value configured for reserved.broker.max.id should be reviewed.

**broker.rack**
- **Type**: string
- **Default**: null
- **Importance**: medium
- **Dynamic update**: read-only
- Rack of the broker. This will be used in rack aware replication assignment for fault tolerance. Examples: RACK1, us-east-1d.

**connections.max.idle.ms**
- **Type**: long
- **Default**: 600000
- **Importance**: medium
- **Dynamic update**: read-only
- Idle connections timeout: the server socket processor threads close the connections that idle more than this.
**connections.max.reauth.ms**

- **Type:** long
- **Default:** 0
- **Importance:** medium
- **Dynamic update:** read-only

When explicitly set to a positive number (the default is 0, not a positive number), a session lifetime that will not exceed the configured value will be communicated to v2.2.0 or later clients when they authenticate. The broker will disconnect any such connection that is not re-authenticated within the session lifetime and that is then subsequently used for any purpose other than re-authentication. Configuration names can optionally be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.oauthbearer.connections.max.reauth.ms=3600000.

**controlled.shutdown.enable**

- **Type:** boolean
- **Default:** true
- **Importance:** medium
- **Dynamic update:** read-only

Enable controlled shutdown of the server.

**controlled.shutdown.max.retries**

- **Type:** int
- **Default:** 3
- **Importance:** medium
- **Dynamic update:** read-only

Controlled shutdown can fail for multiple reasons. This determines the number of retries when such failure happens.

**controlled.shutdown.retry.backoff.ms**

- **Type:** long
- **Default:** 5000
- **Importance:** medium
- **Dynamic update:** read-only

Before each retry, the system needs time to recover from the state that caused the previous failure (Controller fail over, replica lag etc). This config determines the amount of time to wait before retrying.

**controller.socket.timeout.ms**

- **Type:** int
- **Default:** 30000
- **Importance:** medium
- **Dynamic update:** read-only

The socket timeout for controller-to-broker channels.

**default.replication.factor**

- **Type:** int
- **Default:** 1
- **Importance:** medium
- **Dynamic update:** read-only

default replication factors for automatically created topics.

**delegation.token.expiry.time.ms**
delegation.token.master.key
Type: password
Default: null
Importance: medium
Dynamic update: read-only
Master/secret key to generate and verify delegation tokens. Same key must be configured across all
the brokers. If the key is not set or set to empty string, brokers will disable the delegation token
support.

deviation.token.max.lifetime.ms
Type: long
Default: 604800000
Valid Values: [1,...]
Importance: medium
Dynamic update: read-only
The token has a maximum lifetime beyond which it cannot be renewed anymore. Default value 7
days.

delete.records.purgatory.purge.interval.requests
Type: int
Default: 1
Importance: medium
Dynamic update: read-only
The purge interval (in number of requests) of the delete records request purgatory.

fetch.purgatory.purge.interval.requests
Type: int
Default: 1000
Importance: medium
Dynamic update: read-only
The purge interval (in number of requests) of the fetch request purgatory.

group.initial.rebalance.delay.ms
Type: int
Default: 3000
Importance: medium
Dynamic update: read-only
The amount of time the group coordinator will wait for more consumers to join a new group before
performing the first rebalance. A longer delay means potentially fewer rebalances, but increases the
time until processing begins.

group.max.session.timeout.ms
Type: int
Default: 1800000
Importance: medium
Dynamic update: read-only
The maximum allowed session timeout for registered consumers. Longer timeouts give consumers more time to process messages in between heartbeats at the cost of a longer time to detect failures.

**group.max.size**

Type: int  
Default: 2147483647  
Valid Values: [1,...]  
Importance: medium  
Dynamic update: read-only  
The maximum number of consumers that a single consumer group can accommodate.

**group.min.session.timeout.ms**

Type: int  
Default: 6000  
Importance: medium  
Dynamic update: read-only  
The minimum allowed session timeout for registered consumers. Shorter timeouts result in quicker failure detection at the cost of more frequent consumer heartbeating, which can overwhelm broker resources.

**inter.broker.listener.name**

Type: string  
Default: null  
Importance: medium  
Dynamic update: read-only  
Name of listener used for communication between brokers. If this is unset, the listener name is defined by security.inter.broker.protocol. It is an error to set this and security.inter.broker.protocol properties at the same time.

**inter.broker.protocol.version**

Type: string  
Default: 2.3-IV1  
Valid Values: [0.8.0, 0.8.1, 0.8.2, 0.9.0, 0.10.0-IV0, 0.10.0-IV1, 0.10.1-IV0, 0.10.1-IV1, 0.10.1-IV2, 0.10.2-IV0, 0.11.0-IV0, 0.11.0-IV1, 0.11.0-IV2, 1.0-IV0, 1.0-IV1, 2.0-IV0, 2.0-IV1, 2.1-IV0, 2.1-IV1, 2.1-IV2, 2.2-IV0, 2.2-IV1, 2.3-IV0, 2.3-IV1]  
Importance: medium  
Dynamic update: read-only  
Specify which version of the inter-broker protocol will be used. This is typically bumped after all brokers were upgraded to a new version. Example of some valid values are: 0.8.0, 0.8.1, 0.8.1.1, 0.8.2, 0.8.2.0, 0.8.2.1, 0.9.0.0, 0.9.0.1 Check ApiVersion for the full list.

**log.cleaner.backoff.ms**

Type: long  
Default: 15000  
Valid Values: [0,...]  
Importance: medium  
Dynamic update: cluster-wide  
The amount of time to sleep when there are no logs to clean.

**log.cleaner.dedupe.buffer.size**

Type: long
The total memory used for log deduplication across all cleaner threads.

**log.cleaner.delete.retention.ms**
- **Type:** long
- **Default:** 86400000
- **Importance:** medium
- **Dynamic update:** cluster-wide
- How long are delete records retained?

**log.cleaner.enable**
- **Type:** boolean
- **Default:** true
- **Importance:** medium
- **Dynamic update:** read-only
- Enable the log cleaner process to run on the server. Should be enabled if using any topics with cleanup.policy=compact including the internal offsets topic. If disabled those topics will not be compacted and continually grow in size.

**log.cleaner.io.buffer.load.factor**
- **Type:** double
- **Default:** 0.9
- **Importance:** medium
- **Dynamic update:** cluster-wide
- Log cleaner dedupe buffer load factor. The percentage full the dedupe buffer can become. A higher value will allow more log to be cleaned at once but will lead to more hash collisions.

**log.cleaner.io.buffer.size**
- **Type:** int
- **Default:** 524288
- **Valid Values:** [0,...]
- **Importance:** medium
- **Dynamic update:** cluster-wide
- The total memory used for log cleaner I/O buffers across all cleaner threads.

**log.cleaner.io.max.bytes.per.second**
- **Type:** double
- **Default:** 1.7976931348623157E308
- **Importance:** medium
- **Dynamic update:** cluster-wide
- The log cleaner will be throttled so that the sum of its read and write i/o will be less than this value on average.

**log.cleaner.max.compaction.lag.ms**
- **Type:** long
- **Default:** 9223372036854775807
- **Importance:** medium
- **Dynamic update:** cluster-wide
- The maximum time a message will remain ineligible for compaction in the log. Only applicable for logs that are being compacted.
**log.cleaner.min.cleanable.ratio**

- **Type:** double
- **Default:** 0.5
- **Importance:** medium
- **Dynamic update:** cluster-wide

The minimum ratio of dirty log to total log for a log to eligible for cleaning. If the log.cleaner.max.compaction.lag.ms or the log.cleaner.min.compaction.lag.ms configurations are also specified, then the log compactor considers the log eligible for compaction as soon as either: (i) the dirty ratio threshold has been met and the log has had dirty (uncompacted) records for at least the log.cleaner.min.compaction.lag.ms duration, or (ii) if the log has had dirty (uncompacted) records for at most the log.cleaner.max.compaction.lag.ms period.

**log.cleaner.min.compaction.lag.ms**

- **Type:** long
- **Default:** 0
- **Importance:** medium
- **Dynamic update:** cluster-wide

The minimum time a message will remain uncompacted in the log. Only applicable for logs that are being compacted.

**log.cleaner.threads**

- **Type:** int
- **Default:** 1
- **Valid Values:** [0,...]
- **Importance:** medium
- **Dynamic update:** cluster-wide

The number of background threads to use for log cleaning.

**log.cleanup.policy**

- **Type:** list
- **Default:** delete
- **Valid Values:** [compact, delete]
- **Importance:** medium
- **Dynamic update:** cluster-wide

The default cleanup policy for segments beyond the retention window. A comma separated list of valid policies. Valid policies are: "delete" and "compact".

**log.index.interval.bytes**

- **Type:** int
- **Default:** 4096
- **Valid Values:** [0,...]
- **Importance:** medium
- **Dynamic update:** cluster-wide

The interval with which we add an entry to the offset index.

**log.index.size.max.bytes**

- **Type:** int
- **Default:** 10485760
- **Valid Values:** [4,...]
- **Importance:** medium
- **Dynamic update:** cluster-wide

The maximum size in bytes of the offset index.
log.message.format.version
  Type: string
  Default: 2.3-IV1
  Valid Values: 0.8.0, 0.8.1, 0.8.2, 0.9.0, 0.10.0-IV0, 0.10.0-IVI, 0.10.1-IV0, 0.10.1-IVI, 0.10.2-IV0, 0.11.0-IV0, 0.11.0-IVI, 0.11.0-IV2, 1.0-IV0, 1.0-IVI, 2.0-IV0, 2.0-IVI, 2.1-IV0, 2.1-IVI, 2.1-IV2, 2.2-IV0, 2.2-IVI, 2.3-IV0, 2.3-IVI
  Importance: medium
  Dynamic update: read-only
  Specify the message format version the broker will use to append messages to the logs. The value should be a valid ApiVersion. Some examples are: 0.8.2, 0.9.0.0, 0.10.0, check ApiVersion for more details. By setting a particular message format version, the user is certifying that all the existing messages on disk are smaller or equal than the specified version. Setting this value incorrectly will cause consumers with older versions to break as they will receive messages with a format that they don’t understand.

log.message.timestamp.difference.max.ms
  Type: long
  Default: 9223372036854775807
  Importance: medium
  Dynamic update: cluster-wide
  The maximum difference allowed between the timestamp when a broker receives a message and the timestamp specified in the message. If log.message.timestamp.type=CreateTime, a message will be rejected if the difference in timestamp exceeds this threshold. This configuration is ignored if log.message.timestamp.type=LogAppendTime. The maximum timestamp difference allowed should be no greater than log.retention.ms to avoid unnecessarily frequent log rolling.

log.message.timestamp.type
  Type: string
  Default: CreateTime
  Valid Values: [CreateTime, LogAppendTime]
  Importance: medium
  Dynamic update: cluster-wide
  Define whether the timestamp in the message is message create time or log append time. The value should be either CreateTime or LogAppendTime.

log.preallocate
  Type: boolean
  Default: false
  Importance: medium
  Dynamic update: cluster-wide
  Should pre allocate file when create new segment? If you are using Kafka on Windows, you probably need to set it to true.

log.retention.check.interval.ms
  Type: long
  Default: 300000
  Valid Values: [1,...]
  Importance: medium
  Dynamic update: read-only
  The frequency in milliseconds that the log cleaner checks whether any log is eligible for deletion.

max.connections
max.connections.per.ip
Type: int
Default: 2147483647
Valid Values: [0,...]
Importance: medium
Dynamic update: cluster-wide
The maximum number of connections we allow from each ip address. This can be set to 0 if there are overrides configured using max.connections.per.ip.overrides property. New connections from the ip address are dropped if the limit is reached.

max.connections.per.ip.overrides
Type: string
Default: ""
Importance: medium
Dynamic update: cluster-wide
A comma-separated list of per-ip or hostname overrides to the default maximum number of connections. An example value is "hostName:100,127.0.0.1:200".

max.incremental.fetch.session.cache.slots
Type: int
Default: 1000
Valid Values: [0,...]
Importance: medium
Dynamic update: read-only
The maximum number of incremental fetch sessions that we will maintain.

num.partitions
Type: int
Default: 1
Valid Values: [1,...]
Importance: medium
Dynamic update: read-only
The default number of log partitions per topic.

password.encoder.old.secret
Type: password
Default: null
Importance: medium
Dynamic update: read-only
The old secret that was used for encoding dynamically configured passwords. This is required only when the secret is updated. If specified, all dynamically encoded passwords are decoded using this old secret and re-encoded using password.encoder.secret when broker starts up.

**password.encoder.secret**

Type: password  
Default: null  
Importance: medium  
Dynamic update: read-only  
The secret used for encoding dynamically configured passwords for this broker.

**principal.builder.class**

Type: class  
Default: null  
Importance: medium  
Dynamic update: per-broker  
The fully qualified name of a class that implements the KafkaPrincipalBuilder interface, which is used to build the KafkaPrincipal object used during authorization. This config also supports the deprecated PrincipalBuilder interface which was previously used for client authentication over SSL. If no principal builder is defined, the default behavior depends on the security protocol in use. For SSL authentication, the principal will be derived using the rules defined by `ssl.principal.mapping.rules` applied on the distinguished name from the client certificate if one is provided; otherwise, if client authentication is not required, the principal name will be ANONYMOUS. For SASL authentication, the principal will be derived using the rules defined by `sasl.kerberos.principal.to.local.rules` if GSSAPI is in use, and the SASL authentication ID for other mechanisms. For PLAINTEXT, the principal will be ANONYMOUS.

**producer.purgatory.purge.interval.requests**

Type: int  
Default: 1000  
Importance: medium  
Dynamic update: read-only  
The purge interval (in number of requests) of the producer request purgatory.

**queued.max.request.bytes**

Type: long  
Default: -1  
Importance: medium  
Dynamic update: read-only  
The number of queued bytes allowed before no more requests are read.

**replica.fetch.backoff.ms**

Type: int  
Default: 1000  
Valid Values: [0,...]  
Importance: medium  
Dynamic update: read-only  
The amount of time to sleep when fetch partition error occurs.

**replica.fetch.max.bytes**

Type: int  
Default: 1048576
Valid Values: [0, ...]
Importance: medium
Dynamic update: read-only
The number of bytes of messages to attempt to fetch for each partition. This is not an absolute maximum, if the first record batch in the first non-empty partition of the fetch is larger than this value, the record batch will still be returned to ensure that progress can be made. The maximum record batch size accepted by the broker is defined via `message.max.bytes` (broker config) or `max.message.bytes` (topic config).

**replica.fetch.response.max.bytes**

Type: int
Default: 10485760
Valid Values: [0, ...]
Importance: medium
Dynamic update: read-only
Maximum bytes expected for the entire fetch response. Records are fetched in batches, and if the first record batch in the first non-empty partition of the fetch is larger than this value, the record batch will still be returned to ensure that progress can be made. As such, this is not an absolute maximum. The maximum record batch size accepted by the broker is defined via `message.max.bytes` (broker config) or `max.message.bytes` (topic config).

**reserved.broker.max.id**

Type: int
Default: 1000
Valid Values: [0, ...]
Importance: medium
Dynamic update: read-only
Max number that can be used for a broker.id.

**sasl.client.callback.handler.class**

Type: class
Default: null
Importance: medium
Dynamic update: read-only
The fully qualified name of a SASL client callback handler class that implements the AuthenticateCallbackHandler interface.

**sasl.enabled.mechanisms**

Type: list
Default: GSSAPI
Importance: medium
Dynamic update: per-broker
The list of SASL mechanisms enabled in the Kafka server. The list may contain any mechanism for which a security provider is available. Only GSSAPI is enabled by default.

**sasl.jaas.config**

Type: password
Default: null
Importance: medium
Dynamic update: per-broker
JAAS login context parameters for SASL connections in the format used by JAAS configuration files. JAAS configuration file format is described here. The format for the value is: 'loginModuleClass
controlFlag (optionName=optionValue)*.’. For brokers, the config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.jaas.config=com.example.ScramLoginModule required;

**sasl.kerberos.kinit.cmd**

*Type:* string  
*Default:* /usr/bin/kinit  
*Importance:* medium  
*Dynamic update:* per-broker

Kerberos kinit command path.

**sasl.kerberos.min.time.before.relogin**

*Type:* long  
*Default:* 60000  
*Importance:* medium  
*Dynamic update:* per-broker

Login thread sleep time between refresh attempts.

**sasl.kerberos.principal.to.local.rules**

*Type:* list  
*Default:* DEFAULT  
*Importance:* medium  
*Dynamic update:* per-broker

A list of rules for mapping from principal names to short names (typically operating system usernames). The rules are evaluated in order and the first rule that matches a principal name is used to map it to a short name. Any later rules in the list are ignored. By default, principal names of the form `{username}/{hostname}@{REALM}` are mapped to `{username}`. For more details on the format please see [security authorization and acls](#). Note that this configuration is ignored if an extension of KafkaPrincipalBuilder is provided by the `principal.builder.class` configuration.

**sasl.kerberos.service.name**

*Type:* string  
*Default:* null  
*Importance:* medium  
*Dynamic update:* per-broker

The Kerberos principal name that Kafka runs as. This can be defined either in Kafka’s JAAS config or in Kafka’s config.

**sasl.kerberos.ticket.renew.jitter**

*Type:* double  
*Default:* 0.05  
*Importance:* medium  
*Dynamic update:* per-broker

Percentage of random jitter added to the renewal time.

**sasl.kerberos.ticket.renew.window.factor**

*Type:* double  
*Default:* 0.8  
*Importance:* medium  
*Dynamic update:* per-broker

Login thread will sleep until the specified window factor of time from last refresh to ticket’s expiry has been reached, at which time it will try to renew the ticket.
sasl.login.callback.handler.class
Type: class
Default: null
Importance: medium
Dynamic update: read-only
The fully qualified name of a SASL login callback handler class that implements the AuthenticateCallbackHandler interface. For brokers, login callback handler config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.login.callback.handler.class=com.example.CustomScramLoginCallbackHandler.

sasl.login.class
Type: class
Default: null
Importance: medium
Dynamic update: read-only
The fully qualified name of a class that implements the Login interface. For brokers, login config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.login.class=com.example.CustomScramLogin.

sasl.login.refresh.buffer.seconds
Type: short
Default: 300
Importance: medium
Dynamic update: per-broker
The amount of buffer time before credential expiration to maintain when refreshing a credential, in seconds. If a refresh would otherwise occur closer to expiration than the number of buffer seconds then the refresh will be moved up to maintain as much of the buffer time as possible. Legal values are between 0 and 3600 (1 hour); a default value of 300 (5 minutes) is used if no value is specified. This value and sasl.login.refresh.min.period.seconds are both ignored if their sum exceeds the remaining lifetime of a credential. Currently applies only to OAUTHBEARER.

sasl.login.refresh.min.period.seconds
Type: short
Default: 60
Importance: medium
Dynamic update: per-broker
The desired minimum time for the login refresh thread to wait before refreshing a credential, in seconds. Legal values are between 0 and 900 (15 minutes); a default value of 60 (1 minute) is used if no value is specified. This value and sasl.login.refresh.buffer.seconds are both ignored if their sum exceeds the remaining lifetime of a credential. Currently applies only to OAUTHBEARER.

sasl.login.refresh.window.factor
Type: double
Default: 0.8
Importance: medium
Dynamic update: per-broker
Login refresh thread will sleep until the specified window factor relative to the credential’s lifetime has been reached, at which time it will try to refresh the credential. Legal values are between 0.5 (50%) and 1.0 (100%) inclusive; a default value of 0.8 (80%) is used if no value is specified. Currently applies only to OAUTHBEARER.

sasl.login.refresh.window.jitter
The maximum amount of random jitter relative to the credential’s lifetime that is added to the login refresh thread’s sleep time. Legal values are between 0 and 0.25 (25%) inclusive; a default value of 0.05 (5%) is used if no value is specified. Currently applies only to OAUTHBEARER.

**sasl.mechanism.inter.broker.protocol**

- **Type:** string
- **Default:** GSSAPI
- **Importance:** medium
- **Dynamic update:** per-broker

SASL mechanism used for inter-broker communication. Default is GSSAPI.

**sasl.server.callback.handler.class**

- **Type:** class
- **Default:** null
- **Importance:** medium
- **Dynamic update:** read-only

The fully qualified name of a SASL server callback handler class that implements the AuthenticateCallbackHandler interface. Server callback handlers must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.plain.sasl.server.callback.handler.class=com.example.CustomPlainCallbackHandler.

**security.inter.broker.protocol**

- **Type:** string
- **Default:** PLAINTEXT
- **Importance:** medium
- **Dynamic update:** read-only

Security protocol used to communicate between brokers. Valid values are: PLAINTEXT, SSL, SASL_PLAINTEXT, SASL_SSL. It is an error to set this and inter.broker.listener.name properties at the same time.

**ssl.cipher.suites**

- **Type:** list
- **Default:** ""
- **Importance:** medium
- **Dynamic update:** per-broker

A list of cipher suites. This is a named combination of authentication, encryption, MAC and key exchange algorithm used to negotiate the security settings for a network connection using TLS or SSL network protocol. By default all the available cipher suites are supported.

**ssl.client.auth**

- **Type:** string
- **Default:** none
- **Valid Values:** [required, requested, none]
- **Importance:** medium
- **Dynamic update:** per-broker

Configures kafka broker to request client authentication. The following settings are common:

- **ssl.client.auth=required** If set to required client authentication is required.
- **ssl.client.auth=requested** This means client authentication is optional. Unlike requested, if this option is set, client can choose not to provide authentication information about itself.

- **ssl.client.auth=none** This means client authentication is not needed.

**ssl.enabled.protocols**
- **Type:** list
- **Default:** TLSv1.2, TLSv1.1, TLSv1
- **Importance:** medium
- **Dynamic update:** per-broker
  
  The list of protocols enabled for SSL connections.

**ssl.key.password**
- **Type:** password
- **Default:** null
- **Importance:** medium
- **Dynamic update:** per-broker
  
  The password of the private key in the key store file. This is optional for client.

**ssl.keymanager.algorithm**
- **Type:** string
- **Default:** SunX509
- **Importance:** medium
- **Dynamic update:** per-broker
  
  The algorithm used by key manager factory for SSL connections. Default value is the key manager factory algorithm configured for the Java Virtual Machine.

**ssl.keystore.location**
- **Type:** string
- **Default:** null
- **Importance:** medium
- **Dynamic update:** per-broker
  
  The location of the key store file. This is optional for client and can be used for two-way authentication for client.

**ssl.keystore.password**
- **Type:** password
- **Default:** null
- **Importance:** medium
- **Dynamic update:** per-broker
  
  The store password for the key store file. This is optional for client and only needed if ssl.keystore.location is configured.

**ssl.keystore.type**
- **Type:** string
- **Default:** JKS
- **Importance:** medium
- **Dynamic update:** per-broker
  
  The file format of the key store file. This is optional for client.

**ssl.protocol**
The SSL protocol used to generate the SSLContext. Default setting is TLS, which is fine for most cases. Allowed values in recent JVMs are TLS, TLSv1.1 and TLSv1.2. SSL, SSLv2 and SSLv3 may be supported in older JVMs, but their usage is discouraged due to known security vulnerabilities.

**ssl.provider**

Type: string  
Default: null  
Importance: medium  
Dynamic update: per-broker  
The name of the security provider used for SSL connections. Default value is the default security provider of the JVM.

**ssl.trustmanager.algorithm**

Type: string  
Default: PKIX  
Importance: medium  
Dynamic update: per-broker  
The algorithm used by trust manager factory for SSL connections. Default value is the trust manager factory algorithm configured for the Java Virtual Machine.

**ssl.truststore.location**

Type: string  
Default: null  
Importance: medium  
Dynamic update: per-broker  
The location of the trust store file.

**ssl.truststore.password**

Type: password  
Default: null  
Importance: medium  
Dynamic update: per-broker  
The password for the trust store file. If a password is not set access to the truststore is still available, but integrity checking is disabled.

**ssl.truststore.type**

Type: string  
Default: JKS  
Importance: medium  
Dynamic update: per-broker  
The file format of the trust store file.

**alter.config.policy.class.name**

Type: class  
Default: null  
Importance: low  
Dynamic update: read-only
The alter configs policy class that should be used for validation. The class should implement the org.apache.kafka.server.policy.AlterConfigPolicy interface.

**alter.log.dirs.replication.quota.window.num**

- **Type:** int
- **Default:** 11
- **Valid Values:** [1,...]
- **Importance:** low
- **Dynamic update:** read-only

The number of samples to retain in memory for alter log dirs replication quotas.

**alter.log.dirs.replication.quota.window.size.seconds**

- **Type:** int
- **Default:** 1
- **Valid Values:** [1,...]
- **Importance:** low
- **Dynamic update:** read-only

The time span of each sample for alter log dirs replication quotas.

**authorizer.class.name**

- **Type:** string
- **Default:** ""
- **Importance:** low
- **Dynamic update:** read-only

The authorizer class that should be used for authorization.

**client.quota.callback.class**

- **Type:** class
- **Default:** null
- **Importance:** low
- **Dynamic update:** read-only

The fully qualified name of a class that implements the ClientQuotaCallback interface, which is used to determine quota limits applied to client requests. By default, <user, client-id>, <user> or <client-id> quotas stored in ZooKeeper are applied. For any given request, the most specific quota that matches the user principal of the session and the client-id of the request is applied.

**connection.failed.authentication.delay.ms**

- **Type:** int
- **Default:** 100
- **Valid Values:** [0,...]
- **Importance:** low
- **Dynamic update:** read-only

Connection close delay on failed authentication: this is the time (in milliseconds) by which connection close will be delayed on authentication failure. This must be configured to be less than connections.max.idle.ms to prevent connection timeout.

**create.topic.policy.class.name**

- **Type:** class
- **Default:** null
- **Importance:** low
- **Dynamic update:** read-only
The create topic policy class that should be used for validation. The class should implement the `org.apache.kafka.server.policy.CreateTopicPolicy` interface.

delegation.token.expiry.check.interval.ms
- **Type:** long
- **Default:** 3600000
- **Valid Values:** [1,…]
- **Importance:** low
- **Dynamic update:** read-only
- Scan interval to remove expired delegation tokens.

kafka.metrics.polling.interval.secs
- **Type:** int
- **Default:** 10
- **Valid Values:** [1,…]
- **Importance:** low
- **Dynamic update:** read-only
- The metrics polling interval (in seconds) which can be used in kafka.metrics.reporters implementations.

kafka.metrics.reporters
- **Type:** list
- **Default:** ""
- **Importance:** low
- **Dynamic update:** read-only
- A list of classes to use as Yammer metrics custom reporters. The reporters should implement `kafka.metrics.KafkaMetricsReporter` trait. If a client wants to expose JMX operations on a custom reporter, the custom reporter needs to additionally implement an MBean trait that extends `kafka.metrics.KafkaMetricsReporterMBean` trait so that the registered MBean is compliant with the standard MBean convention.

listener.security.protocol.map
- **Type:** string
- **Default:** PLAINTEXT:PLAINTEXT,SSL:SSL,SASL_PLAINTEXT:SASL_PLAINTEXT,SASL_SSL:SASL_SSL
- **Importance:** low
- **Dynamic update:** per-broker
- Map between listener names and security protocols. This must be defined for the same security protocol to be usable in more than one port or IP. For example, internal and external traffic can be separated even if SSL is required for both. Concretely, the user could define listeners with names INTERNAL and EXTERNAL and this property as: INTERNAL:SSL,EXTERNAL:SSL. As shown, key and value are separated by a colon and map entries are separated by commas. Each listener name should only appear once in the map. Different security (SSL and SASL) settings can be configured for each listener by adding a normalised prefix (the listener name is lowercased) to the config name. For example, to set a different keystore for the INTERNAL listener, a config with name `listener.name.internal.ssl.keystore.location` would be set. If the config for the listener name is not set, the config will fallback to the generic config (i.e. `ssl.keystore.location`).

log.message.downconversion.enable
- **Type:** boolean
- **Default:** true
- **Importance:** low
- **Dynamic update:** cluster-wide
This configuration controls whether down-conversion of message formats is enabled to satisfy consume requests. When set to `false`, broker will not perform down-conversion for consumers expecting an older message format. The broker responds with `UNSUPPORTED_VERSION` error for consume requests from such older clients. This configuration does not apply to any message format conversion that might be required for replication to followers.

**metric.reporters**
- **Type:** list
- **Default:** ""
- **Importance:** low
- **Dynamic update:** cluster-wide
A list of classes to use as metrics reporters. Implementing the `org.apache.kafka.common.metrics.MetricsReporter` interface allows plugging in classes that will be notified of new metric creation. The JmxReporter is always included to register JMX statistics.

**metrics.num.samples**
- **Type:** int
- **Default:** 2
- **Valid Values:** [1,...]
- **Importance:** low
- **Dynamic update:** read-only
The number of samples maintained to compute metrics.

**metrics.recording.level**
- **Type:** string
- **Default:** INFO
- **Importance:** low
- **Dynamic update:** read-only
The highest recording level for metrics.

**metrics.sample.window.ms**
- **Type:** long
- **Default:** 30000
- **Valid Values:** [1,...]
- **Importance:** low
- **Dynamic update:** read-only
The window of time a metrics sample is computed over.

**password.encoder.cipher.algorithm**
- **Type:** string
- **Default:** AES/CBC/PKCS5Padding
- **Importance:** low
- **Dynamic update:** read-only
The Cipher algorithm used for encoding dynamically configured passwords.

**password.encoder.iterations**
- **Type:** int
- **Default:** 4096
- **Valid Values:** [1024,...]
- **Importance:** low
- **Dynamic update:** read-only
The iteration count used for encoding dynamically configured passwords.
password.encoder.key.length
  Type: int
  Default: 128
  Valid Values: [8,...]
  Importance: low
  Dynamic update: read-only
  The key length used for encoding dynamically configured passwords.

password.encoder.keyfactory.algorithm
  Type: string
  Default: null
  Importance: low
  Dynamic update: read-only
  The SecretKeyFactory algorithm used for encoding dynamically configured passwords. Default is PBKDF2WithHmacSHA512 if available and PBKDF2WithHmacSHA1 otherwise.

quota.window.num
  Type: int
  Default: 11
  Valid Values: [1,...]
  Importance: low
  Dynamic update: read-only
  The number of samples to retain in memory for client quotas.

quota.window.size.seconds
  Type: int
  Default: 1
  Valid Values: [1,...]
  Importance: low
  Dynamic update: read-only
  The time span of each sample for client quotas.

replication.quota.window.num
  Type: int
  Default: 11
  Valid Values: [1,...]
  Importance: low
  Dynamic update: read-only
  The number of samples to retain in memory for replication quotas.

replication.quota.window.size.seconds
  Type: int
  Default: 1
  Valid Values: [1,...]
  Importance: low
  Dynamic update: read-only
  The time span of each sample for replication quotas.

ssl.endpoint.identification.algorithm
  Type: string
  Default: https
The endpoint identification algorithm to validate server hostname using server certificate.

ssl.principal.mapping.rules

Type: list
Default: DEFAULT
Importance: low
Dynamic update: per-broker
A list of rules for mapping from distinguished name from the client certificate to short name. The rules are evaluated in order and the first rule that matches a principal name is used to map it to a short name. Any later rules in the list are ignored. By default, distinguished name of the X.500 certificate will be the principal. For more details on the format please see security authorization and acls. Note that this configuration is ignored if an extension of KafkaPrincipalBuilder is provided by the principal.builder.class configuration.

ssl.secure.random.implementation

Type: string
Default: null
Importance: low
Dynamic update: per-broker
The SecureRandom PRNG implementation to use for SSL cryptography operations.

transaction.abort.timed.out.transaction.cleanup.interval.ms

Type: int
Default: 60000
Valid Values: [1,...]
Importance: low
Dynamic update: read-only
The interval at which to rollback transactions that have timed out.

transaction.remove.expired.transaction.cleanup.interval.ms

Type: int
Default: 3600000
Valid Values: [1,...]
Importance: low
Dynamic update: read-only
The interval at which to remove transactions that have expired due to transactional.id.expiration.ms passing.

zookeeper.sync.time.ms

Type: int
Default: 2000
Importance: low
Dynamic update: read-only
How far a ZK follower can be behind a ZK leader.
APPENDIX B. TOPIC CONFIGURATION PARAMETERS

cleanup.policy
Type: list
Default: delete
Valid Values: [compact, delete]
Server Default Property: log.cleanup.policy
Importance: medium
A string that is either "delete" or "compact" or both. This string designates the retention policy to use on old log segments. The default policy ("delete") will discard old segments when their retention time or size limit has been reached. The "compact" setting will enable log compaction on the topic.

compression.type
Type: string
Default: producer
Valid Values: [uncompressed, zstd, lz4, snappy, gzip, producer]
Server Default Property: compression.type
Importance: medium
Specify the final compression type for a given topic. This configuration accepts the standard compression codecs (‘gzip’, ‘snappy’, ‘lz4’, ‘zstd’). It additionally accepts ‘uncompressed’ which is equivalent to no compression; and ‘producer’ which means retain the original compression codec set by the producer.

delete.retention.ms
Type: long
Default: 86400000
Valid Values: [0,...]
Server Default Property: log.cleaner.delete.retention.ms
Importance: medium
The amount of time to retain delete tombstone markers for log compacted topics. This setting also gives a bound on the time in which a consumer must complete a read if they begin from offset 0 to ensure that they get a valid snapshot of the final stage (otherwise delete tombstones may be collected before they complete their scan).

file.delete.delay.ms
Type: long
Default: 60000
Valid Values: [0,...]
Server Default Property: log.segment.delete.delay.ms
Importance: medium
The time to wait before deleting a file from the filesystem.

flush.messages
Type: long
Default: 9223372036854775807
Valid Values: [0,...]
Server Default Property: log.flush.interval.messages
Importance: medium
This setting allows specifying an interval at which we will force an fsync of data written to the log. For example if this was set to 1 we would fsync after every message; if it were 5 we would fsync after every five messages. In general we recommend you not set this and use replication for durability and
allow the operating system’s background flush capabilities as it is more efficient. This setting can be overridden on a per-topic basis (see the per-topic configuration section).

**flush.ms**

**Type:** long  
**Default:** 9223372036854775807  
**Valid Values:** [0,…]  
**Server Default Property:** log.flush.interval.ms  
**Importance:** medium  
This setting allows specifying a time interval at which we will force an fsync of data written to the log. For example if this was set to 1000 we would fsync after 1000 ms had passed. In general we recommend you not set this and use replication for durability and allow the operating system’s background flush capabilities as it is more efficient.

**follower.replication.throttled.replicas**

**Type:** list  
**Default:** ""  
**Valid Values:** [partitionId]:[brokerId],[partitionId]:[brokerId],…  
**Server Default Property:** follower.replication.throttled.replicas  
**Importance:** medium  
A list of replicas for which log replication should be throttled on the follower side. The list should describe a set of replicas in the form [PartitionId]:[BrokerId],[PartitionId]:[BrokerId]:… or alternatively the wildcard '*' can be used to throttle all replicas for this topic.

**index.interval.bytes**

**Type:** int  
**Default:** 4096  
**Valid Values:** [0,…]  
**Server Default Property:** log.index.interval.bytes  
**Importance:** medium  
This setting controls how frequently Kafka adds an index entry to its offset index. The default setting ensures that we index a message roughly every 4096 bytes. More indexing allows reads to jump closer to the exact position in the log but makes the index larger. You probably don’t need to change this.

**leader.replication.throttled.replicas**

**Type:** list  
**Default:** ""  
**Valid Values:** [partitionId]:[brokerId],[partitionId]:[brokerId],…  
**Server Default Property:** leader.replication.throttled.replicas  
**Importance:** medium  
A list of replicas for which log replication should be throttled on the leader side. The list should describe a set of replicas in the form [PartitionId]:[BrokerId],[PartitionId]:[BrokerId]:… or alternatively the wildcard '*' can be used to throttle all replicas for this topic.

**max.compaction.lag.ms**

**Type:** long  
**Default:** 9223372036854775807  
**Valid Values:** [1,…]  
**Server Default Property:** log.cleaner.max.compaction.lag.ms  
**Importance:** medium  
The maximum time a message will remain ineligible for compaction in the log. Only applicable for logs that are being compacted.
max.message.bytes

Type: int
Default: 1000012
Valid Values: [0,...]
Server Default Property: message.max.bytes
Importance: medium

The largest record batch size allowed by Kafka. If this is increased and there are consumers older than 0.10.2, the consumers’ fetch size must also be increased so that the they can fetch record batches this large.

In the latest message format version, records are always grouped into batches for efficiency. In previous message format versions, uncompressed records are not grouped into batches and this limit only applies to a single record in that case.

message.format.version

Type: string
Default: 2.3-IV1
Valid Values: [0.8.0, 0.8.1, 0.8.2, 0.9.0, 0.10.0-IV0, 0.10.0-IV1, 0.10.1-IV0, 0.10.1-IV1, 0.10.1-IV2, 0.10.2-IV0, 0.11.0-IV0, 0.11.0-IV1, 0.11.0-IV2, 1.0-IV0, 1.1-IV0, 2.0-IV0, 2.0-IV1, 2.1-IV0, 2.1-IV1, 2.1-IV2, 2.2-IV0, 2.2-IV1, 2.3-IV0, 2.3-IV1]
Server Default Property: log.message.format.version
Importance: medium

Specify the message format version the broker will use to append messages to the logs. The value should be a valid ApiVersion. Some examples are: 0.8.2, 0.9.0.0, 0.10.0, check ApiVersion for more details. By setting a particular message format version, the user is certifying that all the existing messages on disk are smaller or equal than the specified version. Setting this value incorrectly will cause consumers with older versions to break as they will receive messages with a format that they don’t understand.

message.timestamp.difference.max.ms

Type: long
Default: 9223372036854775807
Valid Values: [0,...]
Server Default Property: log.message.timestamp.difference.max.ms
Importance: medium

The maximum difference allowed between the timestamp when a broker receives a message and the timestamp specified in the message. If message.timestamp.type=CreateTime, a message will be rejected if the difference in timestamp exceeds this threshold. This configuration is ignored if message.timestamp.type=LogAppendTime.

message.timestamp.type

Type: string
Default: CreateTime
Valid Values: [CreateTime, LogAppendTime]
Server Default Property: log.message.timestamp.type
Importance: medium

Define whether the timestamp in the message is message create time or log append time. The value should be either CreateTime or LogAppendTime.

min.cleanable.dirty.ratio

Type: double
Default: 0.5
Valid Values: [0,...,1]
Server Default Property: log.cleaner.min.cleanable.ratio
Importance: medium
This configuration controls how frequently the log compactor will attempt to clean the log (assuming log compaction is enabled). By default we will avoid cleaning a log where more than 50% of the log has been compacted. This ratio bounds the maximum space wasted in the log by duplicates (at 50% at most 50% of the log could be duplicates). A higher ratio will mean fewer, more efficient cleanings but will mean more wasted space in the log. If the max.compaction.lag.ms or the min.compaction.lag.ms configurations are also specified, then the log compactor considers the log eligible for compaction as soon as either: (i) the dirty ratio threshold has been met and the log has had dirty (uncompacted) records for at least the min.compaction.lag.ms duration, or (ii) if the log has had dirty (uncompacted) records for at most the max.compaction.lag.ms period.

min.compaction.lag.ms
Type: long
Default: 0
Valid Values: [0,...]
Server Default Property: log.cleaner.min.compaction.lag.ms
Importance: medium
The minimum time a message will remain uncompacted in the log. Only applicable for logs that are being compacted.

min.insync.replicas
Type: int
Default: 1
Valid Values: [1,...]
Server Default Property: min.insync.replicas
Importance: medium
When a producer sets acks to "all" (or "-1"), this configuration specifies the minimum number of replicas that must acknowledge a write for the write to be considered successful. If this minimum cannot be met, then the producer will raise an exception (either NotEnoughReplicas or NotEnoughReplicasAfterAppend). When used together, min.insync.replicas and acks allow you to enforce greater durability guarantees. A typical scenario would be to create a topic with a replication factor of 3, set min.insync.replicas to 2, and produce with acks of "all". This will ensure that the producer raises an exception if a majority of replicas do not receive a write.

preallocate
Type: boolean
Default: false
Server Default Property: log.preallocate
Importance: medium
True if we should preallocate the file on disk when creating a new log segment.

retention.bytes
Type: long
Default: -1
Server Default Property: log.retention.bytes
Importance: medium
This configuration controls the maximum size a partition (which consists of log segments) can grow to before we will discard old log segments to free up space if we are using the “delete” retention policy. By default there is no size limit only a time limit. Since this limit is enforced at the partition level, multiply it by the number of partitions to compute the topic retention in bytes.

retention.ms
Type: long  
Default: 604800000  
Valid Values: [-1, ...]  
Server Default Property: log.retention.ms  
Importance: medium  
This configuration controls the maximum time we will retain a log before we will discard old log segments to free up space if we are using the "delete" retention policy. This represents an SLA on how soon consumers must read their data. If set to -1, no time limit is applied.

**segment.bytes**

Type: int  
Default: 1073741824  
Valid Values: [14,...]  
Server Default Property: log.segment.bytes  
Importance: medium  
This configuration controls the segment file size for the log. Retention and cleaning is always done a file at a time so a larger segment size means fewer files but less granular control over retention.

**segment.index.bytes**

Type: int  
Default: 10485760  
Valid Values: [0,...]  
Server Default Property: log.index.size.max.bytes  
Importance: medium  
This configuration controls the size of the index that maps offsets to file positions. We preallocate this index file and shrink it only after log rolls. You generally should not need to change this setting.

**segment.jitter.ms**

Type: long  
Default: 0  
Valid Values: [0,...]  
Server Default Property: log.roll.jitter.ms  
Importance: medium  
The maximum random jitter subtracted from the scheduled segment roll time to avoid thundering herds of segment rolling.

**segment.ms**

Type: long  
Default: 604800000  
Valid Values: [1,...]  
Server Default Property: log.roll.ms  
Importance: medium  
This configuration controls the period of time after which Kafka will force the log to roll even if the segment file isn't full to ensure that retention can delete or compact old data.

**unclean.leader.election.enable**

Type: boolean  
Default: false  
Server Default Property: unclean.leader.election.enable  
Importance: medium  
Indicates whether to enable replicas not in the ISR set to be elected as leader as a last resort, even though doing so may result in data loss.
message.downconversion.enable

Type: boolean
Default: true
Server Default Property: log.message.downconversion.enable
Importance: low
This configuration controls whether down-conversion of message formats is enabled to satisfy consume requests. When set to false, broker will not perform down-conversion for consumers expecting an older message format. The broker responds with UNSUPPORTED_VERSION error for consume requests from such older clients. This configuration does not apply to any message format conversion that might be required for replication to followers.
APPENDIX C. CONSUMER CONFIGURATION PARAMETERS

key.deserializer
  Type: class
  Importance: high
  Deserializer class for key that implements the

value.deserializer
  Type: class
  Importance: high
  Deserializer class for value that implements the

bootstrap.servers
  Type: list
  Default: ""
  Valid Values: non-null string
  Importance: high
  A list of host/port pairs to use for establishing the initial connection to the Kafka cluster. The client
  will make use of all servers irrespective of which servers are specified here for bootstrapping—this list
  only impacts the initial hosts used to discover the full set of servers. This list should be in the form
  host1:port1,host2:port2,… Since these servers are just used for the initial connection to discover
  the full cluster membership (which may change dynamically), this list need not contain the full set of
  servers (you may want more than one, though, in case a server is down).

fetch.min.bytes
  Type: int
  Default: 1
  Valid Values: [0,…]
  Importance: high
  The minimum amount of data the server should return for a fetch request. If insufficient data is
  available the request will wait for that much data to accumulate before answering the request. The
  default setting of 1 byte means that fetch requests are answered as soon as a single byte of data is
  available or the fetch request times out waiting for data to arrive. Setting this to something greater
  than 1 will cause the server to wait for larger amounts of data to accumulate which can improve
  server throughput a bit at the cost of some additional latency.

group.id
  Type: string
  Default: null
  Importance: high
  A unique string that identifies the consumer group this consumer belongs to. This property is
  required if the consumer uses either the group management functionality by using subscribe(topic)
  or the Kafka-based offset management strategy.

heartbeat.interval.ms
  Type: int
  Default: 3000
  Importance: high
  The expected time between heartbeats to the consumer coordinator when using Kafka’s group
  management facilities. Heartbeats are used to ensure that the consumer’s session stays active and to
facilitate rebalancing when new consumers join or leave the group. The value must be set lower than `session.timeout.ms`, but typically should be set no higher than 1/3 of that value. It can be adjusted even lower to control the expected time for normal rebalances.

**max.partition.fetch.bytes**
- **Type:** int
- **Default:** 1048576
- **Valid Values:** [0,...]
- **Importance:** high

The maximum amount of data per-partition the server will return. Records are fetched in batches by the consumer. If the first record batch in the first non-empty partition of the fetch is larger than this limit, the batch will still be returned to ensure that the consumer can make progress. The maximum record batch size accepted by the broker is defined via `message.max.bytes` (broker config) or `max.message.bytes` (topic config). See `fetch.max.bytes` for limiting the consumer request size.

**session.timeout.ms**
- **Type:** int
- **Default:** 10000
- **Importance:** high

The timeout used to detect consumer failures when using Kafka’s group management facility. The consumer sends periodic heartbeats to indicate its liveness to the broker. If no heartbeats are received by the broker before the expiration of this session timeout, then the broker will remove this consumer from the group and initiate a rebalance. Note that the value must be in the allowable range as configured in the broker configuration by `group.min.session.timeout.ms` and `group.max.session.timeout.ms`.

**ssl.key.password**
- **Type:** password
- **Default:** null
- **Importance:** high

The password of the private key in the key store file. This is optional for client.

**ssl.keystore.location**
- **Type:** string
- **Default:** null
- **Importance:** high

The location of the key store file. This is optional for client and can be used for two-way authentication for client.

**ssl.keystore.password**
- **Type:** password
- **Default:** null
- **Importance:** high

The store password for the key store file. This is optional for client and only needed if `ssl.keystore.location` is configured.

**ssl.truststore.location**
- **Type:** string
- **Default:** null
- **Importance:** high

The location of the trust store file.
ssl.truststore.password
  Type: password
  Default: null
  Importance: high
  The password for the trust store file. If a password is not set access to the truststore is still available, but integrity checking is disabled.

allow.auto.create.topics
  Type: boolean
  Default: true
  Importance: medium
  Allow automatic topic creation on the broker when subscribing to or assigning a topic. A topic being subscribed to will be automatically created only if the broker allows for it using auto.create.topics.enable broker configuration. This configuration must be set to false when using brokers older than 0.11.0.

auto.offset.reset
  Type: string
  Default: latest
  Valid Values: [latest, earliest, none]
  Importance: medium
  What to do when there is no initial offset in Kafka or if the current offset does not exist any more on the server (e.g. because that data has been deleted):
    - earliest: automatically reset the offset to the earliest offset
    - latest: automatically reset the offset to the latest offset
    - none: throw exception to the consumer if no previous offset is found for the consumer’s group
    - anything else: throw exception to the consumer.

client.dns.lookup
  Type: string
  Default: default
  Valid Values: [default, use_all_dns_ips, resolve_canonical_bootstrap_servers_only]
  Importance: medium
  Controls how the client uses DNS lookups.
  If set to use_all_dns_ips then, when the lookup returns multiple IP addresses for a hostname, they will all be attempted to connect to before failing the connection. Applies to both bootstrap and advertised servers.
  If the value is resolve_canonical_bootstrap_servers_only each entry will be resolved and expanded into a list of canonical names.

connections.max.idle.ms
  Type: long
  Default: 540000
  Importance: medium
  Close idle connections after the number of milliseconds specified by this config.
**default.api.timeout.ms**

*Type:* int  
*Default:* 60000  
*Valid Values:* [0, ...]  
*Importance:* medium

Specifies the timeout (in milliseconds) for consumer APIs that could block. This configuration is used as the default timeout for all consumer operations that do not explicitly accept a `timeout` parameter.

**enable.auto.commit**

*Type:* boolean  
*Default:* true  
*Importance:* medium

If true the consumer's offset will be periodically committed in the background.

**exclude.internal.topics**

*Type:* boolean  
*Default:* true  
*Importance:* medium

Whether internal topics matching a subscribed pattern should be excluded from the subscription. It is always possible to explicitly subscribe to an internal topic.

**fetch.max.bytes**

*Type:* int  
*Default:* 52428800  
*Valid Values:* [0, ...]  
*Importance:* medium

The maximum amount of data the server should return for a fetch request. Records are fetched in batches by the consumer, and if the first record batch in the first non-empty partition of the fetch is larger than this value, the record batch will still be returned to ensure that the consumer can make progress. As such, this is not a absolute maximum. The maximum record batch size accepted by the broker is defined via `message.max.bytes` (broker config) or `max.message.bytes` (topic config). Note that the consumer performs multiple fetches in parallel.

**group.instance.id**

*Type:* string  
*Default:* null  
*Importance:* medium

A unique identifier of the consumer instance provided by end user. Only non-empty strings are permitted. If set, the consumer is treated as a static member, which means that only one instance with this ID is allowed in the consumer group at any time. This can be used in combination with a larger session timeout to avoid group rebalances caused by transient unavailability (e.g. process restarts). If not set, the consumer will join the group as a dynamic member, which is the traditional behavior.

**isolation.level**

*Type:* string  
*Default:* `read_uncommitted`  
*Valid Values:* `[read_committed, read_uncommitted]`  
*Importance:* medium

Controls how to read messages written transactionally. If set to `read_committed`, `consumer.poll()` will only return transactional messages which have been committed. If set to `read_uncommitted` (the default), `consumer.poll()` will return all messages, even transactional messages which have been
aborted. Non-transactional messages will be returned unconditionally in either mode.

Messages will always be returned in offset order. Hence, in **read_committed** mode, consumer.poll() will only return messages up to the last stable offset (LSO), which is the one less than the offset of the first open transaction. In particular any messages appearing after messages belonging to ongoing transactions will be withheld until the relevant transaction has been completed. As a result, **read_committed** consumers will not be able to read up to the high watermark when there are in flight transactions.

Further, when in `read_committed` the seekToEnd method will return the LSO.

**max.poll.interval.ms**

**Type:** int  
**Default:** 300000  
**Valid Values:** [1, ... ]  
**Importance:** medium  
The maximum delay between invocations of poll() when using consumer group management. This places an upper bound on the amount of time that the consumer can be idle before fetching more records. If poll() is not called before expiration of this timeout, then the consumer is considered failed and the group will rebalance in order to reassign the partitions to another member.

**max.poll.records**

**Type:** int  
**Default:** 500  
**Valid Values:** [1, ... ]  
**Importance:** medium  
The maximum number of records returned in a single call to poll().

**partition.assignment.strategy**

**Type:** list  
**Default:** class org.apache.kafka.clients.consumer.RangeAssignor  
**Valid Values:** non-null string  
**Importance:** medium  
The class name of the partition assignment strategy that the client will use to distribute partition ownership amongst consumer instances when group management is used.

**receive.buffer.bytes**

**Type:** int  
**Default:** 65536  
**Valid Values:** [-1, ... ]  
**Importance:** medium  
The size of the TCP receive buffer (SO_RCVBUF) to use when reading data. If the value is -1, the OS default will be used.

**request.timeout.ms**

**Type:** int  
**Default:** 30000  
**Valid Values:** [0, ... ]  
**Importance:** medium  
The configuration controls the maximum amount of time the client will wait for the response of a request. If the response is not received before the timeout elapses the client will resend the request if necessary or fail the request if retries are exhausted.
**sasl.client.callback.handler.class**

- **Type:** class
- **Default:** null
- **Importance:** medium

The fully qualified name of a SASL client callback handler class that implements the AuthenticateCallbackHandler interface.

**sasl.jaas.config**

- **Type:** password
- **Default:** null
- **Importance:** medium

JAAS login context parameters for SASL connections in the format used by JAAS configuration files. JAAS configuration file format is described [here](#). The format for the value is: `loginModuleName\controlFlag (optionName=optionValue)*;`. For brokers, the config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, `listener.name.sasl_ssl.scram-sha-256.sasl.jaas.config=com.example.ScramLoginModule required;`.

**sasl.kerberos.service.name**

- **Type:** string
- **Default:** null
- **Importance:** medium

The Kerberos principal name that Kafka runs as. This can be defined either in Kafka’s JAAS config or in Kafka’s config.

**sasl.login.callback.handler.class**

- **Type:** class
- **Default:** null
- **Importance:** medium

The fully qualified name of a SASL login callback handler class that implements the AuthenticateCallbackHandler interface. For brokers, login callback handler config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, `listener.name.sasl_ssl.scram-sha-256.sasl.login.callback.handler.class=com.example.CustomScramLoginCallbackHandler`.

**sasl.login.class**

- **Type:** class
- **Default:** null
- **Importance:** medium

The fully qualified name of a class that implements the Login interface. For brokers, login config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, `listener.name.sasl_ssl.scram-sha-256.sasl.login.class=com.example.CustomScramLogin`

**sasl.mechanism**

- **Type:** string
- **Default:** GSSAPI
- **Importance:** medium

SASL mechanism used for client connections. This may be any mechanism for which a security provider is available. GSSAPI is the default mechanism.

**security.protocol**
Type: string  
Default: PLAINTEXT  
Importance: medium  
Protocol used to communicate with brokers. Valid values are: PLAINTEXT, SSL, SASL_PLAINTEXT, SASL_SSL.

send.buffer.bytes  
Type: int  
Default: 131072  
Valid Values: [-1,...]  
Importance: medium  
The size of the TCP send buffer (SO_SNDBUF) to use when sending data. If the value is -1, the OS default will be used.

ssl.enabled.protocols  
Type: list  
Default: TLSv1.2,TLSv1.1,TLSv1  
Importance: medium  
The list of protocols enabled for SSL connections.

ssl.keystore.type  
Type: string  
Default: JKS  
Importance: medium  
The file format of the key store file. This is optional for client.

ssl.protocol  
Type: string  
Default: TLS  
Importance: medium  
The SSL protocol used to generate the SSLContext. Default setting is TLS, which is fine for most cases. Allowed values in recent JVMs are TLS, TLSv1.1 and TLSv1.2. SSL, SSLv2 and SSLv3 may be supported in older JVMs, but their usage is discouraged due to known security vulnerabilities.

ssl.provider  
Type: string  
Default: null  
Importance: medium  
The name of the security provider used for SSL connections. Default value is the default security provider of the JVM.

ssl.truststore.type  
Type: string  
Default: JKS  
Importance: medium  
The file format of the trust store file.

auto.commit.interval.ms  
Type: int  
Default: 5000  
Valid Values: [0,...]
Importance: low
The frequency in milliseconds that the consumer offsets are auto-committed to Kafka if enable.auto.commit is set to true.

cHECK.CRCs
Type: boolean
Default: true
Importance: low
Automatically check the CRC32 of the records consumed. This ensures no on-the-wire or on-disk corruption to the messages occurred. This check adds some overhead, so it may be disabled in cases seeking extreme performance.

client.id
Type: string
Default:"
Importance: low
An id string to pass to the server when making requests. The purpose of this is to be able to track the source of requests beyond just ip/port by allowing a logical application name to be included in server-side request logging.

client.rack
Type: string
Default:"
Importance: low
A rack identifier for this client. This can be any string value which indicates where this client is physically located. It corresponds with the broker config 'broker.rack'.

FETCh.MAX.WAI.T.MS
Type: int
Default: 500
Valid Values: [0,...]
Importance: low
The maximum amount of time the server will block before answering the fetch request if there isn’t sufficient data to immediately satisfy the requirement given by fetch.min.bytes.

INTERCEPTor.ClaSSes
Type: list
Default:"
Valid Values: non-null string
Importance: low
A list of classes to use as interceptors. Implementing the org.apache.kafka.clients.consumer.ConsumerInterceptor interface allows you to intercept (and possibly mutate) records received by the consumer. By default, there are no interceptors.

metadata.max.age.ms
Type: long
Default: 300000
Valid Values: [0,...]
Importance: low
The period of time in milliseconds after which we force a refresh of metadata even if we haven’t seen any partition leadership changes to proactively discover any new brokers or partitions.
**metric.reporters**

Type: list  
Default: ""   
Valid Values: non-null string  
Importance: low  
A list of classes to use as metrics reporters. Implementing the `org.apache.kafka.common.metrics.MetricsReporter` interface allows plugging in classes that will be notified of new metric creation. The JmxReporter is always included to register JMX statistics.

**metrics.num.samples**

Type: int  
Default: 2  
Valid Values: [1,...]  
Importance: low  
The number of samples maintained to compute metrics.

**metrics.recording.level**

Type: string  
Default: INFO  
Valid Values: [INFO, DEBUG]  
Importance: low  
The highest recording level for metrics.

**metrics.sample.window.ms**

Type: long  
Default: 30000  
Valid Values: [0,...]  
Importance: low  
The window of time a metrics sample is computed over.

**reconnect.backoff.max.ms**

Type: long  
Default: 1000  
Valid Values: [0,...]  
Importance: low  
The maximum amount of time in milliseconds to wait when reconnecting to a broker that has repeatedly failed to connect. If provided, the backoff per host will increase exponentially for each consecutive connection failure, up to this maximum. After calculating the backoff increase, 20% random jitter is added to avoid connection storms.

**reconnect.backoff.ms**

Type: long  
Default: 50  
Valid Values: [0,...]  
Importance: low  
The base amount of time to wait before attempting to reconnect to a given host. This avoids repeatedly connecting to a host in a tight loop. This backoff applies to all connection attempts by the client to a broker.

**retry.backoff.ms**

Type: long
The amount of time to wait before attempting to retry a failed request to a given topic partition. This avoids repeatedly sending requests in a tight loop under some failure scenarios.

**sasl.kerberos.kinit.cmd**

*Type:* string  
*Default:* /usr/bin/kinit  
*Importance:* low  
Kerberos kinit command path.

**sasl.kerberos.min.time.before.relogin**

*Type:* long  
*Default:* 60000  
*Importance:* low  
Login thread sleep time between refresh attempts.

**sasl.kerberos.ticket.renew.jitter**

*Type:* double  
*Default:* 0.05  
*Importance:* low  
Percentage of random jitter added to the renewal time.

**sasl.kerberos.ticket.renew.window.factor**

*Type:* double  
*Default:* 0.8  
*Importance:* low  
Login thread will sleep until the specified window factor of time from last refresh to ticket’s expiry has been reached, at which time it will try to renew the ticket.

**sasl.login.refresh.buffer.seconds**

*Type:* short  
*Default:* 300  
*Valid Values:* [0,...,3600]  
*Importance:* low  
The amount of buffer time before credential expiration to maintain when refreshing a credential, in seconds. If a refresh would otherwise occur closer to expiration than the number of buffer seconds then the refresh will be moved up to maintain as much of the buffer time as possible. Legal values are between 0 and 3600 (1 hour); a default value of 300 (5 minutes) is used if no value is specified. This value and sasl.login.refresh.min.period.seconds are both ignored if their sum exceeds the remaining lifetime of a credential. Currently applies only to OAUTHBEARER.

**sasl.login.refresh.min.period.seconds**

*Type:* short  
*Default:* 60  
*Valid Values:* [0,...,900]  
*Importance:* low  
The desired minimum time for the login refresh thread to wait before refreshing a credential, in seconds. Legal values are between 0 and 900 (15 minutes); a default value of 60 (1 minute) is used if no value is specified. This value and sasl.login.refresh.buffer.seconds are both ignored if their sum exceeds the remaining lifetime of a credential. Currently applies only to OAUTHBEARER.
sasl.login.refresh.window.factor

Type: double
Default: 0.8
Valid Values: [0.5,…,1.0]
Importance: low
Login refresh thread will sleep until the specified window factor relative to the credential’s lifetime has been reached, at which time it will try to refresh the credential. Legal values are between 0.5 (50%) and 1.0 (100%) inclusive; a default value of 0.8 (80%) is used if no value is specified. Currently applies only to OAUTHBEARER.

sasl.login.refresh.window.jitter

Type: double
Default: 0.05
Valid Values: [0.0,…,0.25]
Importance: low
The maximum amount of random jitter relative to the credential’s lifetime that is added to the login refresh thread’s sleep time. Legal values are between 0 and 0.25 (25%) inclusive; a default value of 0.05 (5%) is used if no value is specified. Currently applies only to OAUTHBEARER.

ssl.cipher.suites

Type: list
Default: null
Importance: low
A list of cipher suites. This is a named combination of authentication, encryption, MAC and key exchange algorithm used to negotiate the security settings for a network connection using TLS or SSL network protocol. By default all the available cipher suites are supported.

ssl.endpoint.identification.algorithm

Type: string
Default: https
Importance: low
The endpoint identification algorithm to validate server hostname using server certificate.

ssl.keymanager.algorithm

Type: string
Default: SunX509
Importance: low
The algorithm used by key manager factory for SSL connections. Default value is the key manager factory algorithm configured for the Java Virtual Machine.

ssl.secure.random.implementation

Type: string
Default: null
Importance: low
The SecureRandom PRNG implementation to use for SSL cryptography operations.

ssl.trustmanager.algorithm

Type: string
Default: PKIX
Importance: low
The algorithm used by trust manager factory for SSL connections. Default value is the trust manager factory algorithm configured for the Java Virtual Machine.
APPENDIX D. PRODUCER CONFIGURATION PARAMETERS

key.serializer
Type: class
Importance: high
Serializer class for key that implements the `org.apache.kafka.common.serialization.Serializer` interface.

value.serializer
Type: class
Importance: high
Serializer class for value that implements the `org.apache.kafka.common.serialization.Serializer` interface.

acks
Type: string
Default: 1
Valid Values: [all, -1, 0, 1]
Importance: high
The number of acknowledgments the producer requires the leader to have received before considering a request complete. This controls the durability of records that are sent. The following settings are allowed:

- **acks=0**: If set to zero then the producer will not wait for any acknowledgment from the server at all. The record will be immediately added to the socket buffer and considered sent. No guarantee can be made that the server has received the record in this case, and the `retries` configuration will not take effect (as the client won’t generally know of any failures). The offset given back for each record will always be set to -1.

- **acks=1**: This will mean the leader will write the record to its local log but will respond without awaiting full acknowledgement from all followers. In this case should the leader fail immediately after acknowledging the record but before the followers have replicated it then the record will be lost.

- **acks=all**: This means the leader will wait for the full set of in-sync replicas to acknowledge the record. This guarantees that the record will not be lost as long as at least one in-sync replica remains alive. This is the strongest available guarantee. This is equivalent to the `acks=-1` setting.

bootstrap.servers
Type: list
Default: ""
Valid Values: non-null string
Importance: high
A list of host/port pairs to use for establishing the initial connection to the Kafka cluster. The client will make use of all servers irrespective of which servers are specified here for bootstrapping—this list only impacts the initial hosts used to discover the full set of servers. This list should be in the form `host1:port1,host2:port2,...`. Since these servers are just used for the initial connection to discover the full cluster membership (which may change dynamically), this list need not contain the full set of servers (you may want more than one, though, in case a server is down).

buffer.memory
Type: long
Default: 33554432
Valid Values: [0,...]
Importance: high
The total bytes of memory the producer can use to buffer records waiting to be sent to the server. If records are sent faster than they can be delivered to the server the producer will block for max.block.ms after which it will throw an exception.

This setting should correspond roughly to the total memory the producer will use, but is not a hard bound since not all memory the producer uses is used for buffering. Some additional memory will be used for compression (if compression is enabled) as well as for maintaining in-flight requests.

compression.type
Type: string
Default: none
Importance: high
The compression type for all data generated by the producer. The default is none (i.e. no compression). Valid values are none, gzip, snappy, lz4, or zstd. Compression is of full batches of data, so the efficacy of batching will also impact the compression ratio (more batching means better compression).

retries
Type: int
Default: 2147483647
Valid Values: [0,...,2147483647]
Importance: high
Setting a value greater than zero will cause the client to resend any record whose send fails with a potentially transient error. Note that this retry is no different than if the client resent the record upon receiving the error. Allowing retries without setting max.inflight.requests.per.connection to 1 will potentially change the ordering of records because if two batches are sent to a single partition, and the first fails and is retried but the second succeeds, then the records in the second batch may appear first. Note additionally that produce requests will be failed before the number of retries has been exhausted if the timeout configured by delivery.timeout.ms expires first before successful acknowledgement. Users should generally prefer to leave this config unset and instead use delivery.timeout.ms to control retry behavior.

ssl.key.password
Type: password
Default: null
Importance: high
The password of the private key in the key store file. This is optional for client.

ssl.keystore.location
Type: string
Default: null
Importance: high
The location of the key store file. This is optional for client and can be used for two-way authentication for client.

ssl.keystore.password
Type: password
Default: null
Importance: high
The store password for the key store file. This is optional for client and only needed if ssl.keystore.location is configured.

**ssl.truststore.location**
- **Type:** string
- **Default:** null
- **Importance:** high
  - The location of the trust store file.

**ssl.truststore.password**
- **Type:** password
- **Default:** null
- **Importance:** high
  - The password for the trust store file. If a password is not set access to the truststore is still available, but integrity checking is disabled.

**batch.size**
- **Type:** int
- **Default:** 16384
- **Valid Values:** [0,…
- **Importance:** medium
  - The producer will attempt to batch records together into fewer requests whenever multiple records are being sent to the same partition. This helps performance on both the client and the server. This configuration controls the default batch size in bytes.

  No attempt will be made to batch records larger than this size.

  Requests sent to brokers will contain multiple batches, one for each partition with data available to be sent.

  A small batch size will make batching less common and may reduce throughput (a batch size of zero will disable batching entirely). A very large batch size may use memory a bit more wastefully as we will always allocate a buffer of the specified batch size in anticipation of additional records.

**client.dns.lookup**
- **Type:** string
- **Default:** default
- **Valid Values:** [default, use_all_dns_ips, resolve_canonical_bootstrap_servers_only]
- **Importance:** medium
  - Controls how the client uses DNS lookups.

  If set to **use_all_dns_ips** then, when the lookup returns multiple IP addresses for a hostname, they will all be attempted to connect to before failing the connection. Applies to both bootstrap and advertised servers.

  If the value is **resolve_canonical_bootstrap_servers_only** each entry will be resolved and expanded into a list of canonical names.

**client.id**
- **Type:** string
- **Default:** ""
- **Importance:** medium
  - An id string to pass to the server when making requests. The purpose of this is to be able to track
An id string to pass to the server when making requests. The purpose of this is to be able to track the source of requests beyond just ip/port by allowing a logical application name to be included in server-side request logging.

**connections.max.idle.ms**

- **Type:** long
- **Default:** 540000
- **Importance:** medium

Close idle connections after the number of milliseconds specified by this config.

**delivery.timeout.ms**

- **Type:** int
- **Default:** 120000
- **Valid Values:** [0, ...]
- **Importance:** medium

An upper bound on the time to report success or failure after a call to `send()` returns. This limits the total time that a record will be delayed prior to sending, the time to await acknowledgement from the broker (if expected), and the time allowed for retrievable send failures. The producer may report failure to send a record earlier than this config if either an unrecoverable error is encountered, the retries have been exhausted, or the record is added to a batch which reached an earlier delivery expiration deadline. The value of this config should be greater than or equal to the sum of `request.timeout.ms` and `linger.ms`.

**linger.ms**

- **Type:** long
- **Default:** 0
- **Valid Values:** [0, ...]
- **Importance:** medium

The producer groups together any records that arrive in between request transmissions into a single batched request. Normally this occurs only under load when records arrive faster than they can be sent out. However in some circumstances the client may want to reduce the number of requests even under moderate load. This setting accomplishes this by adding a small amount of artificial delay—that is, rather than immediately sending out a record the producer will wait for up to the given delay to allow other records to be sent so that the sends can be batched together. This can be thought of as analogous to Nagle’s algorithm in TCP. This setting gives the upper bound on the delay for batching: once we get `batch.size` worth of records for a partition it will be sent immediately regardless of this setting, however if we have fewer than this many bytes accumulated for this partition we will 'linger' for the specified time waiting for more records to show up. This setting defaults to 0 (i.e. no delay). Setting `linger.ms=5`, for example, would have the effect of reducing the number of requests sent but would add up to 5ms of latency to records sent in the absence of load.

**max.block.ms**

- **Type:** long
- **Default:** 60000
- **Valid Values:** [0, ...]
- **Importance:** medium

The configuration controls how long `KafkaProducer.send()` and `KafkaProducer.partitionsFor()` will block. These methods can be blocked either because the buffer is full or metadata unavailable. Blocking in the user-supplied serializers or partitioner will not be counted against this timeout.

**max.request.size**

- **Type:** int
Default: 1048576
Valid Values: [0,...]
Importance: medium
The maximum size of a request in bytes. This setting will limit the number of record batches the producer will send in a single request to avoid sending huge requests. This is also effectively a cap on the maximum record batch size. Note that the server has its own cap on record batch size which may be different from this.

**partitioner.class**

Type: class
Default: org.apache.kafka.clients.producer.internals.DefaultPartitioner
Importance: medium
Partitioner class that implements the org.apache.kafka.clients.producer.Partitioner interface.

**receive.buffer.bytes**

Type: int
Default: 32768
Valid Values: [-1,...]
Importance: medium
The size of the TCP receive buffer (SO_RCVBUF) to use when reading data. If the value is -1, the OS default will be used.

**request.timeout.ms**

Type: int
Default: 30000
Valid Values: [0,...]
Importance: medium
The configuration controls the maximum amount of time the client will wait for the response of a request. If the response is not received before the timeout elapses the client will resend the request if necessary or fail the request if retries are exhausted. This should be larger than `replica.lag.time.max.ms` (a broker configuration) to reduce the possibility of message duplication due to unnecessary producer retries.

**sasl.client.callback.handler.class**

Type: class
Default: null
Importance: medium
The fully qualified name of a SASL client callback handler class that implements the AuthenticateCallbackHandler interface.

**sasl.jaas.config**

Type: password
Default: null
Importance: medium
JAAS login context parameters for SASL connections in the format used by JAAS configuration files. JAAS configuration file format is described here. The format for the value is: `loginModuleName= moduleName,optionName=optionValue)*;`. For brokers, the config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.jaas.config=com.example.ScramLoginModule required;

**sasl.kerberos.service.name**
Type: string  
Default: null  
Importance: medium  
The Kerberos principal name that Kafka runs as. This can be defined either in Kafka’s JAAS config or in Kafka’s config.

**sasl.login.callback.handler.class**

Type: class  
Default: null  
Importance: medium  
The fully qualified name of a SASL login callback handler class that implements the AuthenticateCallbackHandler interface. For brokers, login callback handler config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.login.callback.handler.class=com.example.CustomScramLoginCallbackHandler.

**sasl.login.class**

Type: class  
Default: null  
Importance: medium  
The fully qualified name of a class that implements the Login interface. For brokers, login config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.login.class=com.example.CustomScramLogin.

**sasl.mechanism**

Type: string  
Default: GSSAPI  
Importance: medium  
SASL mechanism used for client connections. This may be any mechanism for which a security provider is available. GSSAPI is the default mechanism.

**security.protocol**

Type: string  
Default: PLAINTEXT  
Importance: medium  
Protocol used to communicate with brokers. Valid values are: PLAINTEXT, SSL, SASL_PLAINTEXT, SASL_SSL.

**send.buffer.bytes**

Type: int  
Default: 131072  
Valid Values: [-1,...]  
Importance: medium  
The size of the TCP send buffer (SO_SNDBUF) to use when sending data. If the value is -1, the OS default will be used.

**ssl.enabled.protocols**

Type: list  
Default: TLSv1.2,TLSv1.1,TLSv1  
Importance: medium  
The list of protocols enabled for SSL connections.
ssl.keystore.type
  Type: string  
  Default: JKS  
  Importance: medium
  The file format of the key store file. This is optional for client.

ssl.protocol
  Type: string  
  Default: TLS  
  Importance: medium
  The SSL protocol used to generate the SSLContext. Default setting is TLS, which is fine for most cases. Allowed values in recent JVMs are TLS, TLSv1.1 and TLSv1.2. SSL, SSLv2 and SSLv3 may be supported in older JVMs, but their usage is discouraged due to known security vulnerabilities.

ssl.provider
  Type: string  
  Default: null  
  Importance: medium
  The name of the security provider used for SSL connections. Default value is the default security provider of the JVM.

ssl.truststore.type
  Type: string  
  Default: JKS  
  Importance: medium
  The file format of the trust store file.

enable.idempotence
  Type: boolean  
  Default: false  
  Importance: low
  When set to 'true', the producer will ensure that exactly one copy of each message is written in the stream. If 'false', producer retries due to broker failures, etc., may write duplicates of the retried message in the stream. Note that enabling idempotence requires max.in.flight.requests.per.connection to be less than or equal to 5, retries to be greater than 0 and acks must be 'all'. If these values are not explicitly set by the user, suitable values will be chosen. If incompatible values are set, a ConfigException will be thrown.

interceptor.classes
  Type: list  
  Default: ""  
  Valid Values: non-null string  
  Importance: low
  A list of classes to use as interceptors. Implementing the org.apache.kafka.clients.producer.ProducerInterceptor interface allows you to intercept (and possibly mutate) the records received by the producer before they are published to the Kafka cluster. By default, there are no interceptors.

max.in.flight.requests.per.connection
  Type: int  
  Default: 5
Valid Values: [1,...]
Importance: low
The maximum number of unacknowledged requests the client will send on a single connection before blocking. Note that if this setting is set to be greater than 1 and there are failed sends, there is a risk of message re-ordering due to retries (i.e., if retries are enabled).

metadata.max.age.ms

Type: long
Default: 300000
Valid Values: [0,...]
Importance: low
The period of time in milliseconds after which we force a refresh of metadata even if we haven’t seen any partition leadership changes to proactively discover any new brokers or partitions.

metric.reporters

Type: list
Default: ""
Valid Values: non-null string
Importance: low
A list of classes to use as metrics reporters. Implementing the org.apache.kafka.common.metrics.MetricsReporter interface allows plugging in classes that will be notified of new metric creation. The JmxReporter is always included to register JMX statistics.

metrics.num.samples

Type: int
Default: 2
Valid Values: [1,...]
Importance: low
The number of samples maintained to compute metrics.

metrics.recording.level

Type: string
Default: INFO
Valid Values: [INFO, DEBUG]
Importance: low
The highest recording level for metrics.

metrics.sample.window.ms

Type: long
Default: 30000
Valid Values: [0,...]
Importance: low
The window of time a metrics sample is computed over.

reconnect.backoff.max.ms

Type: long
Default: 1000
Valid Values: [0,...]
Importance: low
The maximum amount of time in milliseconds to wait when reconnecting to a broker that has repeatedly failed to connect. If provided, the backoff per host will increase exponentially for each consecutive connection failure, up to this maximum. After calculating the backoff increase, 20%
random jitter is added to avoid connection storms.

**reconnect.backoff.ms**
- **Type:** long
- **Default:** 50
- **Valid Values:** [0,...]
- **Importance:** low
  The base amount of time to wait before attempting to reconnect to a given host. This avoids repeatedly connecting to a host in a tight loop. This backoff applies to all connection attempts by the client to a broker.

**retry.backoff.ms**
- **Type:** long
- **Default:** 100
- **Valid Values:** [0,...]
- **Importance:** low
  The amount of time to wait before attempting to retry a failed request to a given topic partition. This avoids repeatedly sending requests in a tight loop under some failure scenarios.

**sasl.kerberos.kinit.cmd**
- **Type:** string
- **Default:** /usr/bin/kinit
- **Importance:** low
  Kerberos kinit command path.

**sasl.kerberos.min.time.before.relogin**
- **Type:** long
- **Default:** 60000
- **Importance:** low
  Login thread sleep time between refresh attempts.

**sasl.kerberos.ticket.renew.jitter**
- **Type:** double
- **Default:** 0.05
- **Importance:** low
  Percentage of random jitter added to the renewal time.

**sasl.kerberos.ticket.renew.window.factor**
- **Type:** double
- **Default:** 0.8
- **Importance:** low
  Login thread will sleep until the specified window factor of time from last refresh to ticket’s expiry has been reached, at which time it will try to renew the ticket.

**sasl.login.refresh.buffer.seconds**
- **Type:** short
- **Default:** 300
- **Valid Values:** [0,...,3600]
- **Importance:** low
  The amount of buffer time before credential expiration to maintain when refreshing a credential, in seconds. If a refresh would otherwise occur closer to expiration than the number of buffer seconds
then the refresh will be moved up to maintain as much of the buffer time as possible. Legal values are between 0 and 3600 (1 hour); a default value of 300 (5 minutes) is used if no value is specified. This value and sasl.login.refresh.min.period.seconds are both ignored if their sum exceeds the remaining lifetime of a credential. Currently applies only to OAUTHBEARER.

**sasl.login.refresh.min.period.seconds**

Type: short  
Default: 60  
Valid Values: [0,...,900]  
Importance: low  
The desired minimum time for the login refresh thread to wait before refreshing a credential, in seconds. Legal values are between 0 and 900 (15 minutes); a default value of 60 (1 minute) is used if no value is specified. This value and sasl.login.refresh.buffer.seconds are both ignored if their sum exceeds the remaining lifetime of a credential. Currently applies only to OAUTHBEARER.

**sasl.login.refresh.window.factor**

Type: double  
Default: 0.8  
Valid Values: [0.5,...,1.0]  
Importance: low  
Login refresh thread will sleep until the specified window factor relative to the credential’s lifetime has been reached, at which time it will try to refresh the credential. Legal values are between 0.5 (50%) and 1.0 (100%) inclusive; a default value of 0.8 (80%) is used if no value is specified. Currently applies only to OAUTHBEARER.

**sasl.login.refresh.window.jitter**

Type: double  
Default: 0.05  
Valid Values: [0.0,...,0.25]  
Importance: low  
The maximum amount of random jitter relative to the credential’s lifetime that is added to the login refresh thread’s sleep time. Legal values are between 0 and 0.25 (25%) inclusive; a default value of 0.05 (5%) is used if no value is specified. Currently applies only to OAUTHBEARER.

**ssl.cipher.suites**

Type: list  
Default: null  
Importance: low  
A list of cipher suites. This is a named combination of authentication, encryption, MAC and key exchange algorithm used to negotiate the security settings for a network connection using TLS or SSL network protocol. By default all the available cipher suites are supported.

**ssl.endpoint.identification.algorithm**

Type: string  
Default: https  
Importance: low  
The endpoint identification algorithm to validate server hostname using server certificate.

**ssl.keymanager.algorithm**

Type: string  
Default: SunX509  
Importance: low
The algorithm used by key manager factory for SSL connections. Default value is the key manager factory algorithm configured for the Java Virtual Machine.

ssl.secure.random.implementation

Type: string
Default: null
Importance: low
The SecureRandom PRNG implementation to use for SSL cryptography operations.

ssl.trustmanager.algorithm

Type: string
Default: PKIX
Importance: low
The algorithm used by trust manager factory for SSL connections. Default value is the trust manager factory algorithm configured for the Java Virtual Machine.

transaction.timeout.ms

Type: int
Default: 60000
Importance: low
The maximum amount of time in ms that the transaction coordinator will wait for a transaction status update from the producer before proactively aborting the ongoing transaction. If this value is larger than the transaction.max.timeout.ms setting in the broker, the request will fail with a InvalidTransactionTimeout error.

transactional.id

Type: string
Default: null
Valid Values: non-empty string
Importance: low
The TransactionalId to use for transactional delivery. This enables reliability semantics which span multiple producer sessions since it allows the client to guarantee that transactions using the same TransactionalId have been completed prior to starting any new transactions. If no TransactionalId is provided, then the producer is limited to idempotent delivery. Note that enable.idempotence must be enabled if a TransactionalId is configured. The default is null, which means transactions cannot be used. Note that, by default, transactions require a cluster of at least three brokers which is the recommended setting for production; for development you can change this, by adjusting broker setting transaction.state.log.replication.factor.
**APPENDIX E. ADMIN CLIENT CONFIGURATION PARAMETERS**

**bootstrap.servers**
- **Type:** list
- **Importance:** high
A list of host/port pairs to use for establishing the initial connection to the Kafka cluster. The client will make use of all servers irrespective of which servers are specified here for bootstrapping—this list only impacts the initial hosts used to discover the full set of servers. This list should be in the form `host1:port1,host2:port2,...`. Since these servers are just used for the initial connection to discover the full cluster membership (which may change dynamically), this list need not contain the full set of servers (you may want more than one, though, in case a server is down).

**ssl.key.password**
- **Type:** password
- **Default:** null
- **Importance:** high
The password of the private key in the key store file. This is optional for client.

**ssl.keystore.location**
- **Type:** string
- **Default:** null
- **Importance:** high
The location of the key store file. This is optional for client and can be used for two-way authentication for client.

**ssl.keystore.password**
- **Type:** password
- **Default:** null
- **Importance:** high
The store password for the key store file. This is optional for client and only needed if `ssl.keystore.location` is configured.

**ssl.truststore.location**
- **Type:** string
- **Default:** null
- **Importance:** high
The location of the trust store file.

**ssl.truststore.password**
- **Type:** password
- **Default:** null
- **Importance:** high
The password for the trust store file. If a password is not set access to the truststore is still available, but integrity checking is disabled.

**client.dns.lookup**
- **Type:** string
- **Default:** default
- **Valid Values:** [default, use_all_dns_ips, resolve_canonical_bootstrap_servers_only]
- **Importance:** medium
Controls how the client uses DNS lookups.
If set to `use_all_dns_ips` then, when the lookup returns multiple IP addresses for a hostname, they will all be attempted to connect to before failing the connection. Applies to both bootstrap and advertised servers.

If the value is `resolve_canonical_bootstrap_servers_only` each entry will be resolved and expanded into a list of canonical names.

**client.id**

- **Type:** string
- **Default:** ""
- **Importance:** medium

An id string to pass to the server when making requests. The purpose of this is to be able to track the source of requests beyond just ip/port by allowing a logical application name to be included in server-side request logging.

**connections.max.idle.ms**

- **Type:** long
- **Default:** 300000
- **Importance:** medium

Close idle connections after the number of milliseconds specified by this config.

**receive.buffer.bytes**

- **Type:** int
- **Default:** 65536
- **Valid Values:** [-1,...]
- **Importance:** medium

The size of the TCP receive buffer (SO_RCVBUF) to use when reading data. If the value is -1, the OS default will be used.

**request.timeout.ms**

- **Type:** int
- **Default:** 120000
- **Valid Values:** [0,...]
- **Importance:** medium

The configuration controls the maximum amount of time the client will wait for the response of a request. If the response is not received before the timeout elapses the client will resend the request if necessary or fail the request if retries are exhausted.

**sasl.client.callback.handler.class**

- **Type:** class
- **Default:** null
- **Importance:** medium

The fully qualified name of a SASL client callback handler class that implements the AuthenticateCallbackHandler interface.

**sasl.jaas.config**

- **Type:** password
- **Default:** null
- **Importance:** medium

JAAS login context parameters for SASL connections in the format used by JAAS configuration files. JAAS configuration file format is described [here](#). The format for the value is: 'loginModuleClass controlFlag (optionName=optionValue)*;'. For brokers, the config must be prefixed with listener
prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.jaas.config=com.example.ScramLoginModule required;

**sasl.kerberos.service.name**

*Type:* string  
*Default:* null  
*Importance:* medium  
The Kerberos principal name that Kafka runs as. This can be defined either in Kafka’s JAAS config or in Kafka’s config.

**sasl.login.callback.handler.class**

*Type:* class  
*Default:* null  
*Importance:* medium  
The fully qualified name of a SASL login callback handler class that implements the AuthenticateCallbackHandler interface. For brokers, login callback handler config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.login.callback.handler.class=com.example.CustomScramLoginCallbackHandler.

**sasl.login.class**

*Type:* class  
*Default:* null  
*Importance:* medium  
The fully qualified name of a class that implements the Login interface. For brokers, login config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.login.class=com.example.CustomScramLogin.

**sasl.mechanism**

*Type:* string  
*Default:* GSSAPI  
*Importance:* medium  
SASL mechanism used for client connections. This may be any mechanism for which a security provider is available. GSSAPI is the default mechanism.

**security.protocol**

*Type:* string  
*Default:* PLAINTEXT  
*Importance:* medium  
Protocol used to communicate with brokers. Valid values are: PLAINTEXT, SSL, SASL_PLAINTEXT, SASL_SSL.

**send.buffer.bytes**

*Type:* int  
*Default:* 131072  
*Valid Values:* [-1,...]  
*Importance:* medium  
The size of the TCP send buffer (SO_SNDBUF) to use when sending data. If the value is -1, the OS default will be used.

**ssl.enabled.protocols**
The list of protocols enabled for SSL connections.

**ssl.keystore.type**
- **Type:** string
- **Default:** JKS
- **Importance:** medium
- The file format of the key store file. This is optional for client.

**ssl.protocol**
- **Type:** string
- **Default:** TLS
- **Importance:** medium
- The SSL protocol used to generate the SSLContext. Default setting is TLS, which is fine for most cases. Allowed values in recent JVMs are TLS, TLSv1.1 and TLSv1.2. SSL, SSLv2 and SSLv3 may be supported in older JVMs, but their usage is discouraged due to known security vulnerabilities.

**ssl.provider**
- **Type:** string
- **Default:** null
- **Importance:** medium
- The name of the security provider used for SSL connections. Default value is the default security provider of the JVM.

**ssl.truststore.type**
- **Type:** string
- **Default:** JKS
- **Importance:** medium
- The file format of the trust store file.

**metadata.max.age.ms**
- **Type:** long
- **Default:** 300000
- **Valid Values:** [0,...]
- **Importance:** low
- The period of time in milliseconds after which we force a refresh of metadata even if we haven’t seen any partition leadership changes to proactively discover any new brokers or partitions.

**metric.reporters**
- **Type:** list
- **Default:** ""
- **Importance:** low
- A list of classes to use as metrics reporters. Implementing the `org.apache.kafka.common.metrics.MetricsReporter` interface allows plugging in classes that will be notified of new metric creation. The JmxReporter is always included to register JMX statistics.

**metrics.num.samples**
- **Type:** int
- **Default:** 2
Valid Values: [1,...]
Importance: low
The number of samples maintained to compute metrics.

**metrics.recording.level**
- **Type:** string
- **Default:** INFO
- **Valid Values:** [INFO, DEBUG]
- **Importance:** low
  The highest recording level for metrics.

**metrics.sample.window.ms**
- **Type:** long
- **Default:** 30000
- **Valid Values:** [0,...]
- **Importance:** low
  The window of time a metrics sample is computed over.

**reconnect.backoff.max.ms**
- **Type:** long
- **Default:** 1000
- **Valid Values:** [0,...]
- **Importance:** low
  The maximum amount of time in milliseconds to wait when reconnecting to a broker that has repeatedly failed to connect. If provided, the backoff per host will increase exponentially for each consecutive connection failure, up to this maximum. After calculating the backoff increase, 20% random jitter is added to avoid connection storms.

**reconnect.backoff.ms**
- **Type:** long
- **Default:** 50
- **Valid Values:** [0,...]
- **Importance:** low
  The base amount of time to wait before attempting to reconnect to a given host. This avoids repeatedly connecting to a host in a tight loop. This backoff applies to all connection attempts by the client to a broker.

**retries**
- **Type:** int
- **Default:** 5
- **Valid Values:** [0,...]
- **Importance:** low
  Setting a value greater than zero will cause the client to resend any request that fails with a potentially transient error.

**retry.backoff.ms**
- **Type:** long
- **Default:** 100
- **Valid Values:** [0,...]
- **Importance:** low
  The amount of time to wait before attempting to retry a failed request. This avoids repeatedly sending requests in a tight loop under some failure scenarios.
**sasl.kerberos.kinit.cmd**

*Type:* string  
*Default:* /usr/bin/kinit  
*Importance:* low  
Kerberos kinit command path.

**sasl.kerberos.min.time.before.relogin**

*Type:* long  
*Default:* 60000  
*Importance:* low  
Login thread sleep time between refresh attempts.

**sasl.kerberos.ticket.renew.jitter**

*Type:* double  
*Default:* 0.05  
*Importance:* low  
Percentage of random jitter added to the renewal time.

**sasl.kerberos.ticket.renew.window.factor**

*Type:* double  
*Default:* 0.8  
*Importance:* low  
Login thread will sleep until the specified window factor of time from last refresh to ticket’s expiry has been reached, at which time it will try to renew the ticket.

**sasl.login.refresh.buffer.seconds**

*Type:* short  
*Default:* 300  
*Valid Values:* [0,...,3600]  
*Importance:* low  
The amount of buffer time before credential expiration to maintain when refreshing a credential, in seconds. If a refresh would otherwise occur closer to expiration than the number of buffer seconds then the refresh will be moved up to maintain as much of the buffer time as possible. Legal values are between 0 and 3600 (1 hour); a default value of 300 (5 minutes) is used if no value is specified. This value and sasl.login.refresh.min.period.seconds are both ignored if their sum exceeds the remaining lifetime of a credential. Currently applies only to OAUTHBEARER.

**sasl.login.refresh.min.period.seconds**

*Type:* short  
*Default:* 60  
*Valid Values:* [0,...,900]  
*Importance:* low  
The desired minimum time for the login refresh thread to wait before refreshing a credential, in seconds. Legal values are between 0 and 900 (15 minutes); a default value of 60 (1 minute) is used if no value is specified. This value and sasl.login.refresh.buffer.seconds are both ignored if their sum exceeds the remaining lifetime of a credential. Currently applies only to OAUTHBEARER.

**sasl.login.refresh.window.factor**

*Type:* double  
*Default:* 0.8  
*Valid Values:* [0.5,...,1.0]
Importance: low
Login refresh thread will sleep until the specified window factor relative to the credential’s lifetime has been reached, at which time it will try to refresh the credential. Legal values are between 0.5 (50%) and 1.0 (100%) inclusive; a default value of 0.8 (80%) is used if no value is specified. Currently applies only to OAUTHBEARER.

`sasl.login.refresh.window.jitter`

Type: double
Default: 0.05
Valid Values: [0.0,..,0.25]
Importance: low
The maximum amount of random jitter relative to the credential’s lifetime that is added to the login refresh thread’s sleep time. Legal values are between 0 and 0.25 (25%) inclusive; a default value of 0.05 (5%) is used if no value is specified. Currently applies only to OAUTHBEARER.

`ssl.cipher.suites`

Type: list
Default: null
Importance: low
A list of cipher suites. This is a named combination of authentication, encryption, MAC and key exchange algorithm used to negotiate the security settings for a network connection using TLS or SSL network protocol. By default all the available cipher suites are supported.

`ssl.endpoint.identification.algorithm`

Type: string
Default: https
Importance: low
The endpoint identification algorithm to validate server hostname using server certificate.

`ssl.keymanager.algorithm`

Type: string
Default: SunX509
Importance: low
The algorithm used by key manager factory for SSL connections. Default value is the key manager factory algorithm configured for the Java Virtual Machine.

`ssl.secure.random.implementation`

Type: string
Default: null
Importance: low
The SecureRandom PRNG implementation to use for SSL cryptography operations.

`ssl.trustmanager.algorithm`

Type: string
Default: PKIX
Importance: low
The algorithm used by trust manager factory for SSL connections. Default value is the trust manager factory algorithm configured for the Java Virtual Machine.
APPENDIX F. KAFKA CONNECT CONFIGURATION PARAMETERS

**config.storage.topic**
- **Type:** string
- **Importance:** high
  The name of the Kafka topic where connector configurations are stored.

**group.id**
- **Type:** string
- **Importance:** high
  A unique string that identifies the Connect cluster group this worker belongs to.

**key.converter**
- **Type:** class
- **Importance:** high
  Converter class used to convert between Kafka Connect format and the serialized form that is written to Kafka. This controls the format of the keys in messages written to or read from Kafka, and since this is independent of connectors it allows any connector to work with any serialization format. Examples of common formats include JSON and Avro.

**offset.storage.topic**
- **Type:** string
- **Importance:** high
  The name of the Kafka topic where connector offsets are stored.

**status.storage.topic**
- **Type:** string
- **Importance:** high
  The name of the Kafka topic where connector and task status are stored.

**value.converter**
- **Type:** class
- **Importance:** high
  Converter class used to convert between Kafka Connect format and the serialized form that is written to Kafka. This controls the format of the values in messages written to or read from Kafka, and since this is independent of connectors it allows any connector to work with any serialization format. Examples of common formats include JSON and Avro.

**bootstrap.servers**
- **Type:** list
- **Default:** localhost:9092
- **Importance:** high
  A list of host/port pairs to use for establishing the initial connection to the Kafka cluster. The client will make use of all servers irrespective of which servers are specified here for bootstrapping—this list only impacts the initial hosts used to discover the full set of servers. This list should be in the form `host1:port1,host2:port2,...`. Since these servers are just used for the initial connection to discover the full cluster membership (which may change dynamically), this list need not contain the full set of servers (you may want more than one, though, in case a server is down).
heartbeat.interval.ms
Type: int
Default: 3000
Importance: high
The expected time between heartbeats to the group coordinator when using Kafka’s group management facilities. Heartbeats are used to ensure that the worker’s session stays active and to facilitate rebalancing when new members join or leave the group. The value must be set lower than session.timeout.ms, but typically should be set no higher than 1/3 of that value. It can be adjusted even lower to control the expected time for normal rebalances.

rebalance.timeout.ms
Type: int
Default: 60000
Importance: high
The maximum allowed time for each worker to join the group once a rebalance has begun. This is basically a limit on the amount of time needed for all tasks to flush any pending data and commit offsets. If the timeout is exceeded, then the worker will be removed from the group, which will cause offset commit failures.

session.timeout.ms
Type: int
Default: 10000
Importance: high
The timeout used to detect worker failures. The worker sends periodic heartbeats to indicate its liveness to the broker. If no heartbeats are received by the broker before the expiration of this session timeout, then the broker will remove the worker from the group and initiate a rebalance. Note that the value must be in the allowable range as configured in the broker configuration by group.min.session.timeout.ms and group.max.session.timeout.ms.

ssl.key.password
Type: password
Default: null
Importance: high
The password of the private key in the key store file. This is optional for client.

ssl.keystore.location
Type: string
Default: null
Importance: high
The location of the key store file. This is optional for client and can be used for two-way authentication for client.

ssl.keystore.password
Type: password
Default: null
Importance: high
The store password for the key store file. This is optional for client and only needed if ssl.keystore.location is configured.

ssl.truststore.location
Type: string
Default: null
Importance: high
The location of the trust store file.

ssl.truststore.password
Type: password
Default: null
Importance: high
The password for the trust store file. If a password is not set access to the truststore is still available, but integrity checking is disabled.

client.dns.lookup
Type: string
Default: default
Valid Values: [default, use_all_dns_ips, resolve_canonical_bootstrap_servers_only]
Importance: medium
Controls how the client uses DNS lookups.

If set to use_all_dns_ips then, when the lookup returns multiple IP addresses for a hostname, they will all be attempted to connect to before failing the connection. Applies to both bootstrap and advertised servers.

If the value is resolve_canonical_bootstrap_servers_only each entry will be resolved and expanded into a list of canonical names.

connections.max.idle.ms
Type: long
Default: 540000
Importance: medium
Close idle connections after the number of milliseconds specified by this config.

connector.client.config.override.policy
Type: string
Default: None
Importance: medium
Class name or alias of implementation of ConnectorClientConfigOverridePolicy. Defines what client configurations can be overridden by the connector. The default implementation is None. The other possible policies in the framework include All and Principal.

receive.buffer.bytes
Type: int
Default: 32768
Valid Values: [0, ...]
Importance: medium
The size of the TCP receive buffer (SO_RCVBUF) to use when reading data. If the value is -1, the OS default will be used.

request.timeout.ms
Type: int
Default: 40000
Valid Values: [0, ...]
The configuration controls the maximum amount of time the client will wait for the response of a request. If the response is not received before the timeout elapses the client will resend the request if necessary or fail the request if retries are exhausted.

**sasl.client.callback.handler.class**

*Type:* class  
*Default:* null  
*Importance:* medium  
The fully qualified name of a SASL client callback handler class that implements the AuthenticateCallbackHandler interface.

**sasl.jaas.config**

*Type:* password  
*Default:* null  
*Importance:* medium  
JAAS login context parameters for SASL connections in the format used by JAAS configuration files. JAAS configuration file format is described [here](#). The format for the value is: 'loginModuleClass controlFlag (optionName=optionValue)*;'. For brokers, the config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.jaas.config=com.example.ScramLoginModule required;

**sasl.kerberos.service.name**

*Type:* string  
*Default:* null  
*Importance:* medium  
The Kerberos principal name that Kafka runs as. This can be defined either in Kafka’s JAAS config or in Kafka’s config.

**sasl.login.callback.handler.class**

*Type:* class  
*Default:* null  
*Importance:* medium  
The fully qualified name of a SASL login callback handler class that implements the AuthenticateCallbackHandler interface. For brokers, login callback handler config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.login.callback.handler.class=com.example.CustomScramLoginCallbackHandler.

**sasl.login.class**

*Type:* class  
*Default:* null  
*Importance:* medium  
The fully qualified name of a class that implements the Login interface. For brokers, login config must be prefixed with listener prefix and SASL mechanism name in lower-case. For example, listener.name.sasl_ssl.scram-sha-256.sasl.login.class=com.example.CustomScramLogin.

**sasl.mechanism**

*Type:* string  
*Default:* GSSAPI  
*Importance:* medium
SASL mechanism used for client connections. This may be any mechanism for which a security provider is available. GSSAPI is the default mechanism.

**security.protocol**
- **Type:** string
- **Default:** PLAINTEXT
- **Importance:** medium
  - Protocol used to communicate with brokers. Valid values are: PLAINTEXT, SSL, SASL_PLAINTEXT, SASL_SSL.

**send.buffer.bytes**
- **Type:** int
- **Default:** 131072
- **Valid Values:** [0,...]
- **Importance:** medium
  - The size of the TCP send buffer (SO_SNDBUF) to use when sending data. If the value is -1, the OS default will be used.

**ssl.enabled.protocols**
- **Type:** list
- **Default:** TLSv1.2, TLSv1.1, TLSv1
- **Importance:** medium
  - The list of protocols enabled for SSL connections.

**ssl.keystore.type**
- **Type:** string
- **Default:** JKS
- **Importance:** medium
  - The file format of the key store file. This is optional for client.

**ssl.protocol**
- **Type:** string
- **Default:** TLS
- **Importance:** medium
  - The SSL protocol used to generate the SSLContext. Default setting is TLS, which is fine for most cases. Allowed values in recent JVMs are TLS, TLSv1.1 and TLSv1.2. SSL, SSLv2 and SSLv3 may be supported in older JVMs, but their usage is discouraged due to known security vulnerabilities.

**ssl.provider**
- **Type:** string
- **Default:** null
- **Importance:** medium
  - The name of the security provider used for SSL connections. Default value is the default security provider of the JVM.

**ssl.truststore.type**
- **Type:** string
- **Default:** JKS
- **Importance:** medium
  - The file format of the trust store file.
worker.sync.timeout.ms
  Type: int
  Default: 3000
  Importance: medium
  When the worker is out of sync with other workers and needs to resynchronize configurations, wait up to this amount of time before giving up, leaving the group, and waiting a backoff period before rejoining.

worker.unsync.backoff.ms
  Type: int
  Default: 300000
  Importance: medium
  When the worker is out of sync with other workers and fails to catch up within worker.sync.timeout.ms, leave the Connect cluster for this long before rejoining.

access.control.allow.methods
  Type: string
  Default: ""
  Importance: low
  Sets the methods supported for cross origin requests by setting the Access-Control-Allow-Methods header. The default value of the Access-Control-Allow-Methods header allows cross origin requests for GET, POST and HEAD.

access.control.allow.origin
  Type: string
  Default: ""
  Importance: low
  Value to set the Access-Control-Allow-Origin header to for REST API requests. To enable cross origin access, set this to the domain of the application that should be permitted to access the API, or '*' to allow access from any domain. The default value only allows access from the domain of the REST API.

client.id
  Type: string
  Default: ""
  Importance: low
  An id string to pass to the server when making requests. The purpose of this is to be able to track the source of requests beyond just ip/port by allowing a logical application name to be included in server-side request logging.

config.providers
  Type: list
  Default: ""
  Importance: low
  Comma-separated names of ConfigProvider classes, loaded and used in the order specified. Implementing the interface ConfigProvider allows you to replace variable references in connector configurations, such as for externalized secrets.

config.storage.replication.factor
  Type: short
  Default: 3
Valid Values: [1,...]
Importance: low
Replication factor used when creating the configuration storage topic.

**connect.protocol**

- **Type:** string
- **Default:** compatible
- **Valid Values:** [eager, compatible]
- **Importance:** low
  Compatibility mode for Kafka Connect Protocol.

**header.converter**

- **Type:** class
- **Default:** org.apache.kafka.connect.storage.SimpleHeaderConverter
- **Importance:** low
  HeaderConverter class used to convert between Kafka Connect format and the serialized form that is written to Kafka. This controls the format of the header values in messages written to or read from Kafka, and since this is independent of connectors it allows any connector to work with any serialization format. Examples of common formats include JSON and Avro. By default, the SimpleHeaderConverter is used to serialize header values to strings and deserialize them by inferring the schemas.

**internal.key.converter**

- **Type:** class
- **Default:** org.apache.kafka.connect.json.JsonConverter
- **Importance:** low
  Converter class used to convert between Kafka Connect format and the serialized form that is written to Kafka. This controls the format of the keys in messages written to or read from Kafka, and since this is independent of connectors it allows any connector to work with any serialization format. Examples of common formats include JSON and Avro. This setting controls the format used for internal bookkeeping data used by the framework, such as configs and offsets, so users can typically use any functioning Converter implementation. Deprecated; will be removed in an upcoming version.

**internal.value.converter**

- **Type:** class
- **Default:** org.apache.kafka.connect.json.JsonConverter
- **Importance:** low
  Converter class used to convert between Kafka Connect format and the serialized form that is written to Kafka. This controls the format of the values in messages written to or read from Kafka, and since this is independent of connectors it allows any connector to work with any serialization format. Examples of common formats include JSON and Avro. This setting controls the format used for internal bookkeeping data used by the framework, such as configs and offsets, so users can typically use any functioning Converter implementation. Deprecated; will be removed in an upcoming version.

**listeners**

- **Type:** list
- **Default:** null
- **Importance:** low
  List of comma-separated URIs the REST API will listen on. The supported protocols are HTTP and HTTPS. Specify hostname as 0.0.0.0 to bind to all interfaces. Leave hostname empty to bind to default interface. Examples of legal listener lists: HTTP://myhost:8083,HTTPS://myhost:8084.
metadata.max.age.ms

Type: long
Default: 300000
Valid Values: [0,...]
Importance: low
The period of time in milliseconds after which we force a refresh of metadata even if we haven’t seen any partition leadership changes to proactively discover any new brokers or partitions.

metric.reporters

Type: list
Default: “”
Importance: low
A list of classes to use as metrics reporters. Implementing the org.apache.kafka.common.metrics.MetricsReporter interface allows plugging in classes that will be notified of new metric creation. The JmxReporter is always included to register JMX statistics.

metrics.num.samples

Type: int
Default: 2
Valid Values: [1,...]
Importance: low
The number of samples maintained to compute metrics.

metrics.recording.level

Type: string
Default: INFO
Valid Values: [INFO, DEBUG]
Importance: low
The highest recording level for metrics.

metrics.sample.window.ms

Type: long
Default: 30000
Valid Values: [0,...]
Importance: low
The window of time a metrics sample is computed over.

offset.flush.interval.ms

Type: long
Default: 60000
Importance: low
Interval at which to try committing offsets for tasks.

offset.flush.timeout.ms

Type: long
Default: 5000
Importance: low
Maximum number of milliseconds to wait for records to flush and partition offset data to be committed to offset storage before cancelling the process and restoring the offset data to be committed in a future attempt.
offset.storage.partitions
Type: int
Default: 25
Valid Values: [1,...]
Importance: low
The number of partitions used when creating the offset storage topic.

offset.storage.replication.factor
Type: short
Default: 3
Valid Values: [1,...]
Importance: low
Replication factor used when creating the offset storage topic.

plugin.path
Type: list
Default: null
Importance: low
List of paths separated by commas (,) that contain plugins (connectors, converters, transformations). The list should consist of top level directories that include any combination of: a) directories immediately containing jars with plugins and their dependencies b) uber-jars with plugins and their dependencies c) directories immediately containing the package directory structure of classes of plugins and their dependencies Note: symlinks will be followed to discover dependencies or plugins. Examples: 
plugin.path=/usr/local/share/java,/usr/local/share/kafka/plugins,/opt/connectors.

reconnect.backoff.max.ms
Type: long
Default: 1000
Valid Values: [0,...]
Importance: low
The maximum amount of time in milliseconds to wait when reconnecting to a broker that has repeatedly failed to connect. If provided, the backoff per host will increase exponentially for each consecutive connection failure, up to this maximum. After calculating the backoff increase, 20% random jitter is added to avoid connection storms.

reconnect.backoff.ms
Type: long
Default: 50
Valid Values: [0,...]
Importance: low
The base amount of time to wait before attempting to reconnect to a given host. This avoids repeatedly connecting to a host in a tight loop. This backoff applies to all connection attempts by the client to a broker.

rest.advertised.host.name
Type: string
Default: null
Importance: low
If this is set, this is the hostname that will be given out to other workers to connect to.

rest.advertised.listener
rest.advertised.port

Type: int
Default: null
Importance: low

If this is set, this is the port that will be given out to other workers to connect to.

rest.extension.classes

Type: list
Default: 
Importance: low

Comma-separated names of ConnectRestExtension classes, loaded and called in the order specified. Implementing the interface ConnectRestExtension allows you to inject into Connect’s REST API user defined resources like filters. Typically used to add custom capability like logging, security, etc.

rest.host.name

Type: string
Default: null
Importance: low

Hostname for the REST API. If this is set, it will only bind to this interface.

rest.port

Type: int
Default: 8083
Importance: low

Port for the REST API to listen on.

retry.backoff.ms

Type: long
Default: 100
Valid Values: [0,...]
Importance: low

The amount of time to wait before attempting to retry a failed request to a given topic partition. This avoids repeatedly sending requests in a tight loop under some failure scenarios.

sasl.kerberos.kinit.cmd

Type: string
Default: /usr/bin/kinit
Importance: low

Kerberos kinit command path.

sasl.kerberos.min.time.before.relogin

Type: long
Default: 60000
Importance: low

Login thread sleep time between refresh attempts.
sasl.kerberos.ticket.renew.jitter
Type: double
Default: 0.05
Importance: low
Percentage of random jitter added to the renewal time.

sasl.kerberos.ticket.renew.window.factor
Type: double
Default: 0.8
Importance: low
Login thread will sleep until the specified window factor of time from last refresh to ticket’s expiry has been reached, at which time it will try to renew the ticket.

sasl.login.refresh.buffer.seconds
Type: short
Default: 300
Valid Values: [0,...,3600]
Importance: low
The amount of buffer time before credential expiration to maintain when refreshing a credential, in seconds. If a refresh would otherwise occur closer to expiration than the number of buffer seconds then the refresh will be moved up to maintain as much of the buffer time as possible. Legal values are between 0 and 3600 (1 hour); a default value of 300 (5 minutes) is used if no value is specified. This value and sasl.login.refresh.min.period.seconds are both ignored if their sum exceeds the remaining lifetime of a credential. Currently applies only to OAUTHBEARER.

sasl.login.refresh.min.period.seconds
Type: short
Default: 60
Valid Values: [0,...,900]
Importance: low
The desired minimum time for the login refresh thread to wait before refreshing a credential, in seconds. Legal values are between 0 and 900 (15 minutes); a default value of 60 (1 minute) is used if no value is specified. This value and sasl.login.refresh.buffer.seconds are both ignored if their sum exceeds the remaining lifetime of a credential. Currently applies only to OAUTHBEARER.

sasl.login.refresh.window.factor
Type: double
Default: 0.8
Valid Values: [0.5,...,1.0]
Importance: low
Login refresh thread will sleep until the specified window factor relative to the credential’s lifetime has been reached, at which time it will try to refresh the credential. Legal values are between 0.5 (50%) and 1.0 (100%) inclusive; a default value of 0.8 (80%) is used if no value is specified. Currently applies only to OAUTHBEARER.

sasl.login.refresh.window.jitter
Type: double
Default: 0.05
Valid Values: [0.0,...,0.25]
Importance: low
The maximum amount of random jitter relative to the credential’s lifetime that is added to the login refresh thread’s sleep time. Legal values are between 0 and 0.25 (25%) inclusive; a default value of 0.05 (5%) is used if no value is specified. Currently applies only to OAUTHBEARER.

**scheduled.rebalance.max.delay.ms**
- **Type:** int
- **Default:** 300000
- **Valid Values:** [0,…,2147483647]
- **Importance:** low

Compatibility mode for Kafka Connect Protocol.

**ssl.cipher.suites**
- **Type:** list
- **Default:** null
- **Importance:** low

A list of cipher suites. This is a named combination of authentication, encryption, MAC and key exchange algorithm used to negotiate the security settings for a network connection using TLS or SSL network protocol. By default all the available cipher suites are supported.

**ssl.client.auth**
- **Type:** string
- **Default:** none
- **Importance:** low

Configures kafka broker to request client authentication. The following settings are common:

- **ssl.client.auth=required** If set to required client authentication is required.
- **ssl.client.auth=requested** This means client authentication is optional. Unlike requested, if this option is set client can choose not to provide authentication information about itself
- **ssl.client.auth=none** This means client authentication is not needed.

**ssl.endpoint.identification.algorithm**
- **Type:** string
- **Default:** https
- **Importance:** low

The endpoint identification algorithm to validate server hostname using server certificate.

**ssl.keymanager.algorithm**
- **Type:** string
- **Default:** SunX509
- **Importance:** low

The algorithm used by key manager factory for SSL connections. Default value is the key manager factory algorithm configured for the Java Virtual Machine.

**ssl.secure.random.implementation**
- **Type:** string
- **Default:** null
- **Importance:** low

The SecureRandom PRNG implementation to use for SSL cryptography operations.

**ssl.trustmanager.algorithm**
Type: string
Default: PKIX
Importance: low
The algorithm used by trust manager factory for SSL connections. Default value is the trust manager factory algorithm configured for the Java Virtual Machine.

status.storage.partitions
Type: int
Default: 5
Valid Values: [1,...]
Importance: low
The number of partitions used when creating the status storage topic.

status.storage.replication.factor
Type: short
Default: 3
Valid Values: [1,...]
Importance: low
Replication factor used when creating the status storage topic.

task.shutdown.graceful.timeout.ms
Type: long
Default: 5000
Importance: low
Amount of time to wait for tasks to shutdown gracefully. This is the total amount of time, not per task. All task have shutdown triggered, then they are waited on sequentially.
APPENDIX G. KAFKA STREAMS CONFIGURATION PARAMETERS

application.id
Type: string
Importance: high
An identifier for the stream processing application. Must be unique within the Kafka cluster. It is used as 1) the default client-id prefix, 2) the group-id for membership management, 3) the changelog topic prefix.

bootstrap.servers
Type: list
Importance: high
A list of host/port pairs to use for establishing the initial connection to the Kafka cluster. The client will make use of all servers irrespective of which servers are specified here for bootstrapping—this list only impacts the initial hosts used to discover the full set of servers. This list should be in the form host1:port1,host2:port2,... Since these servers are just used for the initial connection to discover the full cluster membership (which may change dynamically), this list need not contain the full set of servers (you may want more than one, though, in case a server is down).

replication.factor
Type: int
Default: 1
Importance: high
The replication factor for change log topics and repartition topics created by the stream processing application.

state.dir
Type: string
Default: /tmp/kafka-streams
Importance: high
Directory location for state store.

cache.max.bytes.buffering
Type: long
Default: 10485760
Valid Values: [0,...]  
Importance: medium
Maximum number of memory bytes to be used for buffering across all threads.

client.id
Type: string
Default: ""
Importance: medium
An ID prefix string used for the client IDs of internal consumer, producer and restore-consumer, with pattern '<client.id>-StreamThread<threadSequenceNumber><consumer|producer|restore-consumer>'

default.deserialization.exception.handler
**Type:** class
**Default:** org.apache.kafka.streams.errors.LogAndFailExceptionHandler
**Importance:** medium
Exception handling class that implements the
org.apache.kafka.streams.errors.DeserializationExceptionHandler interface.

**default.key.serde**

**Type:** class
**Default:** org.apache.kafka.common.serialization.Serdes$ByteArraySerde
**Importance:** medium
Default serializer / deserializer class for key that implements the
org.apache.kafka.common.serialization.Serde interface. Note when windowed serde class is used,
one needs to set the inner serde class that implements the
org.apache.kafka.common.serialization.Serde interface via 'default.windowed.key.serde.inner' or
'default.windowed.value.serde.inner' as well.

**default.production.exception.handler**

**Type:** class
**Default:** org.apache.kafka.streams.errors.DefaultProductionExceptionHandler
**Importance:** medium
Exception handling class that implements the
org.apache.kafka.streams.errors.ProductionExceptionHandler interface.

**default.timestep.extractor**

**Type:** class
**Default:** org.apache.kafka.streams.processor.FailOnInvalidTimestamp
**Importance:** medium
Default timestamp extractor class that implements the

**default.value.serde**

**Type:** class
**Default:** org.apache.kafka.common.serialization.Serdes$ByteArraySerde
**Importance:** medium
Default serializer / deserializer class for value that implements the
org.apache.kafka.common.serialization.Serde interface. Note when windowed serde class is used,
one needs to set the inner serde class that implements the
org.apache.kafka.common.serialization.Serde interface via 'default.windowed.key.serde.inner' or
'default.windowed.value.serde.inner' as well.

**max.task.idle.ms**

**Type:** long
**Default:** 0
**Importance:** medium
Maximum amount of time a stream task will stay idle when not all of its partition buffers contain
records, to avoid potential out-of-order record processing across multiple input streams.

**num.standby.replicas**

**Type:** int
**Default:** 0
**Importance:** medium
The number of standby replicas for each task.
**num.stream.threads**
- **Type:** int
- **Default:** 1
- **Importance:** medium
  
  The number of threads to execute stream processing.

**processing.guarantee**
- **Type:** string
- **Default:** at_least_once
- **Valid Values:** [at_least_once, exactly_once]
- **Importance:** medium
  
  The processing guarantee that should be used. Possible values are at_least_once (default) and exactly_once. Note that exactly-once processing requires a cluster of at least three brokers by default what is the recommended setting for production; for development you can change this, by adjusting broker setting `transaction.state.log.replication.factor` and `transaction.state.log.min.isr`.

**security.protocol**
- **Type:** string
- **Default:** PLAINTEXT
- **Importance:** medium
  
  Protocol used to communicate with brokers. Valid values are: PLAINTEXT, SSL, SASL_PLAINTEXT, SASL_SSL.

**topology.optimization**
- **Type:** string
- **Default:** none
- **Valid Values:** [none, all]
- **Importance:** medium
  
  A configuration telling Kafka Streams if it should optimize the topology, disabled by default.

**application.server**
- **Type:** string
- **Default:** ""
- **Importance:** low
  
  A host:port pair pointing to an embedded user defined endpoint that can be used for discovering the locations of state stores within a single KafkaStreams application.

**buffered.records.per.partition**
- **Type:** int
- **Default:** 1000
- **Importance:** low
  
  Maximum number of records to buffer per partition.

**commit.interval.ms**
- **Type:** long
- **Default:** 30000
- **Valid Values:** [0,...]
- **Importance:** low
  
  The frequency with which to save the position of the processor. (Note, if `processing.guarantee` is set to exactly_once, the default value is 100, otherwise the default value is 30000.)
connections.max.idle.ms
Type: long
Default: 540000
Importance: low
Close idle connections after the number of milliseconds specified by this config.

metadata.max.age.ms
Type: long
Default: 300000
Valid Values: [0,…]
Importance: low
The period of time in milliseconds after which we force a refresh of metadata even if we haven’t seen any partition leadership changes to proactively discover any new brokers or partitions.

metric.reporters
Type: list
Default: ""
Importance: low
A list of classes to use as metrics reporters. Implementing the
org.apache.kafka.common.metrics.MetricsReporter interface allows plugging in classes that will be notified of new metric creation. The JmxReporter is always included to register JMX statistics.

metrics.num.samples
Type: int
Default: 2
Valid Values: [1,…]
Importance: low
The number of samples maintained to compute metrics.

metrics.recording.level
Type: string
Default: INFO
Valid Values: [INFO, DEBUG]
Importance: low
The highest recording level for metrics.

metrics.sample.window.ms
Type: long
Default: 30000
Valid Values: [0,…]
Importance: low
The window of time a metrics sample is computed over.

partition.grouper
Type: class
Default: org.apache.kafka.streams.processor.DefaultPartitionGrouper
Importance: low
Partition grouper class that implements the

poll.ms
Type: long  
Default: 100  
Importance: low  
The amount of time in milliseconds to block waiting for input.

receive.buffer.bytes  
Type: int  
Default: 32768  
Valid Values: [-1,...]  
Importance: low  
The size of the TCP receive buffer (SO_RCVBUF) to use when reading data. If the value is -1, the OS default will be used.

reconnect.backoff.max.ms  
Type: long  
Default: 1000  
Valid Values: [0,...]  
Importance: low  
The maximum amount of time in milliseconds to wait when reconnecting to a broker that has repeatedly failed to connect. If provided, the backoff per host will increase exponentially for each consecutive connection failure, up to this maximum. After calculating the backoff increase, 20% random jitter is added to avoid connection storms.

reconnect.backoff.ms  
Type: long  
Default: 50  
Valid Values: [0,...]  
Importance: low  
The base amount of time to wait before attempting to reconnect to a given host. This avoids repeatedly connecting to a host in a tight loop. This backoff applies to all connection attempts by the client to a broker.

request.timeout.ms  
Type: int  
Default: 40000  
Valid Values: [0,...]  
Importance: low  
The configuration controls the maximum amount of time the client will wait for the response of a request. If the response is not received before the timeout elapses the client will resend the request if necessary or fail the request if retries are exhausted.

retries  
Type: int  
Default: 0  
Valid Values: [0,...,2147483647]  
Importance: low  
Setting a value greater than zero will cause the client to resend any request that fails with a potentially transient error.

retry.backoff.ms  
Type: long  
Default: 100
Valid Values: [0, ...]
Importance: low
The amount of time to wait before attempting to retry a failed request to a given topic partition. This avoids repeatedly sending requests in a tight loop under some failure scenarios.

rocksdb.config.setter
Type: class
Default: null
Importance: low
A Rocks DB config setter class or class name that implements the org.apache.kafka.streams.state.RocksDBConfigSetter interface.

send.buffer.bytes
Type: int
Default: 131072
Valid Values: [-1, ...]
Importance: low
The size of the TCP send buffer (SO_SNDBUF) to use when sending data. If the value is -1, the OS default will be used.

state.cleanup.delay.ms
Type: long
Default: 600000
Importance: low
The amount of time in milliseconds to wait before deleting state when a partition has migrated. Only state directories that have not been modified for at least state.cleanup.delay.ms will be removed.

upgrade.from
Type: string
Default: null
Valid Values: [null, 0.10.0, 0.10.1, 0.10.2, 0.11.0, 1.0, 1.1]
Importance: low
Allows upgrading from versions 0.10.0/0.10.1/0.10.2/0.11.0/1.0/1.1 to version 1.2 (or newer) in a backward compatible way. When upgrading from 1.2 to a newer version it is not required to specify this config. Default is null. Accepted values are "0.10.0", "0.10.1", "0.10.2", "0.11.0", "1.0", "1.1" (for upgrading from the corresponding old version).

windowstore.changelog.additional.retention.ms
Type: long
Default: 86400000
Importance: low
Added to a windows maintainMs to ensure data is not deleted from the log prematurely. Allows for clock drift. Default is 1 day.
APPENDIX H. USING YOUR SUBSCRIPTION

AMQ Streams 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 customer portal to find the relevant files for download.

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

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