Red Hat AMQ Streams 2.4

Configuring AMQ Streams on OpenShift

Configure and manage a deployment of AMQ Streams 2.4 on OpenShift Container Platform

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Legal Notice

Abstract

Configure the operators and Kafka components deployed with AMQ Streams to build a large-scale messaging network.

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MAKING OPEN SOURCE MORE INCLUSIVE

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

CHAPTER 1. CONFIGURATION OVERVIEW

AMQ Streams simplifies the process of running Apache Kafka in an OpenShift cluster.

This guide describes how to configure and manage an AMQ Streams deployment.

1.1. CONFIGURING CUSTOM RESOURCES

Use custom resources to configure your AMQ Streams deployment.

You can use custom resources to configure and create instances of the following components:

- Kafka clusters
- Kafka Connect clusters
- Kafka MirrorMaker
- Kafka Bridge
- Cruise Control

You can also use custom resource configuration to manage your instances or modify your deployment to introduce additional features. This might include configuration that supports the following:

- Securing client access to Kafka brokers
- Accessing Kafka brokers from outside the cluster
- Creating topics
- Creating users (clients)
- Controlling feature gates
- Changing logging frequency
- Allocating resource limits and requests
- Introducing features, such as AMQ Streams Drain Cleaner, Cruise Control, or distributed tracing.

The Custom resource API reference describes the properties you can use in your configuration.

1.2. USING CONFIGMAPS TO ADD CONFIGURATION

Use **ConfigMap** resources to add specific configuration to your AMQ Streams deployment. ConfigMaps use key-value pairs to store non-confidential data. Configuration data added to ConfigMaps is maintained in one place and can be reused amongst components.

ConfigMaps can only store configuration data related to the following:

- Logging configuration
- Metrics configuration
- External configuration for Kafka Connect connectors

You can't use ConfigMaps for other areas of configuration.

When you configure a component, you can add a reference to a ConfigMap using the **configMapKeyRef** property.

For example, you can use **configMapKeyRef** to reference a ConfigMap that provides configuration for logging. You might use a ConfigMap to pass a Log4j configuration file. You add the reference to the **logging** configuration.

Example ConfigMap for logging

```
spec:
  # ...
  logging:
    type: external
    valueFrom:
      configMapKeyRef:
        name: my-config-map
        key: my-config-map-key
```

To use a ConfigMap for metrics configuration, you add a reference to the **metricsConfig** configuration of the component in the same way.

ExternalConfiguration properties make data from a ConfigMap (or Secret) mounted to a pod available as environment variables or volumes. You can use external configuration data for the connectors used by Kafka Connect. The data might be related to an external data source, providing the values needed for the connector to communicate with that data source.

For example, you can use the **configMapKeyRef** property to pass configuration data from a ConfigMap as an environment variable.

Example ConfigMap providing environment variable values

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect
spec:
  # ...
  externalConfiguration:
    env:
      - name: MY_ENVIRONMENT_VARIABLE
        valueFrom:
          configMapKeyRef:
            name: my-config-map
            key: my-key
```

If you are using ConfigMaps that are managed externally, use configuration providers to load the data in the ConfigMaps. For more information on using configuration providers, see Chapter 3, *Loading configuration values from external sources*.

1.2.1. Naming custom ConfigMaps

AMQ Streams creates its own ConfigMaps and other resources when it is deployed to OpenShift. The ConfigMaps contain data necessary for running components. The ConfigMaps created by AMQ Streams must not be edited.

Make sure that any custom ConfigMaps you create do not have the same name as these default ConfigMaps. If they have the same name, they will be overwritten. For example, if your ConfigMap has the same name as the ConfigMap for the Kafka cluster, it will be overwritten when there is an update to the Kafka cluster.

Additional resources

- Section 2.2.7, "List of Kafka cluster resources" (including ConfigMaps)
- Section 2.9, "Logging configuration"
- Section 6.1.8, "**metricsConfig**"
- Section 6.2.74, "**ExternalConfiguration** schema reference"
- Chapter 3, *Loading configuration values from external sources*

1.3. DOCUMENT CONVENTIONS

User-replaced values

User-replaced values, also known as *replaceables*, are shown in *italics* with angle brackets (< >). Underscores (_) are used for multi-word values. If the value refers to code or commands, **monospace** is also used.

For example, in the following code, you will want to replace ***<my_namespace>*** with the name of your namespace:

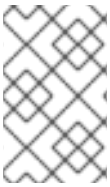
```
sed -i 's/namespace: .*/namespace: <my_namespace>/' install/cluster-operator/*RoleBinding*.yaml
```

1.4. ADDITIONAL RESOURCES

- AMQ Streams Overview
- Deploying and Upgrading AMQ Streams
- Using the AMQ Streams Kafka Bridge

CHAPTER 2. CONFIGURING AN AMQ STREAMS ON OPENSHIFT DEPLOYMENT

Configure your AMQ Streams deployment using custom resources. AMQ Streams provides example configuration files, which can serve as a starting point when building your own Kafka component configuration for deployment.



NOTE

Labels applied to a custom resource are also applied to the OpenShift resources making up its cluster. This provides a convenient mechanism for resources to be labeled as required.

Monitoring an AMQ Streams deployment

You can use Prometheus and Grafana to monitor your AMQ Streams deployment. For more information, see Introducing metrics to Kafka.

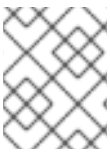
2.1. USING STANDARD KAFKA CONFIGURATION PROPERTIES

Use standard Kafka configuration properties to configure Kafka components.

The properties provide options to control and tune the configuration of the following Kafka components:

- Brokers
- Topics
- Clients (producers and consumers)
- Admin client
- Kafka Connect
- Kafka Streams

Broker and client parameters include options to configure authorization, authentication and encryption.



NOTE

For AMQ Streams on OpenShift, some configuration properties are managed entirely by AMQ Streams and cannot be changed.

For further information on Kafka configuration properties and how to use the properties to tune your deployment, see the following guides:

- Kafka configuration properties
- Kafka configuration tuning

2.2. KAFKA CLUSTER CONFIGURATION

Configure a Kafka deployment using the **Kafka** resource. A Kafka cluster is deployed with a ZooKeeper cluster, so configuration options are also available for ZooKeeper within the **Kafka** resource. The Entity

Operator comprises the Topic Operator and User Operator. You can also configure **entityOperator** properties in the **Kafka** resource to include the Topic Operator and User Operator in the deployment.

Section 6.2.1, "**Kafka** schema reference" describes the full schema of the **Kafka** resource.

For more information about Apache Kafka, see the Apache Kafka documentation.

Listener configuration

You configure listeners for connecting clients to Kafka brokers. For more information on configuring listeners, see Section 6.2.4, "**GenericKafkaListener** schema reference".

Managing TLS certificates

When deploying Kafka, the Cluster Operator automatically sets up and renews TLS certificates to enable encryption and authentication within your cluster. If required, you can manually renew the cluster and clients CA certificates before their renewal period starts. You can also replace the keys used by the cluster and clients CA certificates. For more information, see Renewing CA certificates manually and Replacing private keys.

2.2.1. Configuring Kafka

Use the properties of the **Kafka** resource to configure your Kafka deployment.

As well as configuring Kafka, you can add configuration for ZooKeeper and the AMQ Streams Operators. Common configuration properties, such as logging and healthchecks, are configured independently for each component.

This procedure shows only some of the possible configuration options, but those that are particularly important include:

- Resource requests (CPU / Memory)
- JVM options for maximum and minimum memory allocation
- Listeners (and authentication of clients)
- Authentication
- Storage
- Rack awareness
- Metrics
- Cruise Control for cluster rebalancing

Kafka versions

The **inter.broker.protocol.version** property for the Kafka **config** must be the version supported by the specified Kafka version (**spec.kafka.version**). The property represents the version of Kafka protocol used in a Kafka cluster.

From Kafka 3.0.0, when the **inter.broker.protocol.version** is set to **3.0** or higher, the **log.message.format.version** option is ignored and doesn't need to be set.

An update to the **inter.broker.protocol.version** is required when upgrading your Kafka version. For more information, see Upgrading Kafka.

Prerequisites

- An OpenShift cluster
- A running Cluster Operator

See the *Deploying and Upgrading AMQ Streams on OpenShift* guide for instructions on deploying a:

- Cluster Operator
- Kafka cluster

Procedure

1. Edit the **spec** properties for the **Kafka** resource.
   The properties you can configure are shown in this example configuration:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    replicas: 3 (1)
    version: 3.4.0 (2)
    logging: (3)
      type: inline
      loggers:
        kafka.root.logger.level: "INFO"
    resources: (4)
      requests:
        memory: 64Gi
        cpu: "8"
      limits:
        memory: 64Gi
        cpu: "12"
    readinessProbe: (5)
      initialDelaySeconds: 15
      timeoutSeconds: 5
    livenessProbe:
      initialDelaySeconds: 15
      timeoutSeconds: 5
    jvmOptions: (6)
      -Xms: 8192m
      -Xmx: 8192m
    image: my-org/my-image:latest (7)
    listeners: (8)
      - name: plain (9)
        port: 9092 (10)
        type: internal (11)
        tls: false (12)
        configuration:
          useServiceDnsDomain: true (13)
      - name: tls
```

```
      port: 9093
      type: internal
      tls: true
      authentication: 14
        type: tls
    - name: external 15
      port: 9094
      type: route
      tls: true
      configuration:
        brokerCertChainAndKey: 16
          secretName: my-secret
          certificate: my-certificate.crt
          key: my-key.key
  authorization: 17
    type: simple
  config: 18
    auto.create.topics.enable: "false"
    offsets.topic.replication.factor: 3
    transaction.state.log.replication.factor: 3
    transaction.state.log.min.isr: 2
    default.replication.factor: 3
    min.insync.replicas: 2
    inter.broker.protocol.version: "3.4"
    ssl.cipher.suites: TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 19
    ssl.enabled.protocols: TLSv1.2
    ssl.protocol: TLSv1.2
  storage: 20
    type: persistent-claim 21
    size: 10000Gi 22
  rack: 23
    topologyKey: topology.kubernetes.io/zone
  metricsConfig: 24
    type: jmxPrometheusExporter
    valueFrom:
      configMapKeyRef: 25
        name: my-config-map
        key: my-key
  # ...
zookeeper: 26
  replicas: 3 27
  logging: 28
    type: inline
    loggers:
      zookeeper.root.logger: "INFO"
  resources:
    requests:
      memory: 8Gi
      cpu: "2"
    limits:
      memory: 8Gi
      cpu: "2"
  jvmOptions:
    -Xms: 4096m
```

```
    -Xmx: 4096m
  storage:
    type: persistent-claim
    size: 1000Gi
  metricsConfig:
    # ...
entityOperator: 29
  tlsSidecar: 30
    resources:
      requests:
        cpu: 200m
        memory: 64Mi
      limits:
        cpu: 500m
        memory: 128Mi
  topicOperator:
    watchedNamespace: my-topic-namespace
    reconciliationIntervalSeconds: 60
    logging: 31
      type: inline
      loggers:
        rootLogger.level: "INFO"
    resources:
      requests:
        memory: 512Mi
        cpu: "1"
      limits:
        memory: 512Mi
        cpu: "1"
  userOperator:
    watchedNamespace: my-topic-namespace
    reconciliationIntervalSeconds: 60
    logging: 32
      type: inline
      loggers:
        rootLogger.level: INFO
    resources:
      requests:
        memory: 512Mi
        cpu: "1"
      limits:
        memory: 512Mi
        cpu: "1"
kafkaExporter: 33
  # ...
cruiseControl: 34
  # ...
```

1. The number of replica nodes.
2. Kafka version, which can be changed to a supported version by following the upgrade procedure.
3.

Kafka loggers and log levels added directly (**inline**) or indirectly (**external**) through a ConfigMap. A custom ConfigMap must be placed under the **log4j.properties** key. For the

4 Requests for reservation of supported resources, currently **cpu** and **memory**, and limits to specify the maximum resources that can be consumed.

5 Healthchecks to know when to restart a container (liveness) and when a container can accept traffic (readiness).

6 JVM configuration options to optimize performance for the Virtual Machine (VM) running Kafka.

7 ADVANCED OPTION: Container image configuration, which is recommended only in special situations.

8 Listeners configure how clients connect to the Kafka cluster via bootstrap addresses. Listeners are configured as *internal* or *external* listeners for connection from inside or outside the OpenShift cluster.

9 Name to identify the listener. Must be unique within the Kafka cluster.

10 Port number used by the listener inside Kafka. The port number has to be unique within a given Kafka cluster. Allowed port numbers are 9092 and higher with the exception of ports 9404 and 9999, which are already used for Prometheus and JMX. Depending on the listener type, the port number might not be the same as the port number that connects Kafka clients.

11 Listener type specified as **internal** or **cluster-ip** (to expose Kafka using per-broker **ClusterIP** services), or for external listeners, as **route** (OpenShift only), **loadbalancer**, **nodeport** or **ingress** (Kubernetes only).

12 Enables TLS encryption for each listener. Default is **false**. TLS encryption is not required for **route** listeners.

13 Defines whether the fully-qualified DNS names including the cluster service suffix (usually **.cluster.local**) are assigned.

14 Listener authentication mechanism specified as mTLS, SCRAM-SHA-512, or token-based OAuth 2.0.

15 External listener configuration specifies how the Kafka cluster is exposed outside OpenShift, such as through a **route**, **loadbalancer** or **nodeport**.

16 Optional configuration for a Kafka listener certificate managed by an external CA (certificate authority). The **brokerCertChainAndKey** specifies a **Secret** that contains a server certificate and a private key. You can configure Kafka listener certificates on any listener with enabled TLS encryption.

17 Authorization enables simple, OAUTH 2.0, or OPA authorization on the Kafka broker. Simple authorization uses the **AclAuthorizer** Kafka plugin.

18 Broker configuration. Standard Apache Kafka configuration may be provided, restricted to those properties not managed directly by AMQ Streams.

19 SSL properties for listeners with TLS encryption enabled to enable a specific *cipher suite* or TLS version.

20 Storage is configured as **ephemeral**, **persistent-claim** or **jbod**.

21 Storage size for persistent volumes may be increased and additional volumes may be added to JBOD storage.

22 Persistent storage has additional configuration options, such as a storage **id** and **class** for dynamic volume provisioning.

23 Rack awareness configuration to spread replicas across different racks, data centers, or availability zones. The **topologyKey** must match a node label containing the rack ID. The example used in this configuration specifies a zone using the standard **topology.kubernetes.io/zone** label.

24 Prometheus metrics enabled. In this example, metrics are configured for the Prometheus JMX Exporter (the default metrics exporter).

25 Prometheus rules for exporting metrics to a Grafana dashboard through the Prometheus JMX Exporter, which are enabled by referencing a ConfigMap containing configuration for the Prometheus JMX exporter. You can enable metrics without further configuration using a reference to a ConfigMap containing an empty file under **metricsConfig.valueFrom.configMapKeyRef.key**.

26 ZooKeeper-specific configuration, which contains properties similar to the Kafka configuration.

27 The number of ZooKeeper nodes. ZooKeeper clusters or ensembles usually run with an odd number of nodes, typically three, five, or seven. The majority of nodes must be available in order to maintain an effective quorum. If the ZooKeeper cluster loses its quorum, it will stop responding to clients and the Kafka brokers will stop working. Having a stable and highly available ZooKeeper cluster is crucial for AMQ Streams.

28 Specified ZooKeeper loggers and log levels.

29 Entity Operator configuration, which specifies the configuration for the Topic Operator and User Operator.

30 Entity Operator TLS sidecar configuration. Entity Operator uses the TLS sidecar for secure communication with ZooKeeper.

31 Specified Topic Operator loggers and log levels. This example uses **inline** logging.

32 Specified User Operator loggers and log levels.

33 Kafka Exporter configuration. Kafka Exporter is an optional component for extracting metrics data from Kafka brokers, in particular consumer lag data. For Kafka Exporter to be able to work properly, consumer groups need to be in use.

34 Optional configuration for Cruise Control, which is used to rebalance the Kafka cluster.

2. Create or update the resource:

```
oc apply -f <kafka_configuration_file>
```

2.2.2. Configuring the Entity Operator

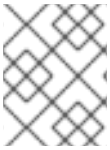
The Entity Operator is responsible for managing Kafka-related entities in a running Kafka cluster.

The Entity Operator comprises the:

- Topic Operator to manage Kafka topics
- User Operator to manage Kafka users

Through **Kafka** resource configuration, the Cluster Operator can deploy the Entity Operator, including one or both operators, when deploying a Kafka cluster.

The operators are automatically configured to manage the topics and users of the Kafka cluster. The Topic Operator and User Operator can only watch a single namespace.



NOTE

When deployed, the Entity Operator pod contains the operators according to the deployment configuration.

2.2.2.1. Entity Operator configuration properties

Use the **entityOperator** property in **Kafka.spec** to configure the Entity Operator.

The **entityOperator** property supports several sub-properties:

- **tlsSidecar**
- **topicOperator**
- **userOperator**
- **template**

The **tlsSidecar** property contains the configuration of the TLS sidecar container, which is used to communicate with ZooKeeper.

The **template** property contains the configuration of the Entity Operator pod, such as labels, annotations, affinity, and tolerations. For more information on configuring templates, see Section 2.7, "Customizing OpenShift resources".

The **topicOperator** property contains the configuration of the Topic Operator. When this option is missing, the Entity Operator is deployed without the Topic Operator.

The **userOperator** property contains the configuration of the User Operator. When this option is missing, the Entity Operator is deployed without the User Operator.

For more information on the properties used to configure the Entity Operator, see the **EntityUserOperatorSpec** schema reference.

Example of basic configuration enabling both operators

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
```

```
kafka:
  # ...
zookeeper:
  # ...
entityOperator:
  topicOperator: {}
  userOperator: {}
```

If an empty object (**{}**) is used for the **topicOperator** and **userOperator**, all properties use their default values.

When both **topicOperator** and **userOperator** properties are missing, the Entity Operator is not deployed.

2.2.2.2. Topic Operator configuration properties

Topic Operator deployment can be configured using additional options inside the **topicOperator** object. The following properties are supported:

watchedNamespace

The OpenShift namespace in which the Topic Operator watches for **KafkaTopic** resources. Default is the namespace where the Kafka cluster is deployed.

reconciliationIntervalSeconds

The interval between periodic reconciliations in seconds. Default **120**.

zookeeperSessionTimeoutSeconds

The ZooKeeper session timeout in seconds. Default **18**.

topicMetadataMaxAttempts

The number of attempts at getting topic metadata from Kafka. The time between each attempt is defined as an exponential back-off. Consider increasing this value when topic creation might take more time due to the number of partitions or replicas. Default **6**.

image

The **image** property can be used to configure the container image which will be used. For more details about configuring custom container images, see Section 6.1.6, "**image**".

resources

The **resources** property configures the amount of resources allocated to the Topic Operator. For more details about resource request and limit configuration, see Section 6.1.5, "**resources**".

logging

The **logging** property configures the logging of the Topic Operator. For more details, see Section 6.2.45.1, "**logging**".

Example Topic Operator configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
  zookeeper:
    # ...
```

```
entityOperator:
  # ...
  topicOperator:
    watchedNamespace: my-topic-namespace
    reconciliationIntervalSeconds: 60
  # ...
```

2.2.2.3. User Operator configuration properties

User Operator deployment can be configured using additional options inside the **userOperator** object. The following properties are supported:

watchedNamespace

The OpenShift namespace in which the User Operator watches for **KafkaUser** resources. Default is the namespace where the Kafka cluster is deployed.

reconciliationIntervalSeconds

The interval between periodic reconciliations in seconds. Default **120**.

image

The **image** property can be used to configure the container image which will be used. For more details about configuring custom container images, see Section 6.1.6, "**image**".

resources

The **resources** property configures the amount of resources allocated to the User Operator. For more details about resource request and limit configuration, see Section 6.1.5, "**resources**".

logging

The **logging** property configures the logging of the User Operator. For more details, see Section 6.2.45.1, "**logging**".

secretPrefix

The **secretPrefix** property adds a prefix to the name of all Secrets created from the KafkaUser resource. For example, **secretPrefix: kafka-** would prefix all Secret names with **kafka-**. So a KafkaUser named **my-user** would create a Secret named **kafka-my-user**.

Example User Operator configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
  zookeeper:
    # ...
  entityOperator:
    # ...
    userOperator:
      watchedNamespace: my-user-namespace
      reconciliationIntervalSeconds: 60
    # ...
```

2.2.3. Configuring Kafka and ZooKeeper storage

As stateful applications, Kafka and ZooKeeper store data on disk. AMQ Streams supports three storage types for this data:

- Ephemeral (Recommended for development only)
- Persistent
- JBOD (**Kafka only** not ZooKeeper)

When configuring a **Kafka** resource, you can specify the type of storage used by the Kafka broker and its corresponding ZooKeeper node. You configure the storage type using the **storage** property in the following resources:

- **Kafka.spec.kafka**
- **Kafka.spec.zookeeper**

The storage type is configured in the **type** field.

Refer to the schema reference for more information on storage configuration properties:

- **EphemeralStorage** schema reference
- **PersistentClaimStorage** schema reference
- **JbodStorage** schema reference

WARNING

The storage type cannot be changed after a Kafka cluster is deployed.

2.2.3.1. Data storage considerations

For AMQ Streams to work well, an efficient data storage infrastructure is essential. We strongly recommend using block storage. AMQ Streams is only tested for use with block storage. File storage, such as NFS, is not tested and there is no guarantee it will work.

Choose one of the following options for your block storage:

- A cloud-based block storage solution, such as Amazon Elastic Block Store (EBS)
- Persistent storage using local persistent volumes
- Storage Area Network (SAN) volumes accessed by a protocol such as *Fibre Channel* or *iSCSI*

NOTE

AMQ Streams does not require OpenShift raw block volumes.

2.2.3.1.1. File systems

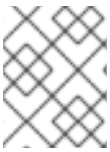
Kafka uses a file system for storing messages. AMQ Streams is compatible with the XFS and ext4 file systems, which are commonly used with Kafka. Consider the underlying architecture and requirements of your deployment when choosing and setting up your file system.

For more information, refer to Filesystem Selection in the Kafka documentation.

2.2.3.1.2. Disk usage

Use separate disks for Apache Kafka and ZooKeeper.

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.

2.2.3.2. Ephemeral storage

Ephemeral data storage is transient. All pods on a node share a local ephemeral storage space. Data is retained for as long as the pod that uses it is running. The data is lost when a pod is deleted. Although a pod can recover data in a highly available environment.

Because of its transient nature, ephemeral storage is only recommended for development and testing.

Ephemeral storage uses **emptyDir** volumes to store data. An **emptyDir** volume is created when a pod is assigned to a node. You can set the total amount of storage for the **emptyDir** using the **sizeLimit** property .

IMPORTANT

Ephemeral storage is not suitable for single-node ZooKeeper clusters or Kafka topics with a replication factor of 1.

To use ephemeral storage, you set the storage type configuration in the **Kafka** or **ZooKeeper** resource to **ephemeral**.

Example ephemeral storage configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
    storage:
      type: ephemeral
    # ...
  zookeeper:
    # ...
```

```
storage:
  type: ephemeral
# ...
```

2.2.3.2.1. Mount path of Kafka log directories

The ephemeral volume is used by Kafka brokers as log directories mounted into the following path:

```
/var/lib/kafka/data/kafka-log IDX
```

Where ***IDX*** is the Kafka broker pod index. For example **/var/lib/kafka/data/kafka-log0**.

2.2.3.3. Persistent storage

Persistent data storage retains data in the event of system disruption. For pods that use persistent data storage, data is persisted across pod failures and restarts.

A dynamic provisioning framework enables clusters to be created with persistent storage. Pod configuration uses Persistent Volume Claims (PVCs) to make storage requests on persistent volumes (PVs). PVs are storage resources that represent a storage volume. PVs are independent of the pods that use them. The PVC requests the amount of storage required when a pod is being created. The underlying storage infrastructure of the PV does not need to be understood. If a PV matches the storage criteria, the PVC is bound to the PV.

Because of its permanent nature, persistent storage is recommended for production.

PVCs can request different types of persistent storage by specifying a StorageClass. Storage classes define storage profiles and dynamically provision PVs. If a storage class is not specified, the default storage class is used. Persistent storage options might include SAN storage types or local persistent volumes.

To use persistent storage, you set the storage type configuration in the **Kafka** or **ZooKeeper** resource to **persistent-claim**.

In the production environment, the following configuration is recommended:

- For Kafka, configure **type: jbod** with one or more **type: persistent-claim** volumes
- For ZooKeeper, configure **type: persistent-claim**

Persistent storage also has the following configuration options:

id (optional)
: A storage identification number. This option is mandatory for storage volumes defined in a JBOD storage declaration. Default is **0**.

size (required)
: The size of the persistent volume claim, for example, "1000Gi".

class (optional)
: The OpenShift StorageClass to use for dynamic volume provisioning. Storage **class** configuration includes parameters that describe the profile of a volume in detail.

selector (optional)
: Configuration to specify a specific PV. Provides key:value pairs representing the labels of the volume selected.

deleteClaim (optional)

Boolean value to specify whether the PVC is deleted when the cluster is uninstalled. Default is **false**.

WARNING

Increasing the size of persistent volumes in an existing AMQ Streams cluster is only supported in OpenShift versions that support persistent volume resizing. The persistent volume to be resized must use a storage class that supports volume expansion. For other versions of OpenShift and storage classes that do not support volume expansion, you must decide the necessary storage size before deploying the cluster. Decreasing the size of existing persistent volumes is not possible.

Example persistent storage configuration for Kafka and ZooKeeper

```
# ...
spec:
  kafka:
    # ...
    storage:
      type: jbod
      volumes:
      - id: 0
        type: persistent-claim
        size: 100Gi
        deleteClaim: false
      - id: 1
        type: persistent-claim
        size: 100Gi
        deleteClaim: false
      - id: 2
        type: persistent-claim
        size: 100Gi
        deleteClaim: false
    # ...
  zookeeper:
    storage:
      type: persistent-claim
      size: 1000Gi
# ...
```

If you do not specify a storage class, the default is used. The following example specifies a storage class.

Example persistent storage configuration with specific storage class

```
# ...
storage:
  type: persistent-claim
  size: 1Gi
  class: my-storage-class
# ...
```

Use a **selector** to specify a labeled persistent volume that provides certain features, such as an SSD.

Example persistent storage configuration with selector

```
# ...
storage:
  type: persistent-claim
  size: 1Gi
  selector:
    hdd-type: ssd
  deleteClaim: true
# ...
```

2.2.3.3.1. Storage class overrides

Instead of using the default storage class, you can specify a different storage class for one or more Kafka brokers or ZooKeeper nodes. This is useful, for example, when storage classes are restricted to different availability zones or data centers. You can use the **overrides** field for this purpose.

In this example, the default storage class is named **my-storage-class**:

Example AMQ Streams cluster using storage class overrides

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  labels:
    app: my-cluster
  name: my-cluster
  namespace: myproject
spec:
  # ...
  kafka:
    replicas: 3
    storage:
      type: jbod
      volumes:
      - id: 0
        type: persistent-claim
        size: 100Gi
        deleteClaim: false
        class: my-storage-class
        overrides:
        - broker: 0
          class: my-storage-class-zone-1a
        - broker: 1
          class: my-storage-class-zone-1b
        - broker: 2
          class: my-storage-class-zone-1c
      # ...
  # ...
  zookeeper:
    replicas: 3
    storage:
```

```
    deleteClaim: true
    size: 100Gi
    type: persistent-claim
    class: my-storage-class
    overrides:
      - broker: 0
        class: my-storage-class-zone-1a
      - broker: 1
        class: my-storage-class-zone-1b
      - broker: 2
        class: my-storage-class-zone-1c
# ...
```

As a result of the configured **overrides** property, the volumes use the following storage classes:

- The persistent volumes of ZooKeeper node 0 use **my-storage-class-zone-1a**.
- The persistent volumes of ZooKeeper node 1 use **my-storage-class-zone-1b**.
- The persistent volumes of ZooKeeepr node 2 use **my-storage-class-zone-1c**.
- The persistent volumes of Kafka broker 0 use **my-storage-class-zone-1a**.
- The persistent volumes of Kafka broker 1 use **my-storage-class-zone-1b**.
- The persistent volumes of Kafka broker 2 use **my-storage-class-zone-1c**.

The **overrides** property is currently used only to override storage class configurations. Overrides for other storage configuration properties is not currently supported. Other storage configuration properties are currently not supported.

2.2.3.3.2. PVC resources for persistent storage

When persistent storage is used, it creates PVCs with the following names:

data-*cluster-name*-kafka-*idx*

PVC for the volume used for storing data for the Kafka broker pod ***idx***.

data-*cluster-name*-zookeeper-*idx*

PVC for the volume used for storing data for the ZooKeeper node pod ***idx***.

2.2.3.3.3. Mount path of Kafka log directories

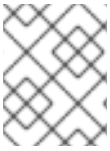
The persistent volume is used by the Kafka brokers as log directories mounted into the following path:

```
/var/lib/kafka/data/kafka-log IDX
```

Where ***IDX*** is the Kafka broker pod index. For example **/var/lib/kafka/data/kafka-log0**.

2.2.3.4. Resizing persistent volumes

You can provision increased storage capacity by increasing the size of the persistent volumes used by an existing AMQ Streams cluster. Resizing persistent volumes is supported in clusters that use either a single persistent volume or multiple persistent volumes in a JBOD storage configuration.



NOTE

You can increase but not decrease the size of persistent volumes. Decreasing the size of persistent volumes is not currently supported in OpenShift.

Prerequisites

- An OpenShift cluster with support for volume resizing.
- The Cluster Operator is running.
- A Kafka cluster using persistent volumes created using a storage class that supports volume expansion.

Procedure

1. Edit the **Kafka** resource for your cluster.
   Change the **size** property to increase the size of the persistent volume allocated to a Kafka cluster, a ZooKeeper cluster, or both.
   - For Kafka clusters, update the **size** property under **spec.kafka.storage**.
   - For ZooKeeper clusters, update the **size** property under **spec.zookeeper.storage**.

   Kafka configuration to increase the volume size to 2000Gi

   ```
   apiVersion: kafka.strimzi.io/v1beta2
   kind: Kafka
   metadata:
     name: my-cluster
   spec:
     kafka:
       # ...
       storage:
         type: persistent-claim
         size: 2000Gi
         class: my-storage-class
       # ...
     zookeeper:
       # ...
   ```

2. Create or update the resource:

   ```
   oc apply -f <kafka_configuration_file>
   ```

   OpenShift increases the capacity of the selected persistent volumes in response to a request from the Cluster Operator. When the resizing is complete, the Cluster Operator restarts all pods that use the resized persistent volumes. This happens automatically.

3. Verify that the storage capacity has increased for the relevant pods on the cluster:

   ```
   oc get pv
   ```

   Kafka broker pods with increased storage

```
NAME                CAPACITY   CLAIM
pvc-0ca459ce-...    2000Gi     my-project/data-my-cluster-kafka-2
pvc-6e1810be-...    2000Gi     my-project/data-my-cluster-kafka-0
pvc-82dc78c9-...    2000Gi     my-project/data-my-cluster-kafka-1
```

The output shows the names of each PVC associated with a broker pod.

Additional resources

- For more information about resizing persistent volumes in OpenShift, see Resizing Persistent Volumes using Kubernetes.

2.2.3.5. JBOD storage

You can configure AMQ Streams to use JBOD, a data storage configuration of multiple disks or volumes. JBOD is one approach to providing increased data storage for Kafka brokers. It can also improve performance.

NOTE

JBOD storage is supported for **Kafka only** not ZooKeeper.

A JBOD configuration is described by one or more volumes, each of which can be either ephemeral or persistent. The rules and constraints for JBOD volume declarations are the same as those for ephemeral and persistent storage. For example, you cannot decrease the size of a persistent storage volume after it has been provisioned, or you cannot change the value of **sizeLimit** when the type is **ephemeral**.

To use JBOD storage, you set the storage type configuration in the **Kafka** resource to **jbod**. The **volumes** property allows you to describe the disks that make up your JBOD storage array or configuration.

Example JBOD storage configuration

```
# ...
storage:
  type: jbod
  volumes:
  - id: 0
    type: persistent-claim
    size: 100Gi
    deleteClaim: false
  - id: 1
    type: persistent-claim
    size: 100Gi
    deleteClaim: false
# ...
```

The IDs cannot be changed once the JBOD volumes are created. You can add or remove volumes from the JBOD configuration.

2.2.3.5.1. PVC resource for JBOD storage

When persistent storage is used to declare JBOD volumes, it creates a PVC with the following name:

data-*id*-*cluster-name*-kafka-*idx*

PVC for the volume used for storing data for the Kafka broker pod ***idx***. The ***id*** is the ID of the volume used for storing data for Kafka broker pod.

2.2.3.5.2. Mount path of Kafka log directories

The JBOD volumes are used by Kafka brokers as log directories mounted into the following path:

```
/var/lib/kafka/data-id/kafka-logidx
```

Where ***id*** is the ID of the volume used for storing data for Kafka broker pod ***idx***. For example **/var/lib/kafka/data-0/kafka-log0**.

2.2.3.6. Adding volumes to JBOD storage

This procedure describes how to add volumes to a Kafka cluster configured to use JBOD storage. It cannot be applied to Kafka clusters configured to use any other storage type.

NOTE

When adding a new volume under an **id** which was already used in the past and removed, you have to make sure that the previously used **PersistentVolumeClaims** have been deleted.

Prerequisites

- An OpenShift cluster
- A running Cluster Operator
- A Kafka cluster with JBOD storage

Procedure

1. Edit the **spec.kafka.storage.volumes** property in the **Kafka** resource. Add the new volumes to the **volumes** array. For example, add the new volume with id **2**:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
    storage:
      type: jbod
      volumes:
      - id: 0
        type: persistent-claim
        size: 100Gi
        deleteClaim: false
      - id: 1
        type: persistent-claim
        size: 100Gi
```

```
      deleteClaim: false
    - id: 2
      type: persistent-claim
      size: 100Gi
      deleteClaim: false
  # ...
zookeeper:
  # ...
```

2. Create or update the resource:

```
oc apply -f <kafka_configuration_file>
```

3. Create new topics or reassign existing partitions to the new disks.

TIP

Cruise Control is an effective tool for reassigning partitions. To perform an intra-broker disk balance, you set **rebalanceDisk** to **true** under the **KafkaRebalance.spec**.

2.2.3.7. Removing volumes from JBOD storage

This procedure describes how to remove volumes from Kafka cluster configured to use JBOD storage. It cannot be applied to Kafka clusters configured to use any other storage type. The JBOD storage always has to contain at least one volume.

IMPORTANT

To avoid data loss, you have to move all partitions before removing the volumes.

Prerequisites

- An OpenShift cluster
- A running Cluster Operator
- A Kafka cluster with JBOD storage with two or more volumes

Procedure

1. Reassign all partitions from the disks which are you going to remove. Any data in partitions still assigned to the disks which are going to be removed might be lost.

TIP

You can use the **kafka-reassign-partitions.sh** tool to reassign the partitions.

2. Edit the **spec.kafka.storage.volumes** property in the **Kafka** resource. Remove one or more volumes from the **volumes** array. For example, remove the volumes with ids **1** and **2**:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
```

```
  name: my-cluster
spec:
  kafka:
    # ...
    storage:
      type: jbod
      volumes:
      - id: 0
        type: persistent-claim
        size: 100Gi
        deleteClaim: false
    # ...
  zookeeper:
    # ...
```

3. Create or update the resource:

```
oc apply -f <kafka_configuration_file>
```

2.2.4. Connecting to ZooKeeper from a terminal

Most Kafka CLI tools can connect directly to Kafka, so under normal circumstances you should not need to connect to ZooKeeper. ZooKeeper services are secured with encryption and authentication and are not intended to be used by external applications that are not part of AMQ Streams.

However, if you want to use Kafka CLI tools that require a connection to ZooKeeper, you can use a terminal inside a ZooKeeper container and connect to **localhost:12181** as the ZooKeeper address.

Prerequisites

- An OpenShift cluster is available.
- A Kafka cluster is running.
- The Cluster Operator is running.

Procedure

1. Open the terminal using the OpenShift console or run the **exec** command from your CLI. For example:

```
oc exec -ti my-cluster-zookeeper-0 -- bin/kafka-topics.sh --list --zookeeper localhost:12181
```

   Be sure to use **localhost:12181**.

   You can now run Kafka commands to ZooKeeper.

2.2.5. Deleting Kafka nodes manually

This procedure describes how to delete an existing Kafka node by using an OpenShift annotation. Deleting a Kafka node consists of deleting both the **Pod** on which the Kafka broker is running and the related **PersistentVolumeClaim** (if the cluster was deployed with persistent storage). After deletion, the **Pod** and its related **PersistentVolumeClaim** are recreated automatically.

WARNING

Deleting a **PersistentVolumeClaim** can cause permanent data loss. The following procedure should only be performed if you have encountered storage issues.

Prerequisites

See the *Deploying and Upgrading AMQ Streams on OpenShift* guide for instructions on running a:

- Cluster Operator
- Kafka cluster

Procedure

1. Find the name of the **Pod** that you want to delete.
   Kafka broker pods are named *<cluster-name>*-kafka-*<index>*, where *<index>* starts at zero and ends at the total number of replicas minus one. For example, **my-cluster-kafka-0**.
2. Annotate the **Pod** resource in OpenShift.
   Use **oc annotate**:

   ```
   oc annotate pod cluster-name-kafka-index strimzi.io/delete-pod-and-pvc=true
   ```

3. Wait for the next reconciliation, when the annotated pod with the underlying persistent volume claim will be deleted and then recreated.

2.2.6. Deleting ZooKeeper nodes manually

This procedure describes how to delete an existing ZooKeeper node by using an OpenShift annotation. Deleting a ZooKeeper node consists of deleting both the **Pod** on which ZooKeeper is running and the related **PersistentVolumeClaim** (if the cluster was deployed with persistent storage). After deletion, the **Pod** and its related **PersistentVolumeClaim** are recreated automatically.

WARNING

Deleting a **PersistentVolumeClaim** can cause permanent data loss. The following procedure should only be performed if you have encountered storage issues.

Prerequisites

See the *Deploying and Upgrading AMQ Streams on OpenShift* guide for instructions on running a:

- Cluster Operator
- Kafka cluster

Procedure

1. Find the name of the **Pod** that you want to delete.
   ZooKeeper pods are named *<cluster-name>*-zookeeper-*<index>*, where *<index>* starts at zero and ends at the total number of replicas minus one. For example, **my-cluster-zookeeper-0**.

2. Annotate the **Pod** resource in OpenShift.
   Use **oc annotate**:

   ```
   oc annotate pod cluster-name-zookeeper-index strimzi.io/delete-pod-and-pvc=true
   ```

3. Wait for the next reconciliation, when the annotated pod with the underlying persistent volume claim will be deleted and then recreated.

2.2.7. List of Kafka cluster resources

The following resources are created by the Cluster Operator in the OpenShift cluster:

Shared resources

***cluster-name*-cluster-ca**

Secret with the Cluster CA private key used to encrypt the cluster communication.

***cluster-name*-cluster-ca-cert**

Secret with the Cluster CA public key. This key can be used to verify the identity of the Kafka brokers.

***cluster-name*-clients-ca**

Secret with the Clients CA private key used to sign user certificates

***cluster-name*-clients-ca-cert**

Secret with the Clients CA public key. This key can be used to verify the identity of the Kafka users.

***cluster-name*-cluster-operator-certs**

Secret with Cluster operators keys for communication with Kafka and ZooKeeper.

ZooKeeper nodes

***cluster-name*-zookeeper**

Name given to the following ZooKeeper resources:

- StrimziPodSet or StatefulSet (if the **UseStrimziPodSets** feature gate is disabled) for managing the ZooKeeper node pods.
- Service account used by the ZooKeeper nodes.
- PodDisruptionBudget configured for the ZooKeeper nodes.

cluster-name*-zookeeper-*idx

Pods created by the ZooKeeper StatefulSet or StrimziPodSet.

***cluster-name*-zookeeper-nodes**

Headless Service needed to have DNS resolve the ZooKeeper pods IP addresses directly.

***cluster-name*-zookeeper-client**

Service used by Kafka brokers to connect to ZooKeeper nodes as clients.

***cluster-name*-zookeeper-config**

ConfigMap that contains the ZooKeeper ancillary configuration, and is mounted as a volume by the ZooKeeper node pods.

***cluster-name*-zookeeper-nodes**

Secret with ZooKeeper node keys.

***cluster-name*-network-policy-zookeeper**

Network policy managing access to the ZooKeeper services.

data-*cluster-name*-zookeeper-*idx*

Persistent Volume Claim for the volume used for storing data for the ZooKeeper node pod ***idx***. This resource will be created only if persistent storage is selected for provisioning persistent volumes to store data.

Kafka brokers

***cluster-name*-kafka**

Name given to the following Kafka resources:

- StrimziPodSet or StatefulSet (if the **UseStrimziPodSets** feature gate is disabled) for managing the Kafka broker pods.
- Service account used by the Kafka pods.
- PodDisruptionBudget configured for the Kafka brokers.

cluster-name*-kafka-*idx

Name given to the following Kafka resources:

- Pods created by the Kafka StatefulSet or StrimziPodSet.
- ConfigMap with Kafka broker configuration (if the **UseStrimziPodSets** feature gate is enabled).

***cluster-name*-kafka-brokers**

Service needed to have DNS resolve the Kafka broker pods IP addresses directly.

***cluster-name*-kafka-bootstrap**

Service can be used as bootstrap servers for Kafka clients connecting from within the OpenShift cluster.

***cluster-name*-kafka-external-bootstrap**

Bootstrap service for clients connecting from outside the OpenShift cluster. This resource is created only when an external listener is enabled. The old service name will be used for backwards compatibility when the listener name is **external** and port is **9094**.

cluster-name*-kafka-*pod-id

Service used to route traffic from outside the OpenShift cluster to individual pods. This resource is created only when an external listener is enabled. The old service name will be used for backwards compatibility when the listener name is **external** and port is **9094**.

***cluster-name*-kafka-external-bootstrap**

Bootstrap route for clients connecting from outside the OpenShift cluster. This resource is created only when an external listener is enabled and set to type **route**. The old route name will be used for backwards compatibility when the listener name is **external** and port is **9094**.

cluster-name*-kafka-*pod-id

Route for traffic from outside the OpenShift cluster to individual pods. This resource is created only when an external listener is enabled and set to type **route**. The old route name will be used for backwards compatibility when the listener name is **external** and port is **9094**.

***cluster-name*-kafka-*listener-name*-bootstrap**

Bootstrap service for clients connecting from outside the OpenShift cluster. This resource is created only when an external listener is enabled. The new service name will be used for all other external listeners.

cluster-name*-kafka-*listener-name*-*pod-id

Service used to route traffic from outside the OpenShift cluster to individual pods. This resource is created only when an external listener is enabled. The new service name will be used for all other external listeners.

***cluster-name*-kafka-*listener-name*-bootstrap**

Bootstrap route for clients connecting from outside the OpenShift cluster. This resource is created only when an external listener is enabled and set to type **route**. The new route name will be used for all other external listeners.

cluster-name*-kafka-*listener-name*-*pod-id

Route for traffic from outside the OpenShift cluster to individual pods. This resource is created only when an external listener is enabled and set to type **route**. The new route name will be used for all other external listeners.

***cluster-name*-kafka-config**

ConfigMap containing the Kafka ancillary configuration, which is mounted as a volume by the broker pods when the **UseStrimziPodSets** feature gate is disabled.

***cluster-name*-kafka-brokers**

Secret with Kafka broker keys.

***cluster-name*-network-policy-kafka**

Network policy managing access to the Kafka services.

strimzi-*namespace-name*-*cluster-name*-kafka-init

Cluster role binding used by the Kafka brokers.

***cluster-name*-jmx**

Secret with JMX username and password used to secure the Kafka broker port. This resource is created only when JMX is enabled in Kafka.

data-*cluster-name*-kafka-*idx*

Persistent Volume Claim for the volume used for storing data for the Kafka broker pod ***idx***. This resource is created only if persistent storage is selected for provisioning persistent volumes to store data.

data-*id*-*cluster-name*-kafka-*idx*

Persistent Volume Claim for the volume ***id*** used for storing data for the Kafka broker pod ***idx***. This resource is created only if persistent storage is selected for JBOD volumes when provisioning persistent volumes to store data.

Entity Operator

These resources are only created if the Entity Operator is deployed using the Cluster Operator.

***cluster-name*-entity-operator**

Name given to the following Entity Operator resources:

- Deployment with Topic and User Operators.

- Deployment with Topic and User Operators.
- Service account used by the Entity Operator.

cluster-name*-entity-operator-*random-string

Pod created by the Entity Operator deployment.

***cluster-name*-entity-topic-operator-config**

ConfigMap with ancillary configuration for Topic Operators.

***cluster-name*-entity-user-operator-config**

ConfigMap with ancillary configuration for User Operators.

***cluster-name*-entity-topic-operator-certs**

Secret with Topic Operator keys for communication with Kafka and ZooKeeper.

***cluster-name*-entity-user-operator-certs**

Secret with User Operator keys for communication with Kafka and ZooKeeper.

strimzi-*cluster-name*-entity-topic-operator

Role binding used by the Entity Topic Operator.

strimzi-*cluster-name*-entity-user-operator

Role binding used by the Entity User Operator.

Kafka Exporter

These resources are only created if the Kafka Exporter is deployed using the Cluster Operator.

***cluster-name*-kafka-exporter**

Name given to the following Kafka Exporter resources:

- Deployment with Kafka Exporter.
- Service used to collect consumer lag metrics.
- Service account used by the Kafka Exporter.

cluster-name*-kafka-exporter-*random-string

Pod created by the Kafka Exporter deployment.

Cruise Control

These resources are only created if Cruise Control was deployed using the Cluster Operator.

***cluster-name*-cruise-control**

Name given to the following Cruise Control resources:

- Deployment with Cruise Control.
- Service used to communicate with Cruise Control.
- Service account used by the Cruise Control.

cluster-name*-cruise-control-*random-string

Pod created by the Cruise Control deployment.

***cluster-name*-cruise-control-config**

ConfigMap that contains the Cruise Control ancillary configuration, and is mounted as a volume by the Cruise Control pods.

***cluster-name*-cruise-control-certs**

Secret with Cruise Control keys for communication with Kafka and ZooKeeper.

***cluster-name*-network-policy-cruise-control**

Network policy managing access to the Cruise Control service.

2.3. KAFKA CONNECT CLUSTER CONFIGURATION

Configure a Kafka Connect deployment using the **KafkaConnect** resource. Kafka Connect is an integration toolkit for streaming data between Kafka brokers and other systems using connector plugins. Kafka Connect provides a framework for integrating Kafka with an external data source or target, such as a database, for import or export of data using connectors. Connectors are plugins that provide the connection configuration needed.

Section 6.2.61, "**KafkaConnect** schema reference" describes the full schema of the **KafkaConnect** resource.

For more information on deploying connector plugins, see Extending Kafka Connect with connector plugins.

2.3.1. Configuring Kafka Connect

Use Kafka Connect to set up external data connections to your Kafka cluster. Use the properties of the **KafkaConnect** resource to configure your Kafka Connect deployment.

KafkaConnector configuration

KafkaConnector resources allow you to create and manage connector instances for Kafka Connect in an OpenShift-native way.

In your Kafka Connect configuration, you enable KafkaConnectors for a Kafka Connect cluster by adding the **strimzi.io/use-connector-resources** annotation. You can also add a **build** configuration so that AMQ Streams automatically builds a container image with the connector plugins you require for your data connections. External configuration for Kafka Connect connectors is specified through the **externalConfiguration** property.

To manage connectors, you can use use **KafkaConnector** custom resources or the Kafka Connect REST API. **KafkaConnector** resources must be deployed to the same namespace as the Kafka Connect cluster they link to. For more information on using these methods to create, reconfigure, or delete connectors, see Adding connectors.

Connector configuration is passed to Kafka Connect as part of an HTTP request and stored within Kafka itself. ConfigMaps and Secrets are standard OpenShift resources used for storing configurations and confidential data. You can use ConfigMaps and Secrets to configure certain elements of a connector. You can then reference the configuration values in HTTP REST commands, which keeps the configuration separate and more secure, if needed. This method applies especially to confidential data, such as usernames, passwords, or certificates.

Handling high volumes of messages

You can tune the configuration to handle high volumes of messages. For more information, see Handling high volumes of messages .

Prerequisites

- An OpenShift cluster
- A running Cluster Operator

See the *Deploying and Upgrading AMQ Streams on OpenShift* guide for instructions on running a:

- Cluster Operator
- Kafka cluster

Procedure

1. Edit the **spec** properties of the **KafkaConnect** resource.
   The properties you can configure are shown in this example configuration:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect (1)
metadata:
  name: my-connect-cluster
  annotations:
    strimzi.io/use-connector-resources: "true" (2)
spec:
  replicas: 3 (3)
  authentication: (4)
    type: tls
    certificateAndKey:
      certificate: source.crt
      key: source.key
      secretName: my-user-source
  bootstrapServers: my-cluster-kafka-bootstrap:9092 (5)
  tls: (6)
    trustedCertificates:
      - secretName: my-cluster-cluster-cert
        certificate: ca.crt
      - secretName: my-cluster-cluster-cert
        certificate: ca2.crt
  config: (7)
    group.id: my-connect-cluster
    offset.storage.topic: my-connect-cluster-offsets
    config.storage.topic: my-connect-cluster-configs
    status.storage.topic: my-connect-cluster-status
    key.converter: org.apache.kafka.connect.json.JsonConverter
    value.converter: org.apache.kafka.connect.json.JsonConverter
    key.converter.schemas.enable: true
    value.converter.schemas.enable: true
    config.storage.replication.factor: 3
    offset.storage.replication.factor: 3
    status.storage.replication.factor: 3
  build: (8)
    output: (9)
      type: docker
      image: my-registry.io/my-org/my-connect-cluster:latest
      pushSecret: my-registry-credentials
    plugins: (10)
```

```
      - name: debezium-postgres-connector
        artifacts:
          - type: tgz
            url: https://repo1.maven.org/maven2/io/debezium/debezium-connector-
postgres/2.1.3.Final/debezium-connector-postgres-2.1.3.Final-plugin.tar.gz
            sha512sum:
c4ddc97846de561755dc0b021a62aba656098829c70eb3ade3b817ce06d852ca12ae50c0281cc
791a5a131cb7fc21fb15f4b8ee76c6cae5dd07f9c11cb7c6e79
      - name: camel-telegram
        artifacts:
          - type: tgz
            url: https://repo.maven.apache.org/maven2/org/apache/camel/kafkaconnector/camel-
telegram-kafka-connector/0.11.5/camel-telegram-kafka-connector-0.11.5-package.tar.gz
            sha512sum:
d6d9f45e0d1dbfcc9f6d1c7ca2046168c764389c78bc4b867dab32d24f710bb74ccf2a007d7d7a8
af2dfca09d9a52ccbc2831fc715c195a3634cca055185bd91
  externalConfiguration: (11)
    env:
      - name: AWS_ACCESS_KEY_ID
        valueFrom:
          secretKeyRef:
            name: aws-creds
            key: awsAccessKey
      - name: AWS_SECRET_ACCESS_KEY
        valueFrom:
          secretKeyRef:
            name: aws-creds
            key: awsSecretAccessKey
  resources: (12)
    requests:
      cpu: "1"
      memory: 2Gi
    limits:
      cpu: "2"
      memory: 2Gi
  logging: (13)
    type: inline
    loggers:
      log4j.rootLogger: "INFO"
  readinessProbe: (14)
    initialDelaySeconds: 15
    timeoutSeconds: 5
  livenessProbe:
    initialDelaySeconds: 15
    timeoutSeconds: 5
  metricsConfig: (15)
    type: jmxPrometheusExporter
    valueFrom:
      configMapKeyRef:
        name: my-config-map
        key: my-key
  jvmOptions: (16)
    "-Xmx": "1g"
    "-Xms": "1g"
  image: my-org/my-image:latest (17)
```

```
    rack:
      topologyKey: topology.kubernetes.io/zone (18)
    template: (19)
      pod:
        affinity:
          podAntiAffinity:
            requiredDuringSchedulingIgnoredDuringExecution:
              - labelSelector:
                  matchExpressions:
                    - key: application
                      operator: In
                      values:
                        - postgresql
                        - mongodb
                topologyKey: "kubernetes.io/hostname"
      connectContainer: (20)
        env:
          - name: JAEGER_SERVICE_NAME
            value: my-jaeger-service
          - name: JAEGER_AGENT_HOST
            value: jaeger-agent-name
          - name: JAEGER_AGENT_PORT
            value: "6831"
```

1. Use **KafkaConnect**.
2. Enables KafkaConnectors for the Kafka Connect cluster.
3. The number of replica nodes for the workers that run tasks.
4. Authentication for the Kafka Connect cluster, specified as mTLS, token-based OAuth, SASL-based SCRAM-SHA-256/SCRAM-SHA-512, or PLAIN. By default, Kafka Connect connects to Kafka brokers using a plain text connection.
5. Bootstrap server for connection to the Kafka Connect cluster.
6. TLS encryption with key names under which TLS certificates are stored in X.509 format for the cluster. If certificates are stored in the same secret, it can be listed multiple times.
7. Kafka Connect configuration of workers (not connectors). Standard Apache Kafka configuration may be provided, restricted to those properties not managed directly by AMQ Streams.
8. Build configuration properties for building a container image with connector plugins automatically.
9. (Required) Configuration of the container registry where new images are pushed.
10. (Required) List of connector plugins and their artifacts to add to the new container image. Each plugin must be configured with at least one **artifact**.
11. External configuration for Kafka connectors using environment variables, as shown here, or volumes. You can also use *configuration provider plugins* to load configuration values from external sources.
12. Requests for reservation of supported resources, currently **cpu** and **memory**, and limits to specify the maximum resources that can be consumed.

13 Specified Kafka Connect loggers and log levels added directly (**inline**) or indirectly (**external**) through a ConfigMap. A custom ConfigMap must be placed under the **log4j.properties** or **log4j2.properties** key. For the Kafka Connect **log4j.rootLogger** logger, you can set the log level to INFO, ERROR, WARN, TRACE, DEBUG, FATAL or OFF.

14 Healthchecks to know when to restart a container (liveness) and when a container can accept traffic (readiness).

15 Prometheus metrics, which are enabled by referencing a ConfigMap containing configuration for the Prometheus JMX exporter in this example. You can enable metrics without further configuration using a reference to a ConfigMap containing an empty file under **metricsConfig.valueFrom.configMapKeyRef.key**.

16 JVM configuration options to optimize performance for the Virtual Machine (VM) running Kafka Connect.

17 ADVANCED OPTION: Container image configuration, which is recommended only in special situations.

18 SPECIALIZED OPTION: Rack awareness configuration for the deployment. This is a specialized option intended for a deployment within the same location, not across regions. Use this option if you want connectors to consume from the closest replica rather than the leader replica. In certain cases, consuming from the closest replica can improve network utilization or reduce costs . The **topologyKey** must match a node label containing the rack ID. The example used in this configuration specifies a zone using the standard **topology.kubernetes.io/zone** label. To consume from the closest replica, enable the **RackAwareReplicaSelector** in the Kafka broker configuration.

19 Template customization. Here a pod is scheduled with anti-affinity, so the pod is not scheduled on nodes with the same hostname.

20 Environment variables are set for distributed tracing.

2. Create or update the resource:

```
oc apply -f KAFKA-CONNECT-CONFIG-FILE
```

3. If authorization is enabled for Kafka Connect, configure Kafka Connect users to enable access to the Kafka Connect consumer group and topics.

Additional resources

- Introducing distributed tracing

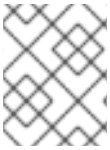
2.3.2. Configuring Kafka Connect for multiple instances

If you are running multiple instances of Kafka Connect, you have to change the default configuration of the following **config** properties:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect
```

```
spec:
  # ...
  config:
    group.id: connect-cluster 1
    offset.storage.topic: connect-cluster-offsets 2
    config.storage.topic: connect-cluster-configs 3
    status.storage.topic: connect-cluster-status 4
    # ...
# ...
```

1. The Kafka Connect cluster ID within Kafka.
2. Kafka topic that stores connector offsets.
3. Kafka topic that stores connector and task status configurations.
4. Kafka topic that stores connector and task status updates.



NOTE

Values for the three topics must be the same for all Kafka Connect instances with the same **group.id**.

Unless you change the default settings, each Kafka Connect instance connecting to the same Kafka cluster is deployed with the same values. What happens, in effect, is all instances are coupled to run in a cluster and use the same topics.

If multiple Kafka Connect clusters try to use the same topics, Kafka Connect will not work as expected and generate errors.

If you wish to run multiple Kafka Connect instances, change the values of these properties for each instance.

2.3.3. Configuring Kafka Connect user authorization

This procedure describes how to authorize user access to Kafka Connect.

When any type of authorization is being used in Kafka, a Kafka Connect user requires read/write access rights to the consumer group and the internal topics of Kafka Connect.

The properties for the consumer group and internal topics are automatically configured by AMQ Streams, or they can be specified explicitly in the **spec** of the **KafkaConnect** resource.

Example configuration properties in the KafkaConnect resource

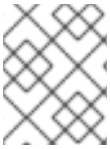
```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect
spec:
  # ...
  config:
    group.id: my-connect-cluster 1
```

```
  offset.storage.topic: my-connect-cluster-offsets 2
  config.storage.topic: my-connect-cluster-configs 3
  status.storage.topic: my-connect-cluster-status 4
  # ...
# ...
```

1. The Kafka Connect cluster ID within Kafka.
2. Kafka topic that stores connector offsets.
3. Kafka topic that stores connector and task status configurations.
4. Kafka topic that stores connector and task status updates.

This procedure shows how access is provided when **simple** authorization is being used.

Simple authorization uses ACL rules, handled by the Kafka **AclAuthorizer** plugin, to provide the right level of access. For more information on configuring a **KafkaUser** resource to use simple authorization, see the **AclRule** schema reference.



NOTE

The default values for the consumer group and topics will differ when running multiple instances.

Prerequisites

- An OpenShift cluster
- A running Cluster Operator

Procedure

1. Edit the **authorization** property in the **KafkaUser** resource to provide access rights to the user. In the following example, access rights are configured for the Kafka Connect topics and consumer group using **literal** name values:

Property	Name
offset.storage.topic	**connect-cluster-offsets**
status.storage.topic	**connect-cluster-status**
config.storage.topic	**connect-cluster-configs**
group	**connect-cluster**

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaUser
metadata:
  name: my-user
```

```
  labels:
    strimzi.io/cluster: my-cluster
spec:
  # ...
  authorization:
    type: simple
    acls:
      # access to offset.storage.topic
      - resource:
          type: topic
          name: connect-cluster-offsets
          patternType: literal
        operations:
          - Create
          - Describe
          - Read
          - Write
        host: "*"
      # access to status.storage.topic
      - resource:
          type: topic
          name: connect-cluster-status
          patternType: literal
        operations:
          - Create
          - Describe
          - Read
          - Write
        host: "*"
      # access to config.storage.topic
      - resource:
          type: topic
          name: connect-cluster-configs
          patternType: literal
        operations:
          - Create
          - Describe
          - Read
          - Write
        host: "*"
      # consumer group
      - resource:
          type: group
          name: connect-cluster
          patternType: literal
        operations:
          - Read
        host: "*"
```

2. Create or update the resource.

```
oc apply -f KAFKA-USER-CONFIG-FILE
```

2.3.4. List of Kafka Connect cluster resources

The following resources are created by the Cluster Operator in the OpenShift cluster:

***connect-cluster-name*-connect**

Name given to the following Kafka Connect resources:

- Deployment that creates the Kafka Connect worker node pods (when **StableConnectIdentities** feature gate is disabled).
- StrimziPodSet that creates the Kafka Connect worker node pods (when **StableConnectIdentities** feature gate is enabled).
- Headless service that provides stable DNS names to the Connect pods (when **StableConnectIdentities** feature gate is enabled).
- Pod Disruption Budget configured for the Kafka Connect worker nodes.

connect-cluster-name*-connect-*idx

Pods created by the Kafka Connect StrimziPodSet (when **StableConnectIdentities** feature gate is enabled).

***connect-cluster-name*-connect-api**

Service which exposes the REST interface for managing the Kafka Connect cluster.

***connect-cluster-name*-config**

ConfigMap which contains the Kafka Connect ancillary configuration and is mounted as a volume by the Kafka broker pods.

2.3.5. Integrating with the Red Hat build of Debezium for change data capture

The Red Hat build of Debezium is a distributed change data capture platform. It captures row-level changes in databases, creates change event records, and streams the records to Kafka topics. Debezium is built on Apache Kafka. You can deploy and integrate the Red Hat build of Debezium with AMQ Streams. Following a deployment of AMQ Streams, you deploy Debezium as a connector configuration through Kafka Connect. Debezium passes change event records to AMQ Streams on OpenShift. Applications can read these *change event streams* and access the change events in the order in which they occurred.

Debezium has multiple uses, including:

- Data replication
- Updating caches and search indexes
- Simplifying monolithic applications
- Data integration
- Enabling streaming queries

To capture database changes, deploy Kafka Connect with a Debezium database connector. You configure a **KafkaConnector** resource to define the connector instance.

For more information on deploying the Red Hat build of Debezium with AMQ Streams, refer to the product documentation. The documentation includes a *Getting Started with Debezium* guide that guides you through the process of setting up the services and connector required to view change event records for database updates.

2.4. KAFKA MIRRORMAKER 2 CLUSTER CONFIGURATION

Configure a Kafka MirrorMaker 2 deployment using the **KafkaMirrorMaker2** resource. MirrorMaker 2 replicates data between two or more Kafka clusters, within or across data centers.

Section 6.2.128, "**KafkaMirrorMaker2** schema reference" describes the full schema of the **KafkaMirrorMaker2** resource.

MirrorMaker 2 resource configuration differs from the previous version of MirrorMaker. If you choose to use MirrorMaker 2, there is currently no legacy support, so any resources must be manually converted into the new format.

2.4.1. MirrorMaker 2 data replication

Data replication across clusters supports scenarios that require:

- Recovery of data in the event of a system failure
- Aggregation of data for analysis
- Restriction of data access to a specific cluster
- Provision of data at a specific location to improve latency

2.4.1.1. MirrorMaker 2 configuration

MirrorMaker 2 consumes messages from a source Kafka cluster and writes them to a target Kafka cluster.

MirrorMaker 2 uses:

- Source cluster configuration to consume data from the source cluster
- Target cluster configuration to output data to the target cluster

MirrorMaker 2 is based on the Kafka Connect framework, *connectors* managing the transfer of data between clusters.

You configure MirrorMaker 2 to define the Kafka Connect deployment, including the connection details of the source and target clusters, and then run a set of MirrorMaker 2 connectors to make the connection.

MirrorMaker 2 consists of the following connectors:

MirrorSourceConnector

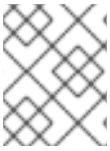
The source connector replicates topics from a source cluster to a target cluster. It also replicates ACLs and is necessary for the **MirrorCheckpointConnector** to run.

MirrorCheckpointConnector

The checkpoint connector periodically tracks offsets. If enabled, it also synchronizes consumer group offsets between the source and target cluster.

MirrorHeartbeatConnector

The heartbeat connector periodically checks connectivity between the source and target cluster.

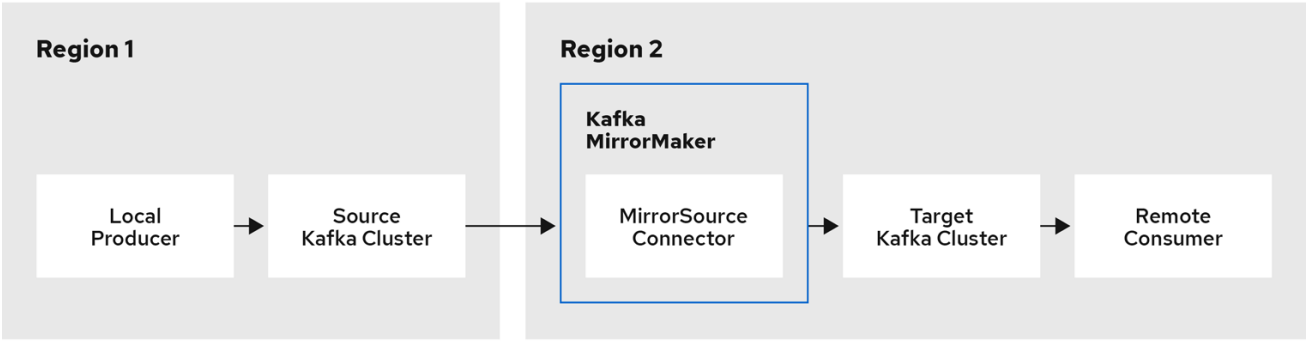


NOTE

If you are using the User Operator to manage ACLs, ACL replication through the connector is not possible.

The process of *mirroring* data from a source cluster to a target cluster is asynchronous. Each MirrorMaker 2 instance mirrors data from one source cluster to one target cluster. You can use more than one MirrorMaker 2 instance to mirror data between any number of clusters.

Figure 2.1. Replication across two clusters



By default, a check for new topics in the source cluster is made every 10 minutes. You can change the frequency by adding **refresh.topics.interval.seconds** to the source connector configuration.

2.4.1.1.1. Cluster configuration

You can use MirrorMaker 2 in *active/passive* or *active/active* cluster configurations.

active/active cluster configuration

An active/active configuration has two active clusters replicating data bidirectionally. Applications can use either cluster. Each cluster can provide the same data. In this way, you can make the same data available in different geographical locations. As consumer groups are active in both clusters, consumer offsets for replicated topics are not synchronized back to the source cluster.

active/passive cluster configuration

An active/passive configuration has an active cluster replicating data to a passive cluster. The passive cluster remains on standby. You might use the passive cluster for data recovery in the event of system failure.

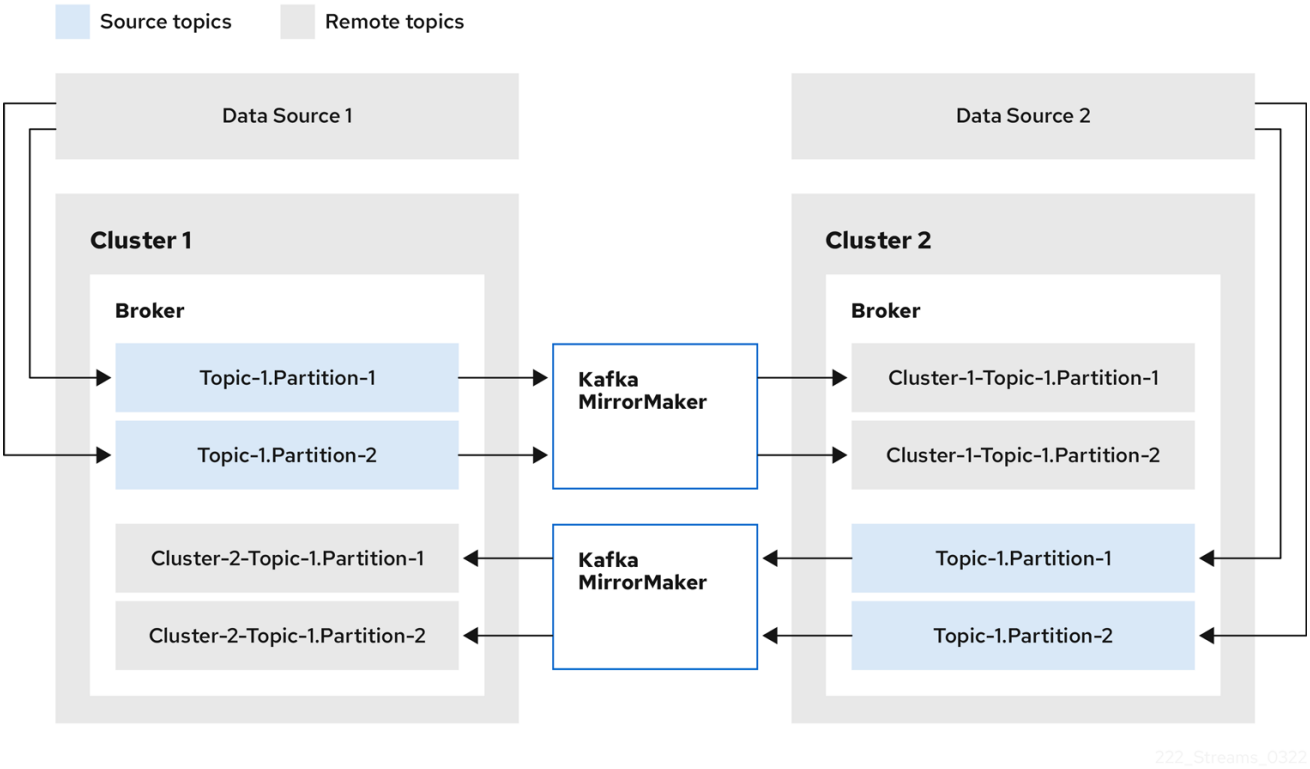
The expectation is that producers and consumers connect to active clusters only. A MirrorMaker 2 cluster is required at each target destination.

2.4.1.1.2. Bidirectional replication (active/active)

The MirrorMaker 2 architecture supports bidirectional replication in an *active/active* cluster configuration.

Each cluster replicates the data of the other cluster using the concept of *source* and *remote* topics. As the same topics are stored in each cluster, remote topics are automatically renamed by MirrorMaker 2 to represent the source cluster. The name of the originating cluster is prepended to the name of the topic.

Figure 2.2. Topic renaming



By flagging the originating cluster, topics are not replicated back to that cluster.

The concept of replication through *remote* topics is useful when configuring an architecture that requires data aggregation. Consumers can subscribe to source and remote topics within the same cluster, without the need for a separate aggregation cluster.

2.4.1.1.3. Unidirectional replication (active/passive)

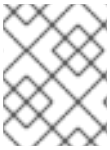
The MirrorMaker 2 architecture supports unidirectional replication in an *active/passive* cluster configuration.

You can use an *active/passive* cluster configuration to make backups or migrate data to another cluster. In this situation, you might not want automatic renaming of remote topics.

You can override automatic renaming by adding **IdentityReplicationPolicy** to the source connector configuration. With this configuration applied, topics retain their original names.

2.4.1.2. Topic configuration synchronization

MirrorMaker 2 supports topic configuration synchronization between source and target clusters. You specify source topics in the MirrorMaker 2 configuration. MirrorMaker 2 monitors the source topics. MirrorMaker 2 detects and propagates changes to the source topics to the remote topics. Changes might include automatically creating missing topics and partitions.



NOTE

In most cases you write to local topics and read from remote topics. Though write operations are not prevented on remote topics, they should be avoided.

2.4.1.3. Offset tracking

MirrorMaker 2 tracks offsets for consumer groups using internal topics.

offset-syncs topic

The **offset-syncs** topic maps the source and target offsets for replicated topic partitions from record metadata.

checkpoints topic

The **checkpoints** topic maps the last committed offset in the source and target cluster for replicated topic partitions in each consumer group.

As they used internally by MirrorMaker 2, you do not interact directly with these topics.

MirrorCheckpointConnector emits *checkpoints* for offset tracking. Offsets for the **checkpoints** topic are tracked at predetermined intervals through configuration. Both topics enable replication to be fully restored from the correct offset position on failover.

The location of the **offset-syncs** topic is the **source** cluster by default. You can use the **offset-syncs.topic.location** connector configuration to change this to the **target** cluster. You need read/write access to the cluster that contains the topic. Using the target cluster as the location of the **offset-syncs** topic allows you to use MirrorMaker 2 even if you have only read access to the source cluster.

2.4.1.4. Synchronizing consumer group offsets

The **__consumer_offsets** topic stores information on committed offsets for each consumer group. Offset synchronization periodically transfers the consumer offsets for the consumer groups of a source cluster into the consumer offsets topic of a target cluster.

Offset synchronization is particularly useful in an *active/passive* configuration. If the active cluster goes down, consumer applications can switch to the passive (standby) cluster and pick up from the last transferred offset position.

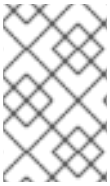
To use topic offset synchronization, enable the synchronization by adding **sync.group.offsets.enabled** to the checkpoint connector configuration, and setting the property to **true**. Synchronization is disabled by default.

When using the **IdentityReplicationPolicy** in the source connector, it also has to be configured in the checkpoint connector configuration. This ensures that the mirrored consumer offsets will be applied for the correct topics.

Consumer offsets are only synchronized for consumer groups that are not active in the target cluster. If the consumer groups are in the target cluster, the synchronization cannot be performed and an **UNKNOWN_MEMBER_ID** error is returned.

If enabled, the synchronization of offsets from the source cluster is made periodically. You can change the frequency by adding **sync.group.offsets.interval.seconds** and **emit.checkpoints.interval.seconds** to the checkpoint connector configuration. The properties specify the frequency in seconds that the consumer group offsets are synchronized, and the frequency of checkpoints emitted for offset tracking. The default for both properties is 60 seconds. You can also change the frequency of checks for new consumer groups using the **refresh.groups.interval.seconds** property, which is performed every 10 minutes by default.

Because the synchronization is time-based, any switchover by consumers to a passive cluster will likely result in some duplication of messages.



NOTE

If you have an application written in Java, you can use the **RemoteClusterUtils.java** utility to synchronize offsets through the application. The utility fetches remote offsets for a consumer group from the **checkpoints** topic.

2.4.1.5. Connectivity checks

MirrorHeartbeatConnector emits *heartbeats* to check connectivity between clusters.

An internal **heartbeat** topic is replicated from the source cluster. Target clusters use the **heartbeat** topic to check the following:

- The connector managing connectivity between clusters is running
- The source cluster is available

2.4.2. Connector configuration

Use Mirrormaker 2 connector configuration for the internal connectors that orchestrate the synchronization of data between Kafka clusters.

The following table describes connector properties and the connectors you configure to use them.

Table 2.1. MirrorMaker 2 connector configuration properties

Property	sourceConnector	checkpointConnector	heartbeatConnector
admin.timeout.ms Timeout for admin tasks, such as detecting new topics. Default is **60000** (1 minute).	✓	✓	✓
replication.policy.class Policy to define the remote topic naming convention. Default is **org.apache.kafka.connect.mirror.DefaultReplicationPolicy**.	✓	✓	✓
replication.policy.separator The separator used for topic naming in the target cluster. Default is **.** (dot).	✓	✓	✓
consumer.poll.timeout.ms Timeout when polling the source cluster. Default is **1000** (1 second).	✓	✓	

Property	sourceConnector	checkpointConnector	heartbeatConnector
offset-syncs.topic.location The location of the **offset-syncs** topic, which can be the **source** (default) or **target** cluster.	✓	✓	
topic.filter.class Topic filter to select the topics to replicate. Default is **org.apache.kafka.connect.mirror.DefaultTopicFilter**.	✓	✓	
config.property.filter.class Topic filter to select the topic configuration properties to replicate. Default is **org.apache.kafka.connect.mirror.DefaultConfigPropertyFilter**.	✓		
config.properties.exclude Topic configuration properties that should not be replicated. Supports comma-separated property names and regular expressions.	✓		
offset.lag.max Maximum allowable (out-of-sync) offset lag before a remote partition is synchronized. Default is **100**.	✓		
offset-syncs.topic.replication.factor Replication factor for the internal **offset-syncs** topic. Default is **3**.	✓		
refresh.topics.enabled Enables check for new topics and partitions. Default is **true**.	✓		
refresh.topics.interval.seconds Frequency of topic refresh. Default is **600** (10 minutes).	✓		

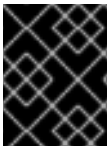
Property	sourceConnector	checkpointConnector	heartbeatConnector
replication.factor The replication factor for new topics. Default is **2**.	✓		
sync.topic.acls.enabled Enables synchronization of ACLs from the source cluster. Default is **true**. Not compatible with the User Operator.	✓		
sync.topic.acls.interval.seconds Frequency of ACL synchronization. Default is **600** (10 minutes).	✓		
sync.topic.configs.enabled Enables synchronization of topic configuration from the source cluster. Default is **true**.	✓		
sync.topic.configs.interval.seconds Frequency of topic configuration synchronization. Default **600** (10 minutes).	✓		
checkpoints.topic.replication.factor Replication factor for the internal **checkpoints** topic. Default is **3**.		✓	
emit.checkpoints.enabled Enables synchronization of consumer offsets to the target cluster. Default is **true**.		✓	
emit.checkpoints.interval.seconds Frequency of consumer offset synchronization. Default is **60** (1 minute).		✓	

Property	sourceConnector	checkpointConnector	heartbeatConnector
group.filter.class Group filter to select the consumer groups to replicate. Default is **org.apache.kafka.connect.mirror.DefaultGroupFilter**.		✓	
refresh.groups.enabled Enables check for new consumer groups. Default is **true**.		✓	
refresh.groups.interval.seconds Frequency of consumer group refresh. Default is **600** (10 minutes).		✓	
sync.group.offsets.enabled Enables synchronization of consumer group offsets to the target cluster **__consumer_offsets** topic. Default is **false**.		✓	
sync.group.offsets.interval.seconds Frequency of consumer group offset synchronization. Default is **60** (1 minute).		✓	
emit.heartbeats.enabled Enables connectivity checks on the target cluster. Default is **true**.			✓
emit.heartbeats.interval.seconds Frequency of connectivity checks. Default is **1** (1 second).			✓
heartbeats.topic.replication.factor Replication factor for the internal **heartbeats** topic. Default is **3**.			✓

2.4.3. Connector producer and consumer configuration

MirrorMaker 2 connectors use internal producers and consumers. If needed, you can configure these producers and consumers to override the default settings.

For example, you can increase the **batch.size** for the source producer that sends topics to the target Kafka cluster to better accommodate large volumes of messages.



IMPORTANT

Producer and consumer configuration options depend on the MirrorMaker 2 implementation, and may be subject to change.

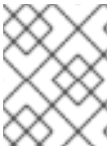
The following tables describe the producers and consumers for each of the connectors and where you can add configuration.

Table 2.2. Source connector producers and consumers

Type	Description	Configuration
Producer	Sends topic messages to the target Kafka cluster. Consider tuning the configuration of this producer when it is handling large volumes of data.	**mirrors.sourceConnector.config: producer.override.***
Producer	Writes to the **offset-syncs** topic, which maps the source and target offsets for replicated topic partitions.	**mirrors.sourceConnector.config: producer.***
Consumer	Retrieves topic messages from the source Kafka cluster.	**mirrors.sourceConnector.config: consumer.***

Table 2.3. Checkpoint connector producers and consumers

Type	Description	Configuration
Producer	Emits consumer offset checkpoints.	**mirrors.checkpointConnector.config: producer.override.***
Consumer	Loads the **offset-syncs** topic.	**mirrors.checkpointConnector.config: consumer.***



NOTE

You can set **offset-syncs.topic.location** to **target** to use the target Kafka cluster as the location of the **offset-syncs** topic.

Table 2.4. Heartbeat connector producer

Type	Description	Configuration
Producer	Emits heartbeats.	**mirrors.heartbeatConnector.config: producer.override.***

The following example shows how you configure the producers and consumers.

Example configuration for connector producers and consumers

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaMirrorMaker2
metadata:
  name: my-mirror-maker2
spec:
  version: 3.4.0
  # ...
  mirrors:
  - sourceCluster: "my-cluster-source"
    targetCluster: "my-cluster-target"
    sourceConnector:
      tasksMax: 5
      config:
        producer.override.batch.size: 327680
        producer.override.linger.ms: 100
        producer.request.timeout.ms: 30000
        consumer.fetch.max.bytes: 52428800
        # ...
    checkpointConnector:
      config:
        producer.override.request.timeout.ms: 30000
        consumer.max.poll.interval.ms: 300000
        # ...
    heartbeatConnector:
      config:
        producer.override.request.timeout.ms: 30000
        # ...
```

Additional resources

- Section 6.2.132, "**KafkaMirrorMaker2ConnectorSpec** schema reference"
- Section 6.2.131, "**KafkaMirrorMaker2MirrorSpec** schema reference"

2.4.4. Specifying a maximum number of tasks

Connectors create the tasks that are responsible for moving data in and out of Kafka. Each connector

comprises one or more tasks that are distributed across a group of worker pods that run the tasks. Increasing the number of tasks can help with performance issues when replicating a large number of partitions or synchronizing the offsets of a large number of consumer groups.

Tasks run in parallel. Workers are assigned one or more tasks. A single task is handled by one worker pod, so you don't need more worker pods than tasks. If there are more tasks than workers, workers handle multiple tasks.

You can specify the maximum number of connector tasks in your MirrorMaker configuration using the **tasksMax** property. Without specifying a maximum number of tasks, the default setting is a single task.

The heartbeat connector always uses a single task.

The number of tasks that are started for the source and checkpoint connectors is the lower value between the maximum number of possible tasks and the value for **tasksMax**. For the source connector, the maximum number of tasks possible is one for each partition being replicated from the source cluster. For the checkpoint connector, the maximum number of tasks possible is one for each consumer group being replicated from the source cluster. When setting a maximum number of tasks, consider the number of partitions and the hardware resources that support the process.

If the infrastructure supports the processing overhead, increasing the number of tasks can improve throughput and latency. For example, adding more tasks reduces the time taken to poll the source cluster when there is a high number of partitions or consumer groups.

Increasing the number of tasks for the checkpoint connector is useful when you have a large number of partitions.

Increasing the number of tasks for the source connector

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaMirrorMaker2
metadata:
  name: my-mirror-maker2
spec:
  # ...
  mirrors:
  - sourceCluster: "my-cluster-source"
    targetCluster: "my-cluster-target"
    sourceConnector:
      tasksMax: 10
  # ...
```

Increasing the number of tasks for the checkpoint connector is useful when you have a large number of consumer groups.

Increasing the number of tasks for the checkpoint connector

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaMirrorMaker2
metadata:
  name: my-mirror-maker2
spec:
  # ...
  mirrors:
  - sourceCluster: "my-cluster-source"
    targetCluster: "my-cluster-target"
```

```
    checkpointConnector:
      tasksMax: 10
  # ...
```

By default, MirrorMaker 2 checks for new consumer groups every 10 minutes. You can adjust the **refresh.groups.interval.seconds** configuration to change the frequency. Take care when adjusting lower. More frequent checks can have a negative impact on performance.

2.4.4.1. Checking connector task operations

If you are using Prometheus and Grafana to monitor your deployment, you can check MirrorMaker 2 performance. The example MirrorMaker 2 Grafana dashboard provided with AMQ Streams shows the following metrics related to tasks and latency.

- The number of tasks
- Replication latency
- Offset synchronization latency

Additional resources

- Grafana dashboards

2.4.5. ACL rules synchronization

ACL access to remote topics is possible if you are **not** using the User Operator.

If **AclAuthorizer** is being used, without the User Operator, ACL rules that manage access to brokers also apply to remote topics. Users that can read a source topic can read its remote equivalent.

NOTE

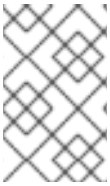
OAuth 2.0 authorization does not support access to remote topics in this way.

2.4.6. Configuring Kafka MirrorMaker 2

Use the properties of the **KafkaMirrorMaker2** resource to configure your Kafka MirrorMaker 2 deployment. Use MirrorMaker 2 to synchronize data between Kafka clusters.

The configuration must specify:

- Each Kafka cluster
- Connection information for each cluster, including authentication
- The replication flow and direction
  - Cluster to cluster
  - Topic to topic



NOTE

The previous version of MirrorMaker continues to be supported. If you wish to use the resources configured for the previous version, they must be updated to the format supported by MirrorMaker 2.

MirrorMaker 2 provides default configuration values for properties such as replication factors. A minimal configuration, with defaults left unchanged, would be something like this example:

Minimal configuration for MirrorMaker 2

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaMirrorMaker2
metadata:
  name: my-mirror-maker2
spec:
  version: 3.4.0
  connectCluster: "my-cluster-target"
  clusters:
  - alias: "my-cluster-source"
    bootstrapServers: my-cluster-source-kafka-bootstrap:9092
  - alias: "my-cluster-target"
    bootstrapServers: my-cluster-target-kafka-bootstrap:9092
  mirrors:
  - sourceCluster: "my-cluster-source"
    targetCluster: "my-cluster-target"
    sourceConnector: {}
```

You can configure access control for source and target clusters using mTLS or SASL authentication. This procedure shows a configuration that uses TLS encryption and mTLS authentication for the source and target cluster.

You can specify the topics and consumer groups you wish to replicate from a source cluster in the **KafkaMirrorMaker2** resource. You use the **topicsPattern** and **groupsPattern** properties to do this. You can provide a list of names or use a regular expression. By default, all topics and consumer groups are replicated if you do not set the **topicsPattern** and **groupsPattern** properties. You can also replicate all topics and consumer groups by using **".*"** as a regular expression. However, try to specify only the topics and consumer groups you need to avoid causing any unnecessary extra load on the cluster.

Handling high volumes of messages

You can tune the configuration to handle high volumes of messages. For more information, see Handling high volumes of messages .

Prerequisites

- AMQ Streams is running
- Source and target Kafka clusters are available

Procedure

1. Edit the **spec** properties for the **KafkaMirrorMaker2** resource.
   The properties you can configure are shown in this example configuration:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaMirrorMaker2
metadata:
  name: my-mirror-maker2
spec:
  version: 3.4.0 1
  replicas: 3 2
  connectCluster: "my-cluster-target" 3
  clusters: 4
  - alias: "my-cluster-source" 5
    authentication: 6
      certificateAndKey:
        certificate: source.crt
        key: source.key
        secretName: my-user-source
      type: tls
    bootstrapServers: my-cluster-source-kafka-bootstrap:9092 7
    tls: 8
      trustedCertificates:
      - certificate: ca.crt
        secretName: my-cluster-source-cluster-ca-cert
  - alias: "my-cluster-target" 9
    authentication: 10
      certificateAndKey:
        certificate: target.crt
        key: target.key
        secretName: my-user-target
      type: tls
    bootstrapServers: my-cluster-target-kafka-bootstrap:9092 11
    config: 12
      config.storage.replication.factor: 1
      offset.storage.replication.factor: 1
      status.storage.replication.factor: 1
      ssl.cipher.suites: TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 13
      ssl.enabled.protocols: TLSv1.2
      ssl.protocol: TLSv1.2
      ssl.endpoint.identification.algorithm: HTTPS 14
    tls: 15
      trustedCertificates:
      - certificate: ca.crt
        secretName: my-cluster-target-cluster-ca-cert
  mirrors: 16
  - sourceCluster: "my-cluster-source" 17
    targetCluster: "my-cluster-target" 18
    sourceConnector: 19
      tasksMax: 10 20
      autoRestart: 21
        enabled: true
      config:
        replication.factor: 1 22
        offset-syncs.topic.replication.factor: 1 23
        sync.topic.acls.enabled: "false" 24
```

```
      refresh.topics.interval.seconds: 60 25
      replication.policy.separator: "." 26
      replication.policy.class: "org.apache.kafka.connect.mirror.IdentityReplicationPolicy" 27
  heartbeatConnector: 28
    autoRestart:
      enabled: true
    config:
      heartbeats.topic.replication.factor: 1 29
  checkpointConnector: 30
    autoRestart:
      enabled: true
    config:
      checkpoints.topic.replication.factor: 1 31
      refresh.groups.interval.seconds: 600 32
      sync.group.offsets.enabled: true 33
      sync.group.offsets.interval.seconds: 60 34
      emit.checkpoints.interval.seconds: 60 35
      replication.policy.class: "org.apache.kafka.connect.mirror.IdentityReplicationPolicy"
  topicsPattern: "topic1|topic2|topic3" 36
  groupsPattern: "group1|group2|group3" 37
resources: 38
  requests:
    cpu: "1"
    memory: 2Gi
  limits:
    cpu: "2"
    memory: 2Gi
logging: 39
  type: inline
  loggers:
    connect.root.logger.level: "INFO"
readinessProbe: 40
  initialDelaySeconds: 15
  timeoutSeconds: 5
livenessProbe:
  initialDelaySeconds: 15
  timeoutSeconds: 5
jvmOptions: 41
  "-Xmx": "1g"
  "-Xms": "1g"
image: my-org/my-image:latest 42
rack:
  topologyKey: topology.kubernetes.io/zone 43
template: 44
  pod:
    affinity:
      podAntiAffinity:
        requiredDuringSchedulingIgnoredDuringExecution:
          - labelSelector:
              matchExpressions:
                - key: application
                  operator: In
                  values:
```

```
                - postgresql
                - mongodb
          topologyKey: "kubernetes.io/hostname"
  connectContainer: 45
    env:
      - name: JAEGER_SERVICE_NAME
        value: my-jaeger-service
      - name: JAEGER_AGENT_HOST
        value: jaeger-agent-name
      - name: JAEGER_AGENT_PORT
        value: "6831"
tracing:
  type: jaeger 46
externalConfiguration: 47
  env:
    - name: AWS_ACCESS_KEY_ID
      valueFrom:
        secretKeyRef:
          name: aws-creds
          key: awsAccessKey
    - name: AWS_SECRET_ACCESS_KEY
      valueFrom:
        secretKeyRef:
          name: aws-creds
          key: awsSecretAccessKey
```

1. The Kafka Connect and Mirror Maker 2.0 version, which will always be the same.
2. The number of replica nodes for the workers that run tasks.
3. Kafka cluster alias for Kafka Connect, which must specify the **target** Kafka cluster. The Kafka cluster is used by Kafka Connect for its internal topics.
4. Specification for the Kafka clusters being synchronized.
5. Cluster alias for the source Kafka cluster.
6. Authentication for the source cluster, specified as mTLS, token-based OAuth, SASL-based SCRAM-SHA-256/SCRAM-SHA-512, or PLAIN.
7. Bootstrap server for connection to the source Kafka cluster.
8. TLS encryption with key names under which TLS certificates are stored in X.509 format for the source Kafka cluster. If certificates are stored in the same secret, it can be listed multiple times.
9. Cluster alias for the target Kafka cluster.
10. Authentication for the target Kafka cluster is configured in the same way as for the source Kafka cluster.
11. Bootstrap server for connection to the target Kafka cluster.
12. Kafka Connect configuration. Standard Apache Kafka configuration may be provided, restricted to those properties not managed directly by AMQ Streams.

13 SSL properties for external listeners to run with a specific *cipher suite* for a TLS version.

14 Hostname verification is enabled by setting to **HTTPS**. An empty string disables the verification.

15 TLS encryption for the target Kafka cluster is configured in the same way as for the source Kafka cluster.

16 MirrorMaker 2 connectors.

17 Cluster alias for the source cluster used by the MirrorMaker 2 connectors.

18 Cluster alias for the target cluster used by the MirrorMaker 2 connectors.

19 Configuration for the **MirrorSourceConnector** that creates remote topics. The **config** overrides the default configuration options.

20 The maximum number of tasks that the connector may create. Tasks handle the data replication and run in parallel. If the infrastructure supports the processing overhead, increasing this value can improve throughput. Kafka Connect distributes the tasks between members of the cluster. If there are more tasks than workers, workers are assigned multiple tasks. For sink connectors, aim to have one task for each topic partition consumed. For source connectors, the number of tasks that can run in parallel may also depend on the external system. The connector creates fewer than the maximum number of tasks if it cannot achieve the parallelism.

21 Enables automatic restarts of failed connectors and tasks. Up to seven restart attempts are made, after which restarts must be made manually.

22 Replication factor for mirrored topics created at the target cluster.

23 Replication factor for the **MirrorSourceConnector offset-syncs** internal topic that maps the offsets of the source and target clusters.

24 When ACL rules synchronization is enabled, ACLs are applied to synchronized topics. The default is **true**. This feature is not compatible with the User Operator. If you are using the User Operator, set this property to **false**.

25 Optional setting to change the frequency of checks for new topics. The default is for a check every 10 minutes.

26 Defines the separator used for the renaming of remote topics.

27 Adds a policy that overrides the automatic renaming of remote topics. Instead of prepending the name with the name of the source cluster, the topic retains its original name. This optional setting is useful for active/passive backups and data migration. To configure topic offset synchronization, this property must also be set for the **checkpointConnector.config**.

28 Configuration for the **MirrorHeartbeatConnector** that performs connectivity checks. The **config** overrides the default configuration options.

29 Replication factor for the heartbeat topic created at the target cluster.

30 Configuration for the **MirrorCheckpointConnector** that tracks offsets. The **config** overrides the default configuration options.

31 Replication factor for the checkpoints topic created at the target cluster.

32 Optional setting to change the frequency of checks for new consumer groups. The default is for a check every 10 minutes.

33 Optional setting to synchronize consumer group offsets, which is useful for recovery in an active/passive configuration. Synchronization is not enabled by default.

34 If the synchronization of consumer group offsets is enabled, you can adjust the frequency of the synchronization.

35 Adjusts the frequency of checks for offset tracking. If you change the frequency of offset synchronization, you might also need to adjust the frequency of these checks.

36 Topic replication from the source cluster defined as a comma-separated list or regular expression pattern. The source connector replicates the specified topics. The checkpoint connector tracks offsets for the specified topics. Here we request three topics by name.

37 Consumer group replication from the source cluster defined as a comma-separated list or regular expression pattern. The checkpoint connector replicates the specified consumer groups. Here we request three consumer groups by name.

38 Requests for reservation of supported resources, currently **cpu** and **memory**, and limits to specify the maximum resources that can be consumed.

39 Specified Kafka Connect loggers and log levels added directly (**inline**) or indirectly (**external**) through a ConfigMap. A custom ConfigMap must be placed under the **log4j.properties** or **log4j2.properties** key. For the Kafka Connect **log4j.rootLogger** logger, you can set the log level to INFO, ERROR, WARN, TRACE, DEBUG, FATAL or OFF.

40 Healthchecks to know when to restart a container (liveness) and when a container can accept traffic (readiness).

41 JVM configuration options to optimize performance for the Virtual Machine (VM) running Kafka MirrorMaker.

42 ADVANCED OPTION: Container image configuration, which is recommended only in special situations.

43 SPECIALIZED OPTION: Rack awareness configuration for the deployment. This is a specialized option intended for a deployment within the same location, not across regions. Use this option if you want connectors to consume from the closest replica rather than the leader replica. In certain cases, consuming from the closest replica can improve network utilization or reduce costs . The **topologyKey** must match a node label containing the rack ID. The example used in this configuration specifies a zone using the standard **topology.kubernetes.io/zone** label. To consume from the closest replica, enable the **RackAwareReplicaSelector** in the Kafka broker configuration.

44 Template customization. Here a pod is scheduled with anti-affinity, so the pod is not scheduled on nodes with the same hostname.

45 Environment variables are set for distributed tracing.

46 Distributed tracing is enabled for Jaeger.

47 External configuration for an OpenShift Secret mounted to Kafka MirrorMaker as an environment variable. You can also use *configuration provider plugins* to load configuration values from external sources.

values from external sources.

2. Create or update the resource:

```
oc apply -f MIRRORMAKER-CONFIGURATION-FILE
```

Additional resources

- Introducing distributed tracing

2.4.7. Securing a Kafka MirrorMaker 2 deployment

This procedure describes in outline the configuration required to secure a MirrorMaker 2 deployment.

You need separate configuration for the source Kafka cluster and the target Kafka cluster. You also need separate user configuration to provide the credentials required for MirrorMaker to connect to the source and target Kafka clusters.

For the Kafka clusters, you specify internal listeners for secure connections within an OpenShift cluster and external listeners for connections outside the OpenShift cluster.

You can configure authentication and authorization mechanisms. The security options implemented for the source and target Kafka clusters must be compatible with the security options implemented for MirrorMaker 2.

After you have created the cluster and user authentication credentials, you specify them in your MirrorMaker configuration for secure connections.

NOTE

In this procedure, the certificates generated by the Cluster Operator are used, but you can replace them by installing your own certificates. You can also configure your listener to use a Kafka listener certificate managed by an external CA (certificate authority) .

Before you start

Before starting this procedure, take a look at the example configuration files provided by AMQ Streams. They include examples for securing a deployment of MirrorMaker 2 using mTLS or SCRAM-SHA-512 authentication. The examples specify internal listeners for connecting within an OpenShift cluster.

The examples provide the configuration for full authorization, including all the ACLs needed by MirrorMaker 2 to allow operations on the source and target Kafka clusters.

Prerequisites

- AMQ Streams is running
- Separate namespaces for source and target clusters

The procedure assumes that the source and target Kafka clusters are installed to separate namespaces If you want to use the Topic Operator, you'll need to do this. The Topic Operator only watches a single cluster in a specified namespace.

By separating the clusters into namespaces, you will need to copy the cluster secrets so they can be accessed outside the namespace. You need to reference the secrets in the MirrorMaker configuration.

Procedure

1. Configure two **Kafka** resources, one to secure the source Kafka cluster and one to secure the target Kafka cluster.
   You can add listener configuration for authentication and enable authorization.

   In this example, an internal listener is configured for a Kafka cluster with TLS encryption and mTLS authentication. Kafka **simple** authorization is enabled.

   Example source Kafka cluster configuration with TLS encryption and mTLS authentication

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-source-cluster
spec:
  kafka:
    version: 3.4.0
    replicas: 1
    listeners:
      - name: tls
        port: 9093
        type: internal
        tls: true
        authentication:
          type: tls
    authorization:
      type: simple
    config:
      offsets.topic.replication.factor: 1
      transaction.state.log.replication.factor: 1
      transaction.state.log.min.isr: 1
      default.replication.factor: 1
      min.insync.replicas: 1
      inter.broker.protocol.version: "3.4"
    storage:
      type: jbod
      volumes:
      - id: 0
        type: persistent-claim
        size: 100Gi
        deleteClaim: false
  zookeeper:
    replicas: 1
    storage:
      type: persistent-claim
      size: 100Gi
      deleteClaim: false
  entityOperator:
    topicOperator: {}
    userOperator: {}
```

   Example target Kafka cluster configuration with TLS encryption and mTLS authentication

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-target-cluster
spec:
  kafka:
    version: 3.4.0
    replicas: 1
    listeners:
      - name: tls
        port: 9093
        type: internal
        tls: true
        authentication:
          type: tls
    authorization:
      type: simple
    config:
      offsets.topic.replication.factor: 1
      transaction.state.log.replication.factor: 1
      transaction.state.log.min.isr: 1
      default.replication.factor: 1
      min.insync.replicas: 1
      inter.broker.protocol.version: "3.4"
    storage:
      type: jbod
      volumes:
        - id: 0
          type: persistent-claim
          size: 100Gi
          deleteClaim: false
  zookeeper:
    replicas: 1
    storage:
      type: persistent-claim
      size: 100Gi
      deleteClaim: false
  entityOperator:
    topicOperator: {}
    userOperator: {}
```

2. Create or update the **Kafka** resources in separate namespaces.

```
oc apply -f <kafka_configuration_file> -n <namespace>
```

The Cluster Operator creates the listeners and sets up the cluster and client certificate authority (CA) certificates to enable authentication within the Kafka cluster.

The certificates are created in the secret ***<cluster_name>*-cluster-ca-cert**.

3. Configure two **KafkaUser** resources, one for a user of the source Kafka cluster and one for a user of the target Kafka cluster.

   a. Configure the same authentication and authorization types as the corresponding source and target Kafka cluster. For example, if you used **tls** authentication and the **simple** authorization type in the **Kafka** configuration for the source Kafka cluster, use the same in

the **KafkaUser** configuration.

b. Configure the ACLs needed by MirrorMaker 2 to allow operations on the source and target Kafka clusters.
The ACLs are used by the internal MirrorMaker connectors, and by the underlying Kafka Connect framework.

Example source user configuration for mTLS authentication

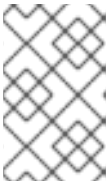
```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaUser
metadata:
  name: my-source-user
  labels:
    strimzi.io/cluster: my-source-cluster
spec:
  authentication:
    type: tls
  authorization:
    type: simple
    acls:
      # MirrorSourceConnector
      - resource: # Not needed if offset-syncs.topic.location=target
          type: topic
          name: mm2-offset-syncs.my-target-cluster.internal
        operations:
          - Create
          - DescribeConfigs
          - Read
          - Write
      - resource: # Needed for every topic which is mirrored
          type: topic
          name: "*"
        operations:
          - DescribeConfigs
          - Read
      # MirrorCheckpointConnector
      - resource:
          type: cluster
        operations:
          - Describe
      - resource: # Needed for every group for which offsets are synced
          type: group
          name: "*"
        operations:
          - Describe
      - resource: # Not needed if offset-syncs.topic.location=target
          type: topic
          name: mm2-offset-syncs.my-target-cluster.internal
        operations:
          - Read
```

Example target user configuration for mTLS authentication

```
apiVersion: kafka.strimzi.io/v1beta2
```

```
kind: KafkaUser
metadata:
  name: my-target-user
  labels:
    strimzi.io/cluster: my-target-cluster
spec:
  authentication:
    type: tls
  authorization:
    type: simple
    acls:
      # Underlying Kafka Connect internal topics to store configuration, offsets, or status
      - resource:
          type: group
          name: mirrormaker2-cluster
        operations:
          - Read
      - resource:
          type: topic
          name: mirrormaker2-cluster-configs
        operations:
          - Create
          - Describe
          - DescribeConfigs
          - Read
          - Write
      - resource:
          type: topic
          name: mirrormaker2-cluster-status
        operations:
          - Create
          - Describe
          - DescribeConfigs
          - Read
          - Write
      - resource:
          type: topic
          name: mirrormaker2-cluster-offsets
        operations:
          - Create
          - Describe
          - DescribeConfigs
          - Read
          - Write
      # MirrorSourceConnector
      - resource: # Needed for every topic which is mirrored
          type: topic
          name: "*"
        operations:
          - Create
          - Alter
          - AlterConfigs
          - Write
      # MirrorCheckpointConnector
      - resource:
          type: cluster
```

```
      operations:
        - Describe
    - resource:
        type: topic
        name: my-source-cluster.checkpoints.internal
      operations:
        - Create
        - Describe
        - Read
        - Write
    - resource: # Needed for every group for which the offset is synced
        type: group
        name: "*"
      operations:
        - Read
        - Describe
    # MirrorHeartbeatConnector
    - resource:
        type: topic
        name: heartbeats
      operations:
        - Create
        - Describe
        - Write
```



NOTE

You can use a certificate issued outside the User Operator by setting **type** to **tls-external**. For more information, see Section 6.2.93, "**KafkaUserSpec** schema reference".

4. Create or update a **KafkaUser** resource in each of the namespaces you created for the source and target Kafka clusters.

```
oc apply -f <kafka_user_configuration_file> -n <namespace>
```

The User Operator creates the users representing the client (MirrorMaker), and the security credentials used for client authentication, based on the chosen authentication type.

The User Operator creates a new secret with the same name as the **KafkaUser** resource. The secret contains a private and public key for mTLS authentication. The public key is contained in a user certificate, which is signed by the clients CA.

5. Configure a **KafkaMirrorMaker2** resource with the authentication details to connect to the source and target Kafka clusters.

Example MirrorMaker 2 configuration with TLS encryption and mTLS authentication

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaMirrorMaker2
metadata:
  name: my-mirror-maker-2
spec:
  version: 3.4.0
  replicas: 1
```

```
connectCluster: "my-target-cluster"
clusters:
  - alias: "my-source-cluster"
    bootstrapServers: my-source-cluster-kafka-bootstrap:9093
    tls: 1
      trustedCertificates:
        - secretName: my-source-cluster-cluster-ca-cert
          certificate: ca.crt
    authentication: 2
      type: tls
      certificateAndKey:
        secretName: my-source-user
        certificate: user.crt
        key: user.key
  - alias: "my-target-cluster"
    bootstrapServers: my-target-cluster-kafka-bootstrap:9093
    tls: 3
      trustedCertificates:
        - secretName: my-target-cluster-cluster-ca-cert
          certificate: ca.crt
    authentication: 4
      type: tls
      certificateAndKey:
        secretName: my-target-user
        certificate: user.crt
        key: user.key
    config:
      # -1 means it will use the default replication factor configured in the broker
      config.storage.replication.factor: -1
      offset.storage.replication.factor: -1
      status.storage.replication.factor: -1
mirrors:
  - sourceCluster: "my-source-cluster"
    targetCluster: "my-target-cluster"
    sourceConnector:
      config:
        replication.factor: 1
        offset-syncs.topic.replication.factor: 1
        sync.topic.acls.enabled: "false"
    heartbeatConnector:
      config:
        heartbeats.topic.replication.factor: 1
    checkpointConnector:
      config:
        checkpoints.topic.replication.factor: 1
        sync.group.offsets.enabled: "true"
    topicsPattern: "topic1|topic2|topic3"
    groupsPattern: "group1|group2|group3"
```

1. The TLS certificates for the source Kafka cluster. If they are in a separate namespace, copy the cluster secrets from the namespace of the Kafka cluster.
2. The user authentication for accessing the source Kafka cluster using the TLS mechanism.
3. The TLS certificates for the target Kafka cluster.

4 The user authentication for accessing the target Kafka cluster.

6. Create or update the **KafkaMirrorMaker2** resource in the same namespace as the target Kafka cluster.

```
oc apply -f <mirrormaker2_configuration_file> -n <namespace_of_target_cluster>
```

Additional resources

- type-KafkaMirrorMaker2ClusterSpec-reference[]

2.4.8. Performing a restart of a Kafka MirrorMaker 2 connector

This procedure describes how to manually trigger a restart of a Kafka MirrorMaker 2 connector by using an OpenShift annotation.

Prerequisites

- The Cluster Operator is running.

Procedure

1. Find the name of the **KafkaMirrorMaker2** custom resource that controls the Kafka MirrorMaker 2 connector you want to restart:

```
oc get KafkaMirrorMaker2
```

2. Find the name of the Kafka MirrorMaker 2 connector to be restarted from the **KafkaMirrorMaker2** custom resource.

```
oc describe KafkaMirrorMaker2 KAFKAMIRRORMAKER-2-NAME
```

3. To restart the connector, annotate the **KafkaMirrorMaker2** resource in OpenShift. In this example, **oc annotate** restarts a connector named **my-source->my-target.MirrorSourceConnector**:

```
oc annotate KafkaMirrorMaker2 KAFKAMIRRORMAKER-2-NAME "strimzi.io/restart-connector=my-source->my-target.MirrorSourceConnector"
```

4. Wait for the next reconciliation to occur (every two minutes by default).
The Kafka MirrorMaker 2 connector is restarted, as long as the annotation was detected by the reconciliation process. When the restart request is accepted, the annotation is removed from the **KafkaMirrorMaker2** custom resource.

Additional resources

- Kafka MirrorMaker 2 cluster configuration .

2.4.9. Performing a restart of a Kafka MirrorMaker 2 connector task

This procedure describes how to manually trigger a restart of a Kafka MirrorMaker 2 connector task by using an OpenShift annotation.

Prerequisites

- The Cluster Operator is running.

Procedure

1. Find the name of the **KafkaMirrorMaker2** custom resource that controls the Kafka MirrorMaker 2 connector you want to restart:

```
oc get KafkaMirrorMaker2
```

2. Find the name of the Kafka MirrorMaker 2 connector and the ID of the task to be restarted from the **KafkaMirrorMaker2** custom resource. Task IDs are non-negative integers, starting from 0.

```
oc describe KafkaMirrorMaker2 KAFKAMIRRORMAKER-2-NAME
```

3. To restart the connector task, annotate the **KafkaMirrorMaker2** resource in OpenShift. In this example, **oc annotate** restarts task *0* of a connector named **my-source->my-target.MirrorSourceConnector**:

```
oc annotate KafkaMirrorMaker2 KAFKAMIRRORMAKER-2-NAME "strimzi.io/restart-connector-task=my-source->my-target.MirrorSourceConnector:0"
```

4. Wait for the next reconciliation to occur (every two minutes by default).
The Kafka MirrorMaker 2 connector task is restarted, as long as the annotation was detected by the reconciliation process. When the restart task request is accepted, the annotation is removed from the **KafkaMirrorMaker2** custom resource.

Additional resources

- Kafka MirrorMaker 2 cluster configuration .

2.5. KAFKA MIRRORMAKER CLUSTER CONFIGURATION

Configure a Kafka MirrorMaker deployment using the **KafkaMirrorMaker** resource. KafkaMirrorMaker replicates data between Kafka clusters.

Section 6.2.108, "**KafkaMirrorMaker** schema reference" describes the full schema of the **KafkaMirrorMaker** resource.

You can use AMQ Streams with MirrorMaker or MirrorMaker 2. MirrorMaker 2 is the latest version, and offers a more efficient way to mirror data between Kafka clusters.

IMPORTANT

Kafka MirrorMaker 1 (referred to as just *MirrorMaker* in the documentation) has been deprecated in Apache Kafka 3.0.0 and will be removed in Apache Kafka 4.0.0. As a result, the **KafkaMirrorMaker** custom resource which is used to deploy Kafka MirrorMaker 1 has been deprecated in AMQ Streams as well. The **KafkaMirrorMaker** resource will be removed from AMQ Streams when we adopt Apache Kafka 4.0.0. As a replacement, use the **KafkaMirrorMaker2** custom resource with the **IdentityReplicationPolicy**.

2.5.1. Configuring Kafka MirrorMaker

Use the properties of the **KafkaMirrorMaker** resource to configure your Kafka MirrorMaker deployment.

You can configure access control for producers and consumers using TLS or SASL authentication. This procedure shows a configuration that uses TLS encryption and mTLS authentication on the consumer and producer side.

Prerequisites

- See the *Deploying and Upgrading AMQ Streams on OpenShift* guide for instructions on running a:
  - Cluster Operator
  - Kafka cluster
- Source and target Kafka clusters must be available

Procedure

1. Edit the **spec** properties for the **KafkaMirrorMaker** resource.
   The properties you can configure are shown in this example configuration:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaMirrorMaker
metadata:
  name: my-mirror-maker
spec:
  replicas: 3 (1)
  consumer:
    bootstrapServers: my-source-cluster-kafka-bootstrap:9092 (2)
    groupId: "my-group" (3)
    numStreams: 2 (4)
    offsetCommitInterval: 120000 (5)
    tls: (6)
      trustedCertificates:
      - secretName: my-source-cluster-ca-cert
        certificate: ca.crt
    authentication: (7)
      type: tls
      certificateAndKey:
        secretName: my-source-secret
        certificate: public.crt
        key: private.key
    config: (8)
      max.poll.records: 100
      receive.buffer.bytes: 32768
      ssl.cipher.suites: TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 (9)
      ssl.enabled.protocols: TLSv1.2
      ssl.protocol: TLSv1.2
      ssl.endpoint.identification.algorithm: HTTPS (10)
  producer:
    bootstrapServers: my-target-cluster-kafka-bootstrap:9092
    abortOnSendFailure: false (11)
    tls:
```

```
    trustedCertificates:
    - secretName: my-target-cluster-ca-cert
      certificate: ca.crt
  authentication:
    type: tls
    certificateAndKey:
      secretName: my-target-secret
      certificate: public.crt
      key: private.key
  config:
    compression.type: gzip
    batch.size: 8192
    ssl.cipher.suites: TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 (12)
    ssl.enabled.protocols: TLSv1.2
    ssl.protocol: TLSv1.2
    ssl.endpoint.identification.algorithm: HTTPS (13)
include: "my-topic|other-topic" (14)
resources: (15)
  requests:
    cpu: "1"
    memory: 2Gi
  limits:
    cpu: "2"
    memory: 2Gi
logging: (16)
  type: inline
  loggers:
    mirrormaker.root.logger: "INFO"
readinessProbe: (17)
  initialDelaySeconds: 15
  timeoutSeconds: 5
livenessProbe:
  initialDelaySeconds: 15
  timeoutSeconds: 5
metricsConfig: (18)
 type: jmxPrometheusExporter
 valueFrom:
   configMapKeyRef:
     name: my-config-map
     key: my-key
jvmOptions: (19)
  "-Xmx": "1g"
  "-Xms": "1g"
image: my-org/my-image:latest (20)
template: (21)
  pod:
    affinity:
      podAntiAffinity:
        requiredDuringSchedulingIgnoredDuringExecution:
          - labelSelector:
              matchExpressions:
                - key: application
                  operator: In
                  values:
                    - postgresql
```

```
                - mongodb
          topologyKey: "kubernetes.io/hostname"
  connectContainer: 22
    env:
      - name: JAEGER_SERVICE_NAME
        value: my-jaeger-service
      - name: JAEGER_AGENT_HOST
        value: jaeger-agent-name
      - name: JAEGER_AGENT_PORT
        value: "6831"
tracing: 23
  type: jaeger
```

1. The number of replica nodes .
2. Bootstrap servers for consumer and producer.
3. Group ID for the consumer .
4. The number of consumer streams .
5. The offset auto-commit interval in milliseconds .
6. TLS encryption with key names under which TLS certificates are stored in X.509 format for consumer or producer. If certificates are stored in the same secret, it can be listed multiple times.
7. Authentication for consumer or producer, specified as mTLS, token-based OAuth, SASL-based SCRAM-SHA-256/SCRAM-SHA-512, or PLAIN.
8. Kafka configuration options for consumer and producer.
9. SSL properties for external listeners to run with a specific *cipher suite* for a TLS version.
10. Hostname verification is enabled by setting to **HTTPS**. An empty string disables the verification.
11. If the **abortOnSendFailure** property is set to **true**, Kafka MirrorMaker will exit and the container will restart following a send failure for a message.
12. SSL properties for external listeners to run with a specific *cipher suite* for a TLS version.
13. Hostname verification is enabled by setting to **HTTPS**. An empty string disables the verification.
14. A included topics mirrored from source to target Kafka cluster.
15. Requests for reservation of supported resources, currently **cpu** and **memory**, and limits to specify the maximum resources that can be consumed.
16. Specified loggers and log levels added directly (**inline**) or indirectly (**external**) through a ConfigMap. A custom ConfigMap must be placed under the **log4j.properties** or **log4j2.properties** key. MirrorMaker has a single logger called **mirrormaker.root.logger**. You can set the log level to INFO, ERROR, WARN, TRACE, DEBUG, FATAL or OFF.
17. Healthchecks to know when to restart a container (liveness) and when a container can accept traffic (readiness).

18 Prometheus metrics, which are enabled by referencing a ConfigMap containing configuration for the Prometheus JMX exporter in this example. You can enable metrics

19 JVM configuration options to optimize performance for the Virtual Machine (VM) running Kafka MirrorMaker.

20 ADVANCED OPTION: Container image configuration, which is recommended only in special situations.

21 Template customization. Here a pod is scheduled with anti-affinity, so the pod is not scheduled on nodes with the same hostname.

22 Environment variables are set for distributed tracing.

23 Distributed tracing is enabled for Jaeger.

WARNING

With the **abortOnSendFailure** property set to **false**, the producer attempts to send the next message in a topic. The original message might be lost, as there is no attempt to resend a failed message.

2. Create or update the resource:

```
oc apply -f <your-file>
```

Additional resources

- Introducing distributed tracing

2.5.2. List of Kafka MirrorMaker cluster resources

The following resources are created by the Cluster Operator in the OpenShift cluster:

<mirror-maker-name>-mirror-maker

Deployment which is responsible for creating the Kafka MirrorMaker pods.

<mirror-maker-name>-config

ConfigMap which contains ancillary configuration for the Kafka MirrorMaker, and is mounted as a volume by the Kafka broker pods.

<mirror-maker-name>-mirror-maker

Pod Disruption Budget configured for the Kafka MirrorMaker worker nodes.

2.6. KAFKA BRIDGE CLUSTER CONFIGURATION

Configure a Kafka Bridge deployment using the **KafkaBridge** resource. Kafka Bridge provides an API for integrating HTTP-based clients with a Kafka cluster.

Section 6.2.114, "**KafkaBridge** schema reference" describes the full schema of the **KafkaBridge** resource.

2.6.1. Configuring the Kafka Bridge

Use the Kafka Bridge to make HTTP-based requests to the Kafka cluster.

Use the properties of the **KafkaBridge** resource to configure your Kafka Bridge deployment.

In order to prevent issues arising when client consumer requests are processed by different Kafka Bridge instances, address-based routing must be employed to ensure that requests are routed to the right Kafka Bridge instance. Additionally, each independent Kafka Bridge instance must have a replica. A Kafka Bridge instance has its own state which is not shared with another instances.

Prerequisites

- An OpenShift cluster
- A running Cluster Operator

See the *Deploying and Upgrading AMQ Streams on OpenShift* guide for instructions on running a:

- Cluster Operator
- Kafka cluster

Procedure

1. Edit the **spec** properties for the **KafkaBridge** resource.
   The properties you can configure are shown in this example configuration:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaBridge
metadata:
  name: my-bridge
spec:
  replicas: 3 (1)
  bootstrapServers: <cluster_name>-cluster-kafka-bootstrap:9092 (2)
  tls: (3)
    trustedCertificates:
      - secretName: my-cluster-cluster-cert
        certificate: ca.crt
      - secretName: my-cluster-cluster-cert
        certificate: ca2.crt
  authentication: (4)
    type: tls
    certificateAndKey:
      secretName: my-secret
      certificate: public.crt
      key: private.key
  http: (5)
    port: 8080
    cors: (6)
      allowedOrigins: "https://strimzi.io"
      allowedMethods: "GET,POST,PUT,DELETE,OPTIONS,PATCH"
```

```
  consumer: 7
    config:
      auto.offset.reset: earliest
  producer: 8
    config:
      delivery.timeout.ms: 300000
  resources: 9
    requests:
      cpu: "1"
      memory: 2Gi
    limits:
      cpu: "2"
      memory: 2Gi
  logging: 10
    type: inline
    loggers:
      logger.bridge.level: "INFO"
      # enabling DEBUG just for send operation
      logger.send.name: "http.openapi.operation.send"
      logger.send.level: "DEBUG"
  jvmOptions: 11
    "-Xmx": "1g"
    "-Xms": "1g"
  readinessProbe: 12
    initialDelaySeconds: 15
    timeoutSeconds: 5
  livenessProbe:
    initialDelaySeconds: 15
    timeoutSeconds: 5
  image: my-org/my-image:latest 13
  template: 14
    pod:
      affinity:
        podAntiAffinity:
          requiredDuringSchedulingIgnoredDuringExecution:
            - labelSelector:
                matchExpressions:
                  - key: application
                    operator: In
                    values:
                      - postgresql
                      - mongodb
              topologyKey: "kubernetes.io/hostname"
    bridgeContainer: 15
      env:
        - name: JAEGER_SERVICE_NAME
          value: my-jaeger-service
        - name: JAEGER_AGENT_HOST
          value: jaeger-agent-name
        - name: JAEGER_AGENT_PORT
          value: "6831"
```

1 The number of replica nodes.

2 Bootstrap server for connection to the target Kafka cluster. Use the name of the Kafka

cluster as the *<cluster_name>*.

3. TLS encryption with key names under which TLS certificates are stored in X.509 format for the source Kafka cluster. If certificates are stored in the same secret, it can be listed multiple times.

4. Authentication for the Kafka Bridge cluster, specified as mTLS, token-based OAuth, SASL-based SCRAM-SHA-256/SCRAM-SHA-512, or PLAIN. By default, the Kafka Bridge connects to Kafka brokers without authentication.

5. HTTP access to Kafka brokers.

6. CORS access specifying selected resources and access methods. Additional HTTP headers in requests describe the origins that are permitted access to the Kafka cluster.

7. Consumer configuration options.

8. Producer configuration options.

9. Requests for reservation of supported resources, currently **cpu** and **memory**, and limits to specify the maximum resources that can be consumed.

10. Specified Kafka Bridge loggers and log levels added directly (**inline**) or indirectly (**external**) through a ConfigMap. A custom ConfigMap must be placed under the **log4j.properties** or **log4j2.properties** key. For the Kafka Bridge loggers, you can set the log level to INFO, ERROR, WARN, TRACE, DEBUG, FATAL or OFF.

11. JVM configuration options to optimize performance for the Virtual Machine (VM) running the Kafka Bridge.

12. Healthchecks to know when to restart a container (liveness) and when a container can accept traffic (readiness).

13. Optional: Container image configuration, which is recommended only in special situations.

14. Template customization. Here a pod is scheduled with anti-affinity, so the pod is not scheduled on nodes with the same hostname.

15. Environment variables are set for distributed tracing.

2. Create or update the resource:

```
oc apply -f KAFKA-BRIDGE-CONFIG-FILE
```

Additional resources

- Using the AMQ Streams Kafka Bridge
- Introducing distributed tracing

2.6.2. List of Kafka Bridge cluster resources

The following resources are created by the Cluster Operator in the OpenShift cluster:

***bridge-cluster-name*-bridge**

Deployment which is in charge to create the Kafka Bridge worker node pods.

bridge-cluster-name-bridge-service

Service which exposes the REST interface of the Kafka Bridge cluster.

bridge-cluster-name-bridge-config

ConfigMap which contains the Kafka Bridge ancillary configuration and is mounted as a volume by the Kafka broker pods.

bridge-cluster-name-bridge

Pod Disruption Budget configured for the Kafka Bridge worker nodes.

2.7. CUSTOMIZING OPENSHIFT RESOURCES

An AMQ Streams deployment creates OpenShift resources, such as **Deployments**, **StatefulSets**, **Pods**, and **Services**. These resources are managed by AMQ Streams operators. Only the operator that is responsible for managing a particular OpenShift resource can change that resource. If you try to manually change an operator-managed OpenShift resource, the operator will revert your changes back.

Changing an operator-managed OpenShift resource can be useful if you want to perform certain tasks, such as:

- Adding custom labels or annotations that control how **Pods** are treated by Istio or other services
- Managing how **Loadbalancer**-type Services are created by the cluster

You can make the changes using the **template** property in the AMQ Streams custom resources. The **template** property is supported in the following resources. The API reference provides more details about the customizable fields.

Kafka.spec.kafka

See Section 6.2.33, "**KafkaClusterTemplate** schema reference"

Kafka.spec.zookeeper

See Section 6.2.43, "**ZookeeperClusterTemplate** schema reference"

Kafka.spec.entityOperator

See Section 6.2.48, "**EntityOperatorTemplate** schema reference"

Kafka.spec.kafkaExporter

See Section 6.2.56, "**KafkaExporterTemplate** schema reference"

Kafka.spec.cruiseControl

See Section 6.2.52, "**CruiseControlTemplate** schema reference"

KafkaConnect.spec

See Section 6.2.72, "**KafkaConnectTemplate** schema reference"

KafkaMirrorMaker.spec

See Section 6.2.112, "**KafkaMirrorMakerTemplate** schema reference"

KafkaMirrorMaker2.spec

See Section 6.2.72, "**KafkaConnectTemplate** schema reference"

KafkaBridge.spec

See Section 6.2.121, "**KafkaBridgeTemplate** schema reference"

KafkaUser.spec

See Section 6.2.106, "**KafkaUserTemplate** schema reference"

In the following example, the **template** property is used to modify the labels in a Kafka broker's pod.

Example template customization

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
  labels:
    app: my-cluster
spec:
  kafka:
    # ...
    template:
      pod:
        metadata:
          labels:
            mylabel: myvalue
    # ...
```

2.7.1. Customizing the image pull policy

AMQ Streams allows you to customize the image pull policy for containers in all pods deployed by the Cluster Operator. The image pull policy is configured using the environment variable **STRIMZI_IMAGE_PULL_POLICY** in the Cluster Operator deployment. The **STRIMZI_IMAGE_PULL_POLICY** environment variable can be set to three different values:

Always

Container images are pulled from the registry every time the pod is started or restarted.

IfNotPresent

Container images are pulled from the registry only when they were not pulled before.

Never

Container images are never pulled from the registry.

Currently, the image pull policy can only be customized for all Kafka, Kafka Connect, and Kafka MirrorMaker clusters at once. Changing the policy will result in a rolling update of all your Kafka, Kafka Connect, and Kafka MirrorMaker clusters.

Additional resources

- Using the Cluster Operator.
- Disruptions.

2.7.2. Applying a termination grace period

Apply a termination grace period to give a Kafka cluster enough time to shut down cleanly.

Specify the time using the **terminationGracePeriodSeconds** property. Add the property to the **template.pod** configuration of the **Kafka** custom resource.

The time you add will depend on the size of your Kafka cluster. The OpenShift default for the termination grace period is 30 seconds. If you observe that your clusters are not shutting down cleanly, you can increase the termination grace period.

A termination grace period is applied every time a pod is restarted. The period begins when OpenShift sends a *term* (termination) signal to the processes running in the pod. The period should reflect the amount of time required to transfer the processes of the terminating pod to another pod before they are stopped. After the period ends, a *kill* signal stops any processes still running in the pod.

The following example adds a termination grace period of 120 seconds to the **Kafka** custom resource. You can also specify the configuration in the custom resources of other Kafka components.

Example termination grace period configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
    template:
      pod:
        terminationGracePeriodSeconds: 120
        # ...
    # ...
```

2.8. CONFIGURING POD SCHEDULING

When two applications are scheduled to the same OpenShift node, both applications might use the same resources like disk I/O and impact performance. That can lead to performance degradation. Scheduling Kafka pods in a way that avoids sharing nodes with other critical workloads, using the right nodes or dedicated a set of nodes only for Kafka are the best ways how to avoid such problems.

2.8.1. Specifying affinity, tolerations, and topology spread constraints

Use affinity, tolerations and topology spread constraints to schedule the pods of kafka resources onto nodes. Affinity, tolerations and topology spread constraints are configured using the **affinity**, **tolerations**, and **topologySpreadConstraint** properties in following resources:

- **Kafka.spec.kafka.template.pod**
- **Kafka.spec.zookeeper.template.pod**
- **Kafka.spec.entityOperator.template.pod**
- **KafkaConnect.spec.template.pod**
- **KafkaBridge.spec.template.pod**
- **KafkaMirrorMaker.spec.template.pod**
- **KafkaMirrorMaker2.spec.template.pod**

The format of the **affinity**, **tolerations**, and **topologySpreadConstraint** properties follows the OpenShift specification. The affinity configuration can include different types of affinity:

- Pod affinity and anti-affinity
- Node affinity

Additional resources

- Kubernetes node and pod affinity documentation
- Kubernetes taints and tolerations
- Controlling pod placement by using pod topology spread constraints

2.8.1.1. Use pod anti-affinity to avoid critical applications sharing nodes

Use pod anti-affinity to ensure that critical applications are never scheduled on the same disk. When running a Kafka cluster, it is recommended to use pod anti-affinity to ensure that the Kafka brokers do not share nodes with other workloads, such as databases.

2.8.1.2. Use node affinity to schedule workloads onto specific nodes

The OpenShift cluster usually consists of many different types of worker nodes. Some are optimized for CPU heavy workloads, some for memory, while other might be optimized for storage (fast local SSDs) or network. Using different nodes helps to optimize both costs and performance. To achieve the best possible performance, it is important to allow scheduling of AMQ Streams components to use the right nodes.

OpenShift uses node affinity to schedule workloads onto specific nodes. Node affinity allows you to create a scheduling constraint for the node on which the pod will be scheduled. The constraint is specified as a label selector. You can specify the label using either the built-in node label like **beta.kubernetes.io/instance-type** or custom labels to select the right node.

2.8.1.3. Use node affinity and tolerations for dedicated nodes

Use taints to create dedicated nodes, then schedule Kafka pods on the dedicated nodes by configuring node affinity and tolerations.

Cluster administrators can mark selected OpenShift nodes as tainted. Nodes with taints are excluded from regular scheduling and normal pods will not be scheduled to run on them. Only services which can tolerate the taint set on the node can be scheduled on it. The only other services running on such nodes will be system services such as log collectors or software defined networks.

Running Kafka and its components on dedicated nodes can have many advantages. There will be no other applications running on the same nodes which could cause disturbance or consume the resources needed for Kafka. That can lead to improved performance and stability.

2.8.2. Configuring pod anti-affinity to schedule each Kafka broker on a different worker node

Many Kafka brokers or ZooKeeper nodes can run on the same OpenShift worker node. If the worker node fails, they will all become unavailable at the same time. To improve reliability, you can use **podAntiAffinity** configuration to schedule each Kafka broker or ZooKeeper node on a different OpenShift worker node.

Prerequisites

- An OpenShift cluster
- A running Cluster Operator

Procedure

1. Edit the **affinity** property in the resource specifying the cluster deployment. To make sure that no worker nodes are shared by Kafka brokers or ZooKeeper nodes, use the **strimzi.io/name** label. Set the **topologyKey** to **kubernetes.io/hostname** to specify that the selected pods are not scheduled on nodes with the same hostname. This will still allow the same worker node to be shared by a single Kafka broker and a single ZooKeeper node. For example:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
spec:
  kafka:
    # ...
    template:
      pod:
        affinity:
          podAntiAffinity:
            requiredDuringSchedulingIgnoredDuringExecution:
              - labelSelector:
                  matchExpressions:
                    - key: strimzi.io/name
                      operator: In
                      values:
                        - CLUSTER-NAME-kafka
                topologyKey: "kubernetes.io/hostname"
    # ...
  zookeeper:
    # ...
    template:
      pod:
        affinity:
          podAntiAffinity:
            requiredDuringSchedulingIgnoredDuringExecution:
              - labelSelector:
                  matchExpressions:
                    - key: strimzi.io/name
                      operator: In
                      values:
                        - CLUSTER-NAME-zookeeper
                topologyKey: "kubernetes.io/hostname"
    # ...
```

Where ***CLUSTER-NAME*** is the name of your Kafka custom resource.

2. If you even want to make sure that a Kafka broker and ZooKeeper node do not share the same worker node, use the **strimzi.io/cluster** label. For example:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
spec:
```

```
kafka:
  # ...
  template:
    pod:
      affinity:
        podAntiAffinity:
          requiredDuringSchedulingIgnoredDuringExecution:
            - labelSelector:
                matchExpressions:
                  - key: strimzi.io/cluster
                    operator: In
                    values:
                      - CLUSTER-NAME
              topologyKey: "kubernetes.io/hostname"
  # ...
zookeeper:
  # ...
  template:
    pod:
      affinity:
        podAntiAffinity:
          requiredDuringSchedulingIgnoredDuringExecution:
            - labelSelector:
                matchExpressions:
                  - key: strimzi.io/cluster
                    operator: In
                    values:
                      - CLUSTER-NAME
              topologyKey: "kubernetes.io/hostname"
  # ...
```

Where ***CLUSTER-NAME*** is the name of your Kafka custom resource.

3. Create or update the resource.

```
oc apply -f <kafka_configuration_file>
```

2.8.3. Configuring pod anti-affinity in Kafka components

Pod anti-affinity configuration helps with the stability and performance of Kafka brokers. By using **podAntiAffinity**, OpenShift will not schedule Kafka brokers on the same nodes as other workloads. Typically, you want to avoid Kafka running on the same worker node as other network or storage intensive applications such as databases, storage or other messaging platforms.

Prerequisites

- An OpenShift cluster
- A running Cluster Operator

Procedure

1. Edit the **affinity** property in the resource specifying the cluster deployment. Use labels to specify the pods which should not be scheduled on the same nodes. The **topologyKey** should be set to **kubernetes.io/hostname** to specify that the selected pods should not be scheduled

on nodes with the same hostname. For example:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
spec:
  kafka:
    # ...
    template:
      pod:
        affinity:
          podAntiAffinity:
            requiredDuringSchedulingIgnoredDuringExecution:
              - labelSelector:
                  matchExpressions:
                    - key: application
                      operator: In
                      values:
                        - postgresql
                        - mongodb
                topologyKey: "kubernetes.io/hostname"
    # ...
  zookeeper:
    # ...
```

2. Create or update the resource.
   This can be done using **oc apply**:

```
oc apply -f <kafka_configuration_file>
```

2.8.4. Configuring node affinity in Kafka components

Prerequisites

- An OpenShift cluster
- A running Cluster Operator

Procedure

1. Label the nodes where AMQ Streams components should be scheduled.
   This can be done using **oc label**:

```
oc label node NAME-OF-NODE node-type=fast-network
```

   Alternatively, some of the existing labels might be reused.

2. Edit the **affinity** property in the resource specifying the cluster deployment. For example:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
spec:
  kafka:
    # ...
```

```
  template:
    pod:
      affinity:
        nodeAffinity:
          requiredDuringSchedulingIgnoredDuringExecution:
            nodeSelectorTerms:
              - matchExpressions:
                - key: node-type
                  operator: In
                  values:
                  - fast-network
    # ...
  zookeeper:
    # ...
```

3. Create or update the resource.
   This can be done using **oc apply**:

```
oc apply -f <kafka_configuration_file>
```

2.8.5. Setting up dedicated nodes and scheduling pods on them

Prerequisites

- An OpenShift cluster
- A running Cluster Operator

Procedure

1. Select the nodes which should be used as dedicated.
2. Make sure there are no workloads scheduled on these nodes.
3. Set the taints on the selected nodes:
   This can be done using **oc adm taint**:

```
oc adm taint node NAME-OF-NODE dedicated=Kafka:NoSchedule
```

4. Additionally, add a label to the selected nodes as well.
   This can be done using **oc label**:

```
oc label node NAME-OF-NODE dedicated=Kafka
```

5. Edit the **affinity** and **tolerations** properties in the resource specifying the cluster deployment.
   For example:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
spec:
  kafka:
    # ...
    template:
```

```
      pod:
        tolerations:
          - key: "dedicated"
            operator: "Equal"
            value: "Kafka"
            effect: "NoSchedule"
        affinity:
          nodeAffinity:
            requiredDuringSchedulingIgnoredDuringExecution:
              nodeSelectorTerms:
              - matchExpressions:
                - key: dedicated
                  operator: In
                  values:
                  - Kafka
    # ...
  zookeeper:
    # ...
```

6. Create or update the resource.
   This can be done using **oc apply**:

```
oc apply -f <kafka_configuration_file>
```

2.9. LOGGING CONFIGURATION

Configure logging levels in the custom resources of Kafka components and AMQ Streams Operators. You can specify the logging levels directly in the **spec.logging** property of the custom resource. Or you can define the logging properties in a ConfigMap that's referenced in the custom resource using the **configMapKeyRef** property.

The advantages of using a ConfigMap are that the logging properties are maintained in one place and are accessible to more than one resource. You can also reuse the ConfigMap for more than one resource. If you are using a ConfigMap to specify loggers for AMQ Streams Operators, you can also append the logging specification to add filters.

You specify a logging **type** in your logging specification:

- **inline** when specifying logging levels directly
- **external** when referencing a ConfigMap

Example inline logging configuration

```
spec:
  # ...
  logging:
    type: inline
    loggers:
      kafka.root.logger.level: "INFO"
```

Example external logging configuration

```
spec:
```

```
# ...
logging:
  type: external
  valueFrom:
    configMapKeyRef:
      name: my-config-map
      key: my-config-map-key
```

Values for the **name** and **key** of the ConfigMap are mandatory. Default logging is used if the **name** or **key** is not set.

2.9.1. Logging options for Kafka components and operators

For more information on configuring logging for specific Kafka components or operators, see the following sections.

Kafka component logging

- Kafka logging
- ZooKeeper logging
- Kafka Connect and Mirror Maker 2.0 logging
- MirrorMaker logging
- Kafka Bridge logging
- Cruise Control logging

Operator logging

- Cluster Operator logging
- Topic Operator logging
- User Operator logging

2.9.2. Creating a ConfigMap for logging

To use a ConfigMap to define logging properties, you create the ConfigMap and then reference it as part of the logging definition in the **spec** of a resource.

The ConfigMap must contain the appropriate logging configuration.

- **log4j.properties** for Kafka components, ZooKeeper, and the Kafka Bridge
- **log4j2.properties** for the Topic Operator and User Operator

The configuration must be placed under these properties.

In this procedure a ConfigMap defines a root logger for a Kafka resource.

Procedure

1. Create the ConfigMap.
   You can create the ConfigMap as a YAML file or from a properties file.

   ConfigMap example with a root logger definition for Kafka:

```
kind: ConfigMap
apiVersion: v1
metadata:
  name: logging-configmap
data:
  log4j.properties:
    kafka.root.logger.level="INFO"
```

   If you are using a properties file, specify the file at the command line:

```
oc create configmap logging-configmap --from-file=log4j.properties
```

   The properties file defines the logging configuration:

```
# Define the logger
kafka.root.logger.level="INFO"
# ...
```

2. Define *external* logging in the **spec** of the resource, setting the **logging.valueFrom.configMapKeyRef.name** to the name of the ConfigMap and **logging.valueFrom.configMapKeyRef.key** to the key in this ConfigMap.

```
spec:
  # ...
  logging:
    type: external
    valueFrom:
      configMapKeyRef:
        name: logging-configmap
        key: log4j.properties
```

3. Create or update the resource.

```
oc apply -f <kafka_configuration_file>
```

2.9.3. Adding logging filters to Operators

If you are using a ConfigMap to configure the (log4j2) logging levels for AMQ Streams Operators, you can also define logging filters to limit what's returned in the log.

Logging filters are useful when you have a large number of logging messages. Suppose you set the log level for the logger as DEBUG (**rootLogger.level="DEBUG"**). Logging filters reduce the number of logs returned for the logger at that level, so you can focus on a specific resource. When the filter is set, only log messages matching the filter are logged.

Filters use *markers* to specify what to include in the log. You specify a kind, namespace and name for the marker. For example, if a Kafka cluster is failing, you can isolate the logs by specifying the kind as **Kafka**, and use the namespace and name of the failing cluster.

This example shows a marker filter for a Kafka cluster named **my-kafka-cluster**.

Basic logging filter configuration

```
rootLogger.level="INFO"
appender.console.filter.filter1.type=MarkerFilter 1
appender.console.filter.filter1.onMatch=ACCEPT 2
appender.console.filter.filter1.onMismatch=DENY 3
appender.console.filter.filter1.marker=Kafka(my-namespace/my-kafka-cluster) 4
```

1. The **MarkerFilter** type compares a specified marker for filtering.
2. The **onMatch** property accepts the log if the marker matches.
3. The **onMismatch** property rejects the log if the marker does not match.
4. The marker used for filtering is in the format *KIND(NAMESPACE/NAME-OF-RESOURCE)*.

You can create one or more filters. Here, the log is filtered for two Kafka clusters.

Multiple logging filter configuration

```
appender.console.filter.filter1.type=MarkerFilter
appender.console.filter.filter1.onMatch=ACCEPT
appender.console.filter.filter1.onMismatch=DENY
appender.console.filter.filter1.marker=Kafka(my-namespace/my-kafka-cluster-1)
appender.console.filter.filter2.type=MarkerFilter
appender.console.filter.filter2.onMatch=ACCEPT
appender.console.filter.filter2.onMismatch=DENY
appender.console.filter.filter2.marker=Kafka(my-namespace/my-kafka-cluster-2)
```

Adding filters to the Cluster Operator

To add filters to the Cluster Operator, update its logging ConfigMap YAML file (**install/cluster-operator/050-ConfigMap-strimzi-cluster-operator.yaml**).

Procedure

1. Update the **050-ConfigMap-strimzi-cluster-operator.yaml** file to add the filter properties to the ConfigMap.
   In this example, the filter properties return logs only for the **my-kafka-cluster** Kafka cluster:

```
kind: ConfigMap
apiVersion: v1
metadata:
  name: strimzi-cluster-operator
data:
  log4j2.properties:
    #...
    appender.console.filter.filter1.type=MarkerFilter
    appender.console.filter.filter1.onMatch=ACCEPT
    appender.console.filter.filter1.onMismatch=DENY
    appender.console.filter.filter1.marker=Kafka(my-namespace/my-kafka-cluster)
```

Alternatively, edit the **ConfigMap** directly:

```
oc edit configmap strimzi-cluster-operator
```

2. If you updated the YAML file instead of editing the **ConfigMap** directly, apply the changes by deploying the ConfigMap:

```
oc create -f install/cluster-operator/050-ConfigMap-strimzi-cluster-operator.yaml
```

Adding filters to the Topic Operator or User Operator

To add filters to the Topic Operator or User Operator, create or edit a logging ConfigMap.

In this procedure a logging ConfigMap is created with filters for the Topic Operator. The same approach is used for the User Operator.

Procedure

1. Create the ConfigMap.
   You can create the ConfigMap as a YAML file or from a properties file.

   In this example, the filter properties return logs only for the **my-topic** topic:

```
kind: ConfigMap
apiVersion: v1
metadata:
  name: logging-configmap
data:
  log4j2.properties:
    rootLogger.level="INFO"
    appender.console.filter.filter1.type=MarkerFilter
    appender.console.filter.filter1.onMatch=ACCEPT
    appender.console.filter.filter1.onMismatch=DENY
    appender.console.filter.filter1.marker=KafkaTopic(my-namespace/my-topic)
```

   If you are using a properties file, specify the file at the command line:

```
oc create configmap logging-configmap --from-file=log4j2.properties
```

   The properties file defines the logging configuration:

```
# Define the logger
rootLogger.level="INFO"
# Set the filters
appender.console.filter.filter1.type=MarkerFilter
appender.console.filter.filter1.onMatch=ACCEPT
appender.console.filter.filter1.onMismatch=DENY
appender.console.filter.filter1.marker=KafkaTopic(my-namespace/my-topic)
# ...
```

2. Define *external* logging in the **spec** of the resource, setting the **logging.valueFrom.configMapKeyRef.name** to the name of the ConfigMap and **logging.valueFrom.configMapKeyRef.key** to the key in this ConfigMap.

For the Topic Operator, logging is specified in the **topicOperator** configuration of the **Kafka** resource.

```
spec:
  # ...
  entityOperator:
    topicOperator:
      logging:
        type: external
        valueFrom:
          configMapKeyRef:
            name: logging-configmap
            key: log4j2.properties
```

3. Apply the changes by deploying the Cluster Operator:

```
create -f install/cluster-operator -n my-cluster-operator-namespace
```

Additional resources

- Configuring Kafka
- Cluster Operator logging
- Topic Operator logging
- User Operator logging

CHAPTER 3. LOADING CONFIGURATION VALUES FROM EXTERNAL SOURCES

Use configuration provider plugins to load configuration data from external sources. The providers operate independently of AMQ Streams. You can use them to load configuration data for all Kafka components, including producers and consumers. Use them, for example, to provide the credentials for Kafka Connect connector configuration.

OpenShift Configuration Provider

The OpenShift Configuration Provider plugin loads configuration data from OpenShift secrets or ConfigMaps.
Suppose you have a **Secret** object that's managed outside the Kafka namespace, or outside the Kafka cluster. The OpenShift Configuration Provider allows you to reference the values of the secret in your configuration without extracting the files. You just need to tell the provider what secret to use and provide access rights. The provider loads the data without needing to restart the Kafka component, even when using a new **Secret** or **ConfigMap** object. This capability avoids disruption when a Kafka Connect instance hosts multiple connectors.

Environment Variables Configuration Provider

The Environment Variables Configuration Provider plugin loads configuration data from environment variables.
The values for the environment variables can be mapped from secrets or ConfigMaps. You can use the Environment Variables Configuration Provider, for example, to load certificates or JAAS configuration from environment variables mapped from OpenShift secrets.

NOTE

OpenShift Configuration Provider can't use mounted files. For example, it can't load values that need the location of a truststore or keystore. Instead, you can mount ConfigMaps or secrets into a Kafka Connect pod as environment variables or volumes. You can use the Environment Variables Configuration Provider to load values for environment variables. You add configuration using the **externalConfiguration** property in **KafkaConnect.spec**. You don't need to set up access rights with this approach. However, Kafka Connect will need a restart when using a new **Secret** or **ConfigMap** for a connector. This will cause disruption to all the Kafka Connect instance's connectors.

3.1. LOADING CONFIGURATION VALUES FROM A CONFIGMAP

This procedure shows how to use the OpenShift Configuration Provider plugin.

In the procedure, an external **ConfigMap** object provides configuration properties for a connector.

Prerequisites

- An OpenShift cluster is available.
- A Kafka cluster is running.
- The Cluster Operator is running.

Procedure

1. Create a **ConfigMap** or **Secret** that contains the configuration properties.
   In this example, a **ConfigMap** object named **my-connector-configuration** contains connector properties:

   Example ConfigMap with connector properties

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: my-connector-configuration
data:
  option1: value1
  option2: value2
```

2. Specify the OpenShift Configuration Provider in the Kafka Connect configuration.
   The specification shown here can support loading values from secrets and ConfigMaps.

   Example Kafka Connect configuration to enable the OpenShift Configuration Provider

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect
  annotations:
    strimzi.io/use-connector-resources: "true"
spec:
  # ...
  config:
    # ...
    config.providers: secrets,configmaps (1)
    config.providers.secrets.class: io.strimzi.kafka.KubernetesSecretConfigProvider (2)
    config.providers.configmaps.class: io.strimzi.kafka.KubernetesConfigMapConfigProvider
(3)
  # ...
```

   (1) The alias for the configuration provider is used to define other configuration parameters. The provider parameters use the alias from **config.providers**, taking the form **config.providers.${alias}.class**.

   (2) **KubernetesSecretConfigProvider** provides values from secrets.

   (3) **KubernetesConfigMapConfigProvider** provides values from config maps.

3. Create or update the resource to enable the provider.

```
oc apply -f <kafka_connect_configuration_file>
```

4. Create a role that permits access to the values in the external config map.

   Example role to access values from a config map

```
apiVersion: rbac.authorization.k8s.io/v1
```

```
kind: Role
metadata:
  name: connector-configuration-role
rules:
- apiGroups: [""]
  resources: ["configmaps"]
  resourceNames: ["my-connector-configuration"]
  verbs: ["get"]
# ...
```

The rule gives the role permission to access the **my-connector-configuration** config map.

5. Create a role binding to permit access to the namespace that contains the config map.

Example role binding to access the namespace that contains the config map

```
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: connector-configuration-role-binding
subjects:
- kind: ServiceAccount
  name: my-connect-connect
  namespace: my-project
roleRef:
  kind: Role
  name: connector-configuration-role
  apiGroup: rbac.authorization.k8s.io
# ...
```

The role binding gives the role permission to access the **my-project** namespace.

The service account must be the same one used by the Kafka Connect deployment. The service account name format is *<cluster_name>*-connect, where *<cluster_name>* is the name of the **KafkaConnect** custom resource.

6. Reference the config map in the connector configuration.

Example connector configuration referencing the config map

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnector
metadata:
  name: my-connector
  labels:
    strimzi.io/cluster: my-connect
spec:
  # ...
  config:
    option: ${configmaps:my-project/my-connector-configuration:option1}
    # ...
# ...
```

Placeholders for the property values in the config map are referenced in the connector configuration. The placeholder structure is **configmaps:*<path_and_file_name>*:*<property>***.

KubernetesConfigMapConfigProvider reads and extracts the *option1* property value from the external config map.

3.2. LOADING CONFIGURATION VALUES FROM ENVIRONMENT VARIABLES

This procedure shows how to use the Environment Variables Configuration Provider plugin.

In the procedure, environment variables provide configuration properties for a connector. A database password is specified as an environment variable.

Prerequisites

- An OpenShift cluster is available.
- A Kafka cluster is running.
- The Cluster Operator is running.

Procedure

1. Specify the Environment Variables Configuration Provider in the Kafka Connect configuration. Define environment variables using the **externalConfiguration** property.

   Example Kafka Connect configuration to enable the Environment Variables Configuration Provider

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect
  annotations:
    strimzi.io/use-connector-resources: "true"
spec:
  # ...
  config:
    # ...
    config.providers: env (1)
    config.providers.env.class: io.strimzi.kafka.EnvVarConfigProvider (2)
  # ...
  externalConfiguration:
    env:
      - name: DB_PASSWORD (3)
        valueFrom:
          secretKeyRef:
            name: db-creds (4)
            key: dbPassword (5)
  # ...
```

(1) The alias for the configuration provider is used to define other configuration parameters. The provider parameters use the alias from **config.providers**, taking the form **config.providers.${alias}.class**.

2 **EnvVarConfigProvider** provides values from environment variables.

3 The **DB_PASSWORD** environment variable takes a password value from a secret.

4 The name of the secret containing the predefined password.

5 The key for the password stored inside the secret.

2. Create or update the resource to enable the provider.

```
oc apply -f <kafka_connect_configuration_file>
```

3. Reference the environment variable in the connector configuration.

Example connector configuration referencing the environment variable

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnector
metadata:
  name: my-connector
  labels:
    strimzi.io/cluster: my-connect
spec:
  # ...
  config:
    option: ${env:DB_PASSWORD}
    # ...
# ...
```

CHAPTER 4. APPLYING SECURITY CONTEXT TO AMQ STREAMS PODS AND CONTAINERS

Security context defines constraints on pods and containers. By specifying a security context, pods and containers only have the permissions they need. For example, permissions can control runtime operations or access to resources.

4.1. HANDLING OF SECURITY CONTEXT BY OPENSHIFT PLATFORM

Handling of security context depends on the tooling of the OpenShift platform you are using.

For example, OpenShift uses built-in security context constraints (SCCs) to control permissions. SCCs are the settings and strategies that control the security features a pod has access to.

By default, OpenShift injects security context configuration automatically. In most cases, this means you don't need to configure security context for the pods and containers created by the Cluster Operator. Although you can still create and manage your own SCCs.

For more information, see the OpenShift documentation.

CHAPTER 5. VALIDATING SCHEMAS WITH THE RED HAT BUILD OF APICURIO REGISTRY

You can use the Red Hat build of Apicurio Registry with AMQ Streams.

Apicurio Registry is a datastore for sharing standard event schemas and API designs across API and event-driven architectures. You can use Apicurio Registry to decouple the structure of your data from your client applications, and to share and manage your data types and API descriptions at runtime using a REST interface.

Apicurio Registry stores schemas used to serialize and deserialize messages, which can then be referenced from your client applications to ensure that the messages that they send and receive are compatible with those schemas. Apicurio Registry provides Kafka client serializers/deserializers for Kafka producer and consumer applications. Kafka producer applications use serializers to encode messages that conform to specific event schemas. Kafka consumer applications use deserializers, which validate that the messages have been serialized using the correct schema, based on a specific schema ID.

You can enable your applications to use a schema from the registry. This ensures consistent schema usage and helps to prevent data errors at runtime.

Additional resources

- Red Hat build of Apicurio Registry documentation
- Red Hat build of Apicurio Registry is built on the Apicurio Registry open source community project available on GitHub: Apicurio/apicurio-registry

CHAPTER 6. CUSTOM RESOURCE API REFERENCE

6.1. COMMON CONFIGURATION PROPERTIES

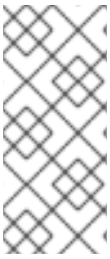
Common configuration properties apply to more than one resource.

6.1.1. replicas

Use the **replicas** property to configure replicas.

The type of replication depends on the resource.

- **KafkaTopic** uses a replication factor to configure the number of replicas of each partition within a Kafka cluster.
- Kafka components use replicas to configure the number of pods in a deployment to provide better availability and scalability.



NOTE

When running a Kafka component on OpenShift it may not be necessary to run multiple replicas for high availability. When the node where the component is deployed crashes, OpenShift will automatically reschedule the Kafka component pod to a different node. However, running Kafka components with multiple replicas can provide faster failover times as the other nodes will be up and running.

6.1.2. bootstrapServers

Use the **bootstrapServers** property to configure a list of bootstrap servers.

The bootstrap server lists can refer to Kafka clusters that are not deployed in the same OpenShift cluster. They can also refer to a Kafka cluster not deployed by AMQ Streams.

If on the same OpenShift cluster, each list must ideally contain the Kafka cluster bootstrap service which is named ***CLUSTER-NAME*-kafka-bootstrap** and a port number. If deployed by AMQ Streams but on different OpenShift clusters, the list content depends on the approach used for exposing the clusters (routes, ingress, nodeports or loadbalancers).

When using Kafka with a Kafka cluster not managed by AMQ Streams, you can specify the bootstrap servers list according to the configuration of the given cluster.

6.1.3. ssl

You can incorporate SSL configuration and cipher suite specifications to further secure TLS-based communication between your client application and a Kafka cluster. In addition to the standard TLS configuration, you can specify a supported TLS version and enable cipher suites in the configuration for the Kafka broker. You can also add the configuration to your clients if you wish to limit the TLS versions and cipher suites they use. The configuration on the client must only use protocols and cipher suites that are enabled on the broker.

A cipher suite is a set of security mechanisms for secure connection and data transfer. For example, the cipher suite **TLS_AES_256_GCM_SHA384** is composed of the following mechanisms, which are used in conjunction with the TLS protocol:

- AES (Advanced Encryption Standard) encryption (256-bit key)
- GCM (Galois/Counter Mode) authenticated encryption
- SHA384 (Secure Hash Algorithm) data integrity protection

The combination is encapsulated in the **TLS_AES_256_GCM_SHA384** cipher suite specification.

The **ssl.enabled.protocols** property specifies the available TLS versions that can be used for secure communication between the cluster and its clients. The **ssl.protocol** property sets the default TLS version for all connections, and it must be chosen from the enabled protocols. Use the **ssl.endpoint.identification.algorithm** property to enable or disable hostname verification.

Example SSL configuration

```
# ...
config:
  ssl.cipher.suites: TLS_AES_256_GCM_SHA384,
TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 (1)
  ssl.enabled.protocols: TLSv1.3, TLSv1.2 (2)
  ssl.protocol: TLSv1.3 (3)
  ssl.endpoint.identification.algorithm: HTTPS (4)
# ...
```

1. Cipher suite specifications enabled.
2. TLS versions supported.
3. Default TLS version is **TLSv1.3**. If a client only supports TLSv1.2, it can still connect to the broker and communicate using that supported version, and vice versa if the configuration is on the client and the broker only supports TLSv1.2.
4. Hostname verification is enabled by setting to **HTTPS**. An empty string disables the verification.

6.1.4. trustedCertificates

Having set **tls** to configure TLS encryption, use the **trustedCertificates** property to provide a list of secrets with key names under which the certificates are stored in X.509 format.

You can use the secrets created by the Cluster Operator for the Kafka cluster, or you can create your own TLS certificate file, then create a **Secret** from the file:

```
oc create secret generic MY-SECRET \
--from-file=MY-TLS-CERTIFICATE-FILE.crt
```

Example TLS encryption configuration

```
tls:
  trustedCertificates:
    - secretName: my-cluster-cluster-cert
      certificate: ca.crt
    - secretName: my-cluster-cluster-cert
      certificate: ca2.crt
```

If certificates are stored in the same secret, it can be listed multiple times.

If you want to enable TLS encryption, but use the default set of public certification authorities shipped with Java, you can specify **trustedCertificates** as an empty array:

Example of enabling TLS with the default Java certificates

```
tls:
  trustedCertificates: []
```

For information on configuring mTLS authentication, see the **KafkaClientAuthenticationTls** schema reference.

6.1.5. resources

Configure resource *requests* and *limits* to control resources for AMQ Streams containers. You can specify requests and limits for **memory** and **cpu** resources. The requests should be enough to ensure a stable performance of Kafka.

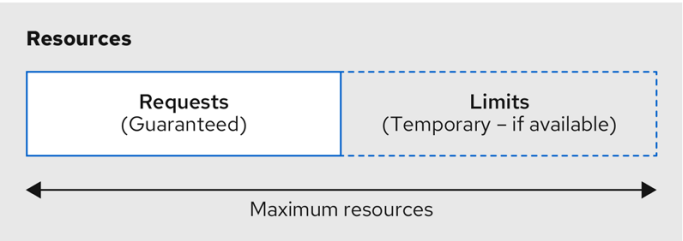
How you configure resources in a production environment depends on a number of factors. For example, applications are likely to be sharing resources in your OpenShift cluster.

For Kafka, the following aspects of a deployment can impact the resources you need:

- Throughput and size of messages
- The number of network threads handling messages
- The number of producers and consumers
- The number of topics and partitions

The values specified for resource requests are reserved and always available to the container. Resource limits specify the maximum resources that can be consumed by a given container. The amount between the request and limit is not reserved and might not be always available. A container can use the resources up to the limit only when they are available. Resource limits are temporary and can be reallocated.

Resource requests and limits



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If you set limits without requests or vice versa, OpenShift uses the same value for both. Setting equal requests and limits for resources guarantees quality of service, as OpenShift will not kill containers unless they exceed their limits.

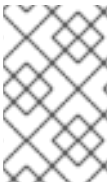
You can configure resource requests and limits for one or more supported resources.

Example resource configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    #...
    resources:
      requests:
        memory: 64Gi
        cpu: "8"
      limits:
        memory: 64Gi
        cpu: "12"
  entityOperator:
    #...
    topicOperator:
      #...
      resources:
        requests:
          memory: 512Mi
          cpu: "1"
        limits:
          memory: 512Mi
          cpu: "1"
```

Resource requests and limits for the Topic Operator and User Operator are set in the **Kafka** resource.

If the resource request is for more than the available free resources in the OpenShift cluster, the pod is not scheduled.



NOTE

AMQ Streams uses the OpenShift syntax for specifying **memory** and **cpu** resources. For more information about managing computing resources on OpenShift, see Managing Compute Resources for Containers.

Memory resources

When configuring memory resources, consider the total requirements of the components. Kafka runs inside a JVM and uses an operating system page cache to store message data before writing to disk. The memory request for Kafka should fit the JVM heap and page cache. You can configure the **jvmOptions** property to control the minimum and maximum heap size.

Other components don't rely on the page cache. You can configure memory resources without configuring the **jvmOptions** to control the heap size.

Memory requests and limits are specified in megabytes, gigabytes, mebibytes, and gibibytes. Use the following suffixes in the specification:

- **M** for megabytes
- **G** for gigabytes
- **Mi** for mebibytes

- **Gi** for gibibytes

Example resources using different memory units

```
# ...
resources:
  requests:
    memory: 512Mi
  limits:
    memory: 2Gi
# ...
```

For more details about memory specification and additional supported units, see Meaning of memory.

CPU resources

A CPU request should be enough to give a reliable performance at any time. CPU requests and limits are specified as *cores* or *millicpus/millicores*.
CPU cores are specified as integers (**5** CPU core) or decimals (**2.5** CPU core). 1000 *millicores* is the same as **1** CPU core.

Example CPU units

```
# ...
resources:
  requests:
    cpu: 500m
  limits:
    cpu: 2.5
# ...
```

The computing power of 1 CPU core may differ depending on the platform where OpenShift is deployed.

For more information on CPU specification, see Meaning of CPU.

6.1.6. image

Use the **image** property to configure the container image used by the component.

Overriding container images is recommended only in special situations where you need to use a different container registry or a customized image.

For example, if your network does not allow access to the container repository used by AMQ Streams, you can copy the AMQ Streams images or build them from the source. However, if the configured image is not compatible with AMQ Streams images, it might not work properly.

A copy of the container image might also be customized and used for debugging.

You can specify which container image to use for a component using the **image** property in the following resources:

- **Kafka.spec.kafka**

- **Kafka.spec.zookeeper**
- **Kafka.spec.entityOperator.topicOperator**
- **Kafka.spec.entityOperator.userOperator**
- **Kafka.spec.entityOperator.tlsSidecar**
- **KafkaConnect.spec**
- **KafkaMirrorMaker.spec**
- **KafkaMirrorMaker2.spec**
- **KafkaBridge.spec**

Configuring the image property for Kafka, Kafka Connect, and Kafka MirrorMaker

Kafka, Kafka Connect, and Kafka MirrorMaker support multiple versions of Kafka. Each component requires its own image. The default images for the different Kafka versions are configured in the following environment variables:

- **STRIMZI_KAFKA_IMAGES**
- **STRIMZI_KAFKA_CONNECT_IMAGES**
- **STRIMZI_KAFKA_MIRROR_MAKER_IMAGES**

These environment variables contain mappings between the Kafka versions and their corresponding images. The mappings are used together with the **image** and **version** properties:

- If neither **image** nor **version** are given in the custom resource then the **version** will default to the Cluster Operator's default Kafka version, and the image will be the one corresponding to this version in the environment variable.
- If **image** is given but **version** is not, then the given image is used and the **version** is assumed to be the Cluster Operator's default Kafka version.
- If **version** is given but **image** is not, then the image that corresponds to the given version in the environment variable is used.
- If both **version** and **image** are given, then the given image is used. The image is assumed to contain a Kafka image with the given version.

The **image** and **version** for the different components can be configured in the following properties:

- For Kafka in **spec.kafka.image** and **spec.kafka.version**.
- For Kafka Connect and Kafka MirrorMaker in **spec.image** and **spec.version**.

WARNING

It is recommended to provide only the **version** and leave the **image** property unspecified. This reduces the chance of making a mistake when configuring the custom resource. If you need to change the images used for different versions of Kafka, it is preferable to configure the Cluster Operator's environment variables.

Configuring the image property in other resources

For the **image** property in the other custom resources, the given value will be used during deployment. If the **image** property is missing, the **image** specified in the Cluster Operator configuration will be used. If the **image** name is not defined in the Cluster Operator configuration, then the default value will be used.

- For Topic Operator:
  1. Container image specified in the **STRIMZI_DEFAULT_TOPIC_OPERATOR_IMAGE** environment variable from the Cluster Operator configuration.
  2. **registry.redhat.io/amq-streams/strimzi-rhel8-operator:2.4.0** container image.
- For User Operator:
  1. Container image specified in the **STRIMZI_DEFAULT_USER_OPERATOR_IMAGE** environment variable from the Cluster Operator configuration.
  2. **registry.redhat.io/amq-streams/strimzi-rhel8-operator:2.4.0** container image.
- For Entity Operator TLS sidecar:
  1. Container image specified in the **STRIMZI_DEFAULT_TLS_SIDECAR_ENTITY_OPERATOR_IMAGE** environment variable from the Cluster Operator configuration.
  2. **registry.redhat.io/amq-streams/kafka-34-rhel8:2.4.0** container image.
- For Kafka Exporter:
  1. Container image specified in the **STRIMZI_DEFAULT_KAFKA_EXPORTER_IMAGE** environment variable from the Cluster Operator configuration.
  2. **registry.redhat.io/amq-streams/kafka-34-rhel8:2.4.0** container image.
- For Kafka Bridge:
  1. Container image specified in the **STRIMZI_DEFAULT_KAFKA_BRIDGE_IMAGE** environment variable from the Cluster Operator configuration.
  2. **registry.redhat.io/amq-streams/bridge-rhel8:2.4.0** container image.
- For Kafka broker initializer:
  1. Container image specified in the **STRIMZI_DEFAULT_KAFKA_INIT_IMAGE** environment variable from the Cluster Operator configuration.

2. **registry.redhat.io/amq-streams/strimzi-rhel8-operator:2.4.0** container image.

Example container image configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
    image: my-org/my-image:latest
    # ...
  zookeeper:
    # ...
```

6.1.7. livenessProbe and readinessProbe healthchecks

Use the **livenessProbe** and **readinessProbe** properties to configure healthcheck probes supported in AMQ Streams.

Healthchecks are periodical tests which verify the health of an application. When a Healthcheck probe fails, OpenShift assumes that the application is not healthy and attempts to fix it.

For more details about the probes, see Configure Liveness and Readiness Probes.

Both **livenessProbe** and **readinessProbe** support the following options:

- **initialDelaySeconds**
- **timeoutSeconds**
- **periodSeconds**
- **successThreshold**
- **failureThreshold**

Example of liveness and readiness probe configuration

```
# ...
readinessProbe:
  initialDelaySeconds: 15
  timeoutSeconds: 5
livenessProbe:
  initialDelaySeconds: 15
  timeoutSeconds: 5
# ...
```

For more information about the **livenessProbe** and **readinessProbe** options, see the Probe schema reference.

6.1.8. metricsConfig

Use the **metricsConfig** property to enable and configure Prometheus metrics.

The **metricsConfig** property contains a reference to a ConfigMap that has additional configurations for the Prometheus JMX Exporter. AMQ Streams supports Prometheus metrics using Prometheus JMX exporter to convert the JMX metrics supported by Apache Kafka and ZooKeeper to Prometheus metrics.

To enable Prometheus metrics export without further configuration, you can reference a ConfigMap containing an empty file under **metricsConfig.valueFrom.configMapKeyRef.key**. When referencing an empty file, all metrics are exposed as long as they have not been renamed.

Example ConfigMap with metrics configuration for Kafka

```
kind: ConfigMap
apiVersion: v1
metadata:
  name: my-configmap
data:
  my-key: |
    lowercaseOutputName: true
    rules:
    # Special cases and very specific rules
    - pattern: kafka.server<type=(.+), name=(.+), clientId=(.+), topic=(.+), partition=(.*)><>Value
      name: kafka_server_$1_$2
      type: GAUGE
      labels:
       clientId: "$3"
       topic: "$4"
       partition: "$5"
    # further configuration
```

Example metrics configuration for Kafka

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
    metricsConfig:
      type: jmxPrometheusExporter
      valueFrom:
        configMapKeyRef:
          name: my-config-map
          key: my-key
    # ...
  zookeeper:
    # ...
```

When metrics are enabled, they are exposed on port 9404.

When the **metricsConfig** (or deprecated **metrics**) property is not defined in the resource, the Prometheus metrics are disabled.

For more information about setting up and deploying Prometheus and Grafana, see Introducing Metrics to Kafka in the *Deploying and Upgrading AMQ Streams on OpenShift* guide.

6.1.9. jvmOptions

The following AMQ Streams components run inside a Java Virtual Machine (JVM):

- Apache Kafka
- Apache ZooKeeper
- Apache Kafka Connect
- Apache Kafka MirrorMaker
- AMQ Streams Kafka Bridge

To optimize their performance on different platforms and architectures, you configure the **jvmOptions** property in the following resources:

- **Kafka.spec.kafka**
- **Kafka.spec.zookeeper**
- **Kafka.spec.entityOperator.userOperator**
- **Kafka.spec.entityOperator.topicOperator**
- **Kafka.spec.cruiseControl**
- **KafkaConnect.spec**
- **KafkaMirrorMaker.spec**
- **KafkaMirrorMaker2.spec**
- **KafkaBridge.spec**

You can specify the following options in your configuration:

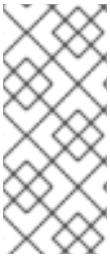
-Xms
: Minimum initial allocation heap size when the JVM starts

-Xmx
: Maximum heap size

-XX
: Advanced runtime options for the JVM

javaSystemProperties
: Additional system properties

gcLoggingEnabled
: Enables garbage collector logging



NOTE

The units accepted by JVM settings, such as **-Xmx** and **-Xms**, are the same units accepted by the JDK **java** binary in the corresponding image. Therefore, **1g** or **1G** means 1,073,741,824 bytes, and **Gi** is not a valid unit suffix. This is different from the units used for memory requests and limits, which follow the OpenShift convention where **1G** means 1,000,000,000 bytes, and **1Gi** means 1,073,741,824 bytes.

-Xms and -Xmx options

In addition to setting memory request and limit values for your containers, you can use the **-Xms** and **-Xmx** JVM options to set specific heap sizes for your JVM. Use the **-Xms** option to set an initial heap size and the **-Xmx** option to set a maximum heap size.

Specify heap size to have more control over the memory allocated to your JVM. Heap sizes should make the best use of a container's memory limit (and request) without exceeding it. Heap size and any other memory requirements need to fit within a specified memory limit. If you don't specify heap size in your configuration, but you configure a memory resource limit (and request), the Cluster Operator imposes default heap sizes automatically. The Cluster Operator sets default maximum and minimum heap values based on a percentage of the memory resource configuration.

The following table shows the default heap values.

Table 6.1. Default heap settings for components

Component	Percent of available memory allocated to the heap	Maximum limit
Kafka	50%	5 GB
ZooKeeper	75%	2 GB
Kafka Connect	75%	None
MirrorMaker 2	75%	None
MirrorMaker	75%	None
Cruise Control	75%	None
Kafka Bridge	50%	31 Gi

If a memory limit (and request) is not specified, a JVM's minimum heap size is set to **128M**. The JVM's maximum heap size is not defined to allow the memory to increase as needed. This is ideal for single node environments in test and development.

Setting an appropriate memory request can prevent the following:

- OpenShift killing a container if there is pressure on memory from other pods running on the node.

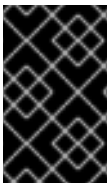
- OpenShift scheduling a container to a node with insufficient memory. If **-Xms** is set to **-Xmx**, the container will crash immediately; if not, the container will crash at a later time.

In this example, the JVM uses 2 GiB (=2,147,483,648 bytes) for its heap. Total JVM memory usage can be a lot more than the maximum heap size.

Example -Xmx and -Xms configuration

```
# ...
jvmOptions:
  "-Xmx": "2g"
  "-Xms": "2g"
# ...
```

Setting the same value for initial (**-Xms**) and maximum (**-Xmx**) heap sizes avoids the JVM having to allocate memory after startup, at the cost of possibly allocating more heap than is really needed.



IMPORTANT

Containers performing lots of disk I/O, such as Kafka broker containers, require available memory for use as an operating system page cache. For such containers, the requested memory should be significantly higher than the memory used by the JVM.

-XX option

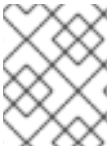
-XX options are used to configure the **KAFKA_JVM_PERFORMANCE_OPTS** option of Apache Kafka.

Example -XX configuration

```
jvmOptions:
  "-XX":
    "UseG1GC": true
    "MaxGCPauseMillis": 20
    "InitiatingHeapOccupancyPercent": 35
    "ExplicitGCInvokesConcurrent": true
```

JVM options resulting from the -XX configuration

```
-XX:+UseG1GC -XX:MaxGCPauseMillis=20 -XX:InitiatingHeapOccupancyPercent=35 -
XX:+ExplicitGCInvokesConcurrent -XX:-UseParNewGC
```



NOTE

When no **-XX** options are specified, the default Apache Kafka configuration of **KAFKA_JVM_PERFORMANCE_OPTS** is used.

javaSystemProperties

javaSystemProperties are used to configure additional Java system properties, such as debugging utilities.

Example javaSystemProperties configuration

```
jvmOptions:
  javaSystemProperties:
    - name: javax.net.debug
      value: ssl
```

For more information about the **jvmOptions**, see the **JvmOptions** schema reference.

6.1.10. Garbage collector logging

The **jvmOptions** property also allows you to enable and disable garbage collector (GC) logging. GC logging is disabled by default. To enable it, set the **gcLoggingEnabled** property as follows:

Example GC logging configuration

```
# ...
jvmOptions:
  gcLoggingEnabled: true
# ...
```

6.2. SCHEMA PROPERTIES

6.2.1. Kafka schema reference

Property	Description
spec	The specification of the Kafka and ZooKeeper clusters, and Topic Operator.
KafkaSpec	
status	The status of the Kafka and ZooKeeper clusters, and Topic Operator.
KafkaStatus	

6.2.2. KafkaSpec schema reference

Used in: **Kafka**

Property	Description
kafka	Configuration of the Kafka cluster.
KafkaClusterSpec	
zookeeper	Configuration of the ZooKeeper cluster.
ZookeeperClusterSpec	

Property	Description
entityOperator	Configuration of the Entity Operator.
EntityOperatorSpec	
clusterCa	Configuration of the cluster certificate authority.
CertificateAuthority	
clientsCa	Configuration of the clients certificate authority.
CertificateAuthority	
cruiseControl	Configuration for Cruise Control deployment. Deploys a Cruise Control instance when specified.
CruiseControlSpec	
kafkaExporter	Configuration of the Kafka Exporter. Kafka Exporter can provide additional metrics, for example lag of consumer group at topic/partition.
KafkaExporterSpec	
maintenanceTimeWindows	A list of time windows for maintenance tasks (that is, certificates renewal). Each time window is defined by a cron expression.
string array	

6.2.3. KafkaClusterSpec schema reference

Used in: **KafkaSpec**

Full list of **KafkaClusterSpec** schema properties

Configures a Kafka cluster.

6.2.3.1. listeners

Use the **listeners** property to configure listeners to provide access to Kafka brokers.

Example configuration of a plain (unencrypted) listener without authentication

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
spec:
  kafka:
    # ...
    listeners:
      - name: plain
        port: 9092
        type: internal
```

```
      tls: false
  # ...
zookeeper:
  # ...
```

6.2.3.2. config

Use the **config** properties to configure Kafka broker options as keys.

Standard Apache Kafka configuration may be provided, restricted to those properties not managed directly by AMQ Streams.

Configuration options that cannot be configured relate to:

- Security (Encryption, Authentication, and Authorization)
- Listener configuration
- Broker ID configuration
- Configuration of log data directories
- Inter-broker communication
- ZooKeeper connectivity

The values can be one of the following JSON types:

- String
- Number
- Boolean

You can specify and configure the options listed in the Apache Kafka documentation with the exception of those options that are managed directly by AMQ Streams. Specifically, all configuration options with keys equal to or starting with one of the following strings are forbidden:

- **listeners**
- **advertised.**
- **broker.**
- **listener.**
- **host.name**
- **port**
- **inter.broker.listener.name**
- **sasl.**
- **ssl.**
- **security.**

- **password.**
- **principal.builder.class**
- **log.dir**
- **zookeeper.connect**
- **zookeeper.set.acl**
- **authorizer.**
- **super.user**

When a forbidden option is present in the **config** property, it is ignored and a warning message is printed to the Cluster Operator log file. All other supported options are passed to Kafka.

There are exceptions to the forbidden options. For client connection using a specific *cipher suite* for a TLS version, you can configure allowed **ssl** properties. You can also configure the **zookeeper.connection.timeout.ms** property to set the maximum time allowed for establishing a ZooKeeper connection.

Example Kafka broker configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
    config:
      num.partitions: 1
      num.recovery.threads.per.data.dir: 1
      default.replication.factor: 3
      offsets.topic.replication.factor: 3
      transaction.state.log.replication.factor: 3
      transaction.state.log.min.isr: 1
      log.retention.hours: 168
      log.segment.bytes: 1073741824
      log.retention.check.interval.ms: 300000
      num.network.threads: 3
      num.io.threads: 8
      socket.send.buffer.bytes: 102400
      socket.receive.buffer.bytes: 102400
      socket.request.max.bytes: 104857600
      group.initial.rebalance.delay.ms: 0
      ssl.cipher.suites: TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
      ssl.enabled.protocols: TLSv1.2
      ssl.protocol: TLSv1.2
      zookeeper.connection.timeout.ms: 6000
    # ...
```

6.2.3.3. brokerRackInitImage

When rack awareness is enabled, Kafka broker pods use init container to collect the labels from the

OpenShift cluster nodes. The container image used for this container can be configured using the **brokerRackInitImage** property. When the **brokerRackInitImage** field is missing, the following images are used in order of priority:

1. Container image specified in **STRIMZI_DEFAULT_KAFKA_INIT_IMAGE** environment variable in the Cluster Operator configuration.
2. **registry.redhat.io/amq-streams/strimzi-rhel8-operator:2.4.0** container image.

Example brokerRackInitImage configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
    rack:
      topologyKey: topology.kubernetes.io/zone
    brokerRackInitImage: my-org/my-image:latest
    # ...
```

NOTE

Overriding container images is recommended only in special situations, where you need to use a different container registry. For example, because your network does not allow access to the container registry used by AMQ Streams. In this case, you should either copy the AMQ Streams images or build them from the source. If the configured image is not compatible with AMQ Streams images, it might not work properly.

6.2.3.4. logging

Kafka has its own configurable loggers:

- **log4j.logger.org.I0Itec.zkclient.ZkClient**
- **log4j.logger.org.apache.zookeeper**
- **log4j.logger.kafka**
- **log4j.logger.org.apache.kafka**
- **log4j.logger.kafka.request.logger**
- **log4j.logger.kafka.network.Processor**
- **log4j.logger.kafka.server.KafkaApis**
- **log4j.logger.kafka.network.RequestChannel$**
- **log4j.logger.kafka.controller**
- **log4j.logger.kafka.log.LogCleaner**
- **log4j.logger.state.change.logger**

- **log4j.logger.kafka.authorizer.logger**

Kafka uses the Apache **log4j** logger implementation.

Use the **logging** property to configure loggers and logger levels.

You can set the log levels by specifying the logger and level directly (inline) or use a custom (external) ConfigMap. If a ConfigMap is used, you set **logging.valueFrom.configMapKeyRef.name** property to the name of the ConfigMap containing the external logging configuration. Inside the ConfigMap, the logging configuration is described using **log4j.properties**. Both **logging.valueFrom.configMapKeyRef.name** and **logging.valueFrom.configMapKeyRef.key** properties are mandatory. A ConfigMap using the exact logging configuration specified is created with the custom resource when the Cluster Operator is running, then recreated after each reconciliation. If you do not specify a custom ConfigMap, default logging settings are used. If a specific logger value is not set, upper-level logger settings are inherited for that logger. For more information about log levels, see Apache logging services.

Here we see examples of **inline** and **external** logging.

Inline logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
spec:
  # ...
  kafka:
    # ...
    logging:
      type: inline
      loggers:
        kafka.root.logger.level: "INFO"
  # ...
```

External logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
spec:
  # ...
  logging:
    type: external
    valueFrom:
      configMapKeyRef:
        name: customConfigMap
        key: kafka-log4j.properties
  # ...
```

Any available loggers that are not configured have their level set to **OFF**.

If Kafka was deployed using the Cluster Operator, changes to Kafka logging levels are applied dynamically.

If you use external logging, a rolling update is triggered when logging appenders are changed.

Garbage collector (GC)

Garbage collector logging can also be enabled (or disabled) using the **jvmOptions** property.

6.2.3.5. KafkaClusterSpec schema properties

Property	Description
version string	The kafka broker version. Defaults to 3.4.0. Consult the user documentation to understand the process required to upgrade or downgrade the version.
replicas integer	The number of pods in the cluster.
image string	The docker image for the pods. The default value depends on the configured **Kafka.spec.kafka.version**.
listeners **GenericKafkaListener** array	Configures listeners of Kafka brokers.
config map	Kafka broker config properties with the following prefixes cannot be set: listeners, advertised., broker., listener., host.name, port, inter.broker.listener.name, sasl., ssl., security., password., log.dir, zookeeper.connect, zookeeper.set.acl, zookeeper.ssl, zookeeper.clientCnxnSocket, authorizer., super.user, cruise.control.metrics.topic, cruise.control.metrics.reporter.bootstrap.servers,node.id, process.roles, controller. (with the exception of: zookeeper.connection.timeout.ms, sasl.server.max.receive.size,ssl.cipher.suites, ssl.protocol, ssl.enabled.protocols, ssl.secure.random.implementation,cruise.control.metrics.topic.num.partitions, cruise.control.metrics.topic.replication.factor, cruise.control.metrics.topic.retention.ms,cruise.control.metrics.topic.auto.create.retries, cruise.control.metrics.topic.auto.create.timeout.ms,cruise.control.metrics.topic.min.insync.replicas,controller.quorum.election.backoff.max.ms, controller.quorum.election.timeout.ms, controller.quorum.fetch.timeout.ms).
storage **EphemeralStorage**, **PersistentClaimStorage**, **JbodStorage**	Storage configuration (disk). Cannot be updated. The type depends on the value of the **storage.type** property within the given object, which must be one of [ephemeral, persistent-claim, jbod].

Property	Description
authorization **KafkaAuthorizationSimple**, **KafkaAuthorizationOpa**, **KafkaAuthorizationKeycloak**, **KafkaAuthorizationCustom**	Authorization configuration for Kafka brokers. The type depends on the value of the **authorization.type** property within the given object, which must be one of [simple, opa, keycloak, custom].
rack **Rack**	Configuration of the **broker.rack** broker config.
brokerRackInitImage string	The image of the init container used for initializing the **broker.rack**.
livenessProbe **Probe**	Pod liveness checking.
readinessProbe **Probe**	Pod readiness checking.
jvmOptions **JvmOptions**	JVM Options for pods.
jmxOptions **KafkaJmxOptions**	JMX Options for Kafka brokers.
resources ResourceRequirements	CPU and memory resources to reserve. For more information, see the external documentation for core/v1 resourcerequirements.
metricsConfig **JmxPrometheusExporterMetrics**	Metrics configuration. The type depends on the value of the **metricsConfig.type** property within the given object, which must be one of [jmxPrometheusExporter].
logging **InlineLogging**, **ExternalLogging**	Logging configuration for Kafka. The type depends on the value of the **logging.type** property within the given object, which must be one of [inline, external].

Property	Description
template	Template for Kafka cluster resources. The template allows users to specify how the **StatefulSet**, **Pods**, and **Services** are generated.
KafkaClusterTemplate	

6.2.4. GenericKafkaListener schema reference

Used in: **KafkaClusterSpec**

Full list of **GenericKafkaListener** schema properties

Configures listeners to connect to Kafka brokers within and outside OpenShift.

You configure the listeners in the **Kafka** resource.

Example Kafka resource showing listener configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    #...
    listeners:
      - name: plain
        port: 9092
        type: internal
        tls: false
      - name: tls
        port: 9093
        type: internal
        tls: true
        authentication:
          type: tls
      - name: external1
        port: 9094
        type: route
        tls: true
      - name: external2
        port: 9095
        type: ingress
        tls: true
        authentication:
          type: tls
        configuration:
          bootstrap:
            host: bootstrap.myingress.com
          brokers:
          - broker: 0
            host: broker-0.myingress.com
          - broker: 1
```

```
      host: broker-1.myingress.com
    - broker: 2
      host: broker-2.myingress.com
#...
```

6.2.4.1. listeners

You configure Kafka broker listeners using the **listeners** property in the **Kafka** resource. Listeners are defined as an array.

Example listener configuration

```
listeners:
  - name: plain
    port: 9092
    type: internal
    tls: false
```

The name and port must be unique within the Kafka cluster. The name can be up to 25 characters long, comprising lower-case letters and numbers. Allowed port numbers are 9092 and higher with the exception of ports 9404 and 9999, which are already used for Prometheus and JMX.

By specifying a unique name and port for each listener, you can configure multiple listeners.

6.2.4.2. type

The type is set as **internal**, or for external listeners, as **route**, **loadbalancer**, **nodeport**, **ingress** or **cluster-ip**. You can also configure a **cluster-ip** listener, a type of internal listener you can use to build custom access mechanisms.

internal

You can configure internal listeners with or without encryption using the **tls** property.

Example internal listener configuration

```
#...
spec:
  kafka:
    #...
    listeners:
      #...
      - name: plain
        port: 9092
        type: internal
        tls: false
      - name: tls
        port: 9093
        type: internal
        tls: true
        authentication:
          type: tls
    #...
```

route

Configures an external listener to expose Kafka using OpenShift **Routes** and the HAProxy router.
A dedicated **Route** is created for every Kafka broker pod. An additional **Route** is created to serve as a Kafka bootstrap address. Kafka clients can use these **Routes** to connect to Kafka on port 443. The client connects on port 443, the default router port, but traffic is then routed to the port you configure, which is **9094** in this example.

Example route listener configuration

```
#...
spec:
  kafka:
    #...
    listeners:
      #...
      - name: external1
        port: 9094
        type: route
        tls: true
    #...
```

ingress

Configures an external listener to expose Kafka using Kubernetes **Ingress** and the Ingress NGINX Controller for Kubernetes.
A dedicated **Ingress** resource is created for every Kafka broker pod. An additional **Ingress** resource is created to serve as a Kafka bootstrap address. Kafka clients can use these **Ingress** resources to connect to Kafka on port 443. The client connects on port 443, the default controller port, but traffic is then routed to the port you configure, which is **9095** in the following example.

You must specify the hostnames used by the bootstrap and per-broker services using **GenericKafkaListenerConfigurationBootstrap** and **GenericKafkaListenerConfigurationBroker** properties.

Example ingress listener configuration

```
#...
spec:
  kafka:
    #...
    listeners:
      #...
      - name: external2
        port: 9095
        type: ingress
        tls: true
        authentication:
          type: tls
        configuration:
          bootstrap:
            host: bootstrap.myingress.com
          brokers:
          - broker: 0
            host: broker-0.myingress.com
          - broker: 1
```

```
        host: broker-1.myingress.com
      - broker: 2
        host: broker-2.myingress.com
  #...
```

NOTE

External listeners using **Ingress** are currently only tested with the Ingress NGINX Controller for Kubernetes.

loadbalancer

Configures an external listener to expose Kafka using a **Loadbalancer** type **Service**.
A new loadbalancer service is created for every Kafka broker pod. An additional loadbalancer is created to serve as a Kafka *bootstrap* address. Loadbalancers listen to the specified port number, which is port **9094** in the following example.

You can use the **loadBalancerSourceRanges** property to configure source ranges to restrict access to the specified IP addresses.

Example loadbalancer listener configuration

```
#...
spec:
  kafka:
    #...
    listeners:
      - name: external3
        port: 9094
        type: loadbalancer
        tls: true
        configuration:
          loadBalancerSourceRanges:
            - 10.0.0.0/8
            - 88.208.76.87/32
    #...
```

nodeport

Configures an external listener to expose Kafka using a **NodePort** type **Service**.
Kafka clients connect directly to the nodes of OpenShift. An additional **NodePort** type of service is created to serve as a Kafka bootstrap address.

When configuring the advertised addresses for the Kafka broker pods, AMQ Streams uses the address of the node on which the given pod is running. You can use **preferredNodePortAddressType** property to configure the first address type checked as the node address.

Example nodeport listener configuration

```
#...
spec:
  kafka:
    #...
    listeners:
```

```
    #...
    - name: external4
      port: 9095
      type: nodeport
      tls: false
      configuration:
        preferredNodePortAddressType: InternalDNS
  #...
```

NOTE

TLS hostname verification is not currently supported when exposing Kafka clusters using node ports.

cluster-ip

Configures an internal listener to expose Kafka using a per-broker **ClusterIP** type **Service**.
The listener does not use a headless service and its DNS names to route traffic to Kafka brokers. You can use this type of listener to expose a Kafka cluster when using the headless service is unsuitable. You might use it with a custom access mechanism, such as one that uses a specific Ingress controller or the OpenShift Gateway API.

A new **ClusterIP** service is created for each Kafka broker pod. The service is assigned a **ClusterIP** address to serve as a Kafka *bootstrap* address with a per-broker port number. For example, you can configure the listener to expose a Kafka cluster over an Nginx Ingress Controller with TCP port configuration.

Example cluster-ip listener configuration

```
#...
spec:
  kafka:
    #...
    listeners:
      - name: external-cluster-ip
        type: cluster-ip
        tls: false
        port: 9096
    #...
```

6.2.4.3. port

The port number is the port used in the Kafka cluster, which might not be the same port used for access by a client.

- **loadbalancer** listeners use the specified port number, as do **internal** and **cluster-ip** listeners
- **ingress** and **route** listeners use port 443 for access
- **nodeport** listeners use the port number assigned by OpenShift

For client connection, use the address and port for the bootstrap service of the listener. You can retrieve this from the status of the **Kafka** resource.

Example command to retrieve the address and port for client connection

```
oc get kafka <kafka_cluster_name> -o=jsonpath='{.status.listeners[?
(@.name=="<listener_name>")].bootstrapServers}{"\n"}'
```

NOTE

Listeners cannot be configured to use the ports set aside for interbroker communication (9090 and 9091) and metrics (9404).

6.2.4.4. tls

The TLS property is required.

By default, TLS encryption is not enabled. To enable it, set the **tls** property to **true**.

For **route** and **ingress** type listeners, TLS encryption must be enabled.

6.2.4.5. authentication

Authentication for the listener can be specified as:

- mTLS (**tls**)
- SCRAM-SHA-512 (**scram-sha-512**)
- Token-based OAuth 2.0 (**oauth**)
- Custom (**custom**)

6.2.4.6. networkPolicyPeers

Use **networkPolicyPeers** to configure network policies that restrict access to a listener at the network level. The following example shows a **networkPolicyPeers** configuration for a **plain** and a **tls** listener.

In the following example:

- Only application pods matching the labels **app: kafka-sasl-consumer** and **app: kafka-sasl-producer** can connect to the **plain** listener. The application pods must be running in the same namespace as the Kafka broker.
- Only application pods running in namespaces matching the labels **project: myproject** and **project: myproject2** can connect to the **tls** listener.

The syntax of the **networkPolicyPeers** property is the same as the **from** property in **NetworkPolicy** resources.

Exanmple network policy configuration

```
listeners:
  #...
  - name: plain
    port: 9092
    type: internal
```

```
    tls: true
    authentication:
      type: scram-sha-512
    networkPolicyPeers:
      - podSelector:
          matchLabels:
            app: kafka-sasl-consumer
      - podSelector:
          matchLabels:
            app: kafka-sasl-producer
  - name: tls
    port: 9093
    type: internal
    tls: true
    authentication:
      type: tls
    networkPolicyPeers:
      - namespaceSelector:
          matchLabels:
            project: myproject
      - namespaceSelector:
          matchLabels:
            project: myproject2
# ...
```

6.2.4.7. **GenericKafkaListener** schema properties

Property	Description
name string	Name of the listener. The name will be used to identify the listener and the related OpenShift objects. The name has to be unique within given a Kafka cluster. The name can consist of lowercase characters and numbers and be up to 11 characters long.
port integer	Port number used by the listener inside Kafka. The port number has to be unique within a given Kafka cluster. Allowed port numbers are 9092 and higher with the exception of ports 9404 and 9999, which are already used for Prometheus and JMX. Depending on the listener type, the port number might not be the same as the port number that connects Kafka clients.

Property	Description
type string (one of [ingress, internal, route, loadbalancer, cluster-ip, nodeport])	Type of the listener. Currently the supported types are **internal**, **route**, **loadbalancer**, **nodeport** and **ingress**. • **internal** type exposes Kafka internally only within the OpenShift cluster. • **route** type uses OpenShift Routes to expose Kafka. • **loadbalancer** type uses LoadBalancer type services to expose Kafka. • **nodeport** type uses NodePort type services to expose Kafka. • **ingress** type uses OpenShift Nginx Ingress to expose Kafka with TLS passthrough. • **cluster-ip** type uses a per-broker **ClusterIP** service.
tls boolean	Enables TLS encryption on the listener. This is a required property.
authentication **KafkaListenerAuthenticationTls**, **KafkaListenerAuthenticationScramSha512**, **KafkaListenerAuthenticationOAuth**, **KafkaListenerAuthenticationCustom**	Authentication configuration for this listener. The type depends on the value of the **authentication.type** property within the given object, which must be one of [tls, scram-sha-512, oauth, custom].
configuration **GenericKafkaListenerConfiguration**	Additional listener configuration.
networkPolicyPeers NetworkPolicyPeer array	List of peers which should be able to connect to this listener. Peers in this list are combined using a logical OR operation. If this field is empty or missing, all connections will be allowed for this listener. If this field is present and contains at least one item, the listener only allows the traffic which matches at least one item in this list. For more information, see the external documentation for networking.k8s.io/v1 networkpolicypeer.

6.2.5. KafkaListenerAuthenticationTls schema reference

Used in: **GenericKafkaListener**

The **type** property is a discriminator that distinguishes use of the **KafkaListenerAuthenticationTls** type from KafkaListenerAuthenticationScramSha512, KafkaListenerAuthenticationOAuth, KafkaListenerAuthenticationCustom. It must have the value **tls** for the type **KafkaListenerAuthenticationTls**.

Property	Description
type string	Must be **tls**.

6.2.6. KafkaListenerAuthenticationScramSha512 schema reference

Used in: GenericKafkaListener

The **type** property is a discriminator that distinguishes use of the **KafkaListenerAuthenticationScramSha512** type from KafkaListenerAuthenticationTls, KafkaListenerAuthenticationOAuth, KafkaListenerAuthenticationCustom. It must have the value **scram-sha-512** for the type **KafkaListenerAuthenticationScramSha512**.

Property	Description
type string	Must be **scram-sha-512**.

6.2.7. KafkaListenerAuthenticationOAuth schema reference

Used in: GenericKafkaListener

The **type** property is a discriminator that distinguishes use of the **KafkaListenerAuthenticationOAuth** type from KafkaListenerAuthenticationTls, KafkaListenerAuthenticationScramSha512, KafkaListenerAuthenticationCustom. It must have the value **oauth** for the type **KafkaListenerAuthenticationOAuth**.

Property	Description
accessTokenIsJwt boolean	Configure whether the access token is treated as JWT. This must be set to **false** if the authorization server returns opaque tokens. Defaults to **true**.
checkAccessTokenType boolean	Configure whether the access token type check is performed or not. This should be set to **false** if the authorization server does not include 'typ' claim in JWT token. Defaults to **true**.

Property	Description
checkAudience boolean	Enable or disable audience checking. Audience checks identify the recipients of tokens. If audience checking is enabled, the OAuth Client ID also has to be configured using the **clientId** property. The Kafka broker will reject tokens that do not have its **clientId** in their **aud** (audience) claim.Default value is **false**.
checkIssuer boolean	Enable or disable issuer checking. By default issuer is checked using the value configured by **validIssuerUri**. Default value is **true**.
clientAudience string	The audience to use when making requests to the authorization server's token endpoint. Used for inter-broker authentication and for configuring OAuth 2.0 over PLAIN using the **clientId** and **secret** method.
clientId string	OAuth Client ID which the Kafka broker can use to authenticate against the authorization server and use the introspect endpoint URI.
clientScope string	The scope to use when making requests to the authorization server's token endpoint. Used for inter-broker authentication and for configuring OAuth 2.0 over PLAIN using the **clientId** and **secret** method.
clientSecret **GenericSecretSource**	Link to OpenShift Secret containing the OAuth client secret which the Kafka broker can use to authenticate against the authorization server and use the introspect endpoint URI.
connectTimeoutSeconds integer	The connect timeout in seconds when connecting to authorization server. If not set, the effective connect timeout is 60 seconds.
customClaimCheck string	JsonPath filter query to be applied to the JWT token or to the response of the introspection endpoint for additional token validation. Not set by default.
disableTlsHostnameVerification boolean	Enable or disable TLS hostname verification. Default value is **false**.

Property	Description
enableECDSA boolean	**The enableECDSA property has been deprecated.** Enable or disable ECDSA support by installing BouncyCastle crypto provider. ECDSA support is always enabled. The BouncyCastle libraries are no longer packaged with AMQ Streams. Value is ignored.
enableMetrics boolean	Enable or disable OAuth metrics. Default value is **false**.
enableOauthBearer boolean	Enable or disable OAuth authentication over SASL_OAUTHBEARER. Default value is **true**.
enablePlain boolean	Enable or disable OAuth authentication over SASL_PLAIN. There is no re-authentication support when this mechanism is used. Default value is **false**.
failFast boolean	Enable or disable termination of Kafka broker processes due to potentially recoverable runtime errors during startup. Default value is **true**.
fallbackUserNameClaim string	The fallback username claim to be used for the user id if the claim specified by **userNameClaim** is not present. This is useful when **client_credentials** authentication only results in the client id being provided in another claim. It only takes effect if **userNameClaim** is set.
fallbackUserNamePrefix string	The prefix to use with the value of **fallbackUserNameClaim** to construct the user id. This only takes effect if **fallbackUserNameClaim** is true, and the value is present for the claim. Mapping usernames and client ids into the same user id space is useful in preventing name collisions.
groupsClaim string	JsonPath query used to extract groups for the user during authentication. Extracted groups can be used by a custom authorizer. By default no groups are extracted.
groupsClaimDelimiter string	A delimiter used to parse groups when they are extracted as a single String value rather than a JSON array. Default value is ',' (comma).

Property	Description
httpRetries integer	The maximum number of retries to attempt if an initial HTTP request fails. If not set, the default is to not attempt any retries.
httpRetryPauseMs integer	The pause to take before retrying a failed HTTP request. If not set, the default is to not pause at all but to immediately repeat a request.
introspectionEndpointUri string	URI of the token introspection endpoint which can be used to validate opaque non-JWT tokens.
jwksEndpointUri string	URI of the JWKS certificate endpoint, which can be used for local JWT validation.
jwksExpirySeconds integer	Configures how often are the JWKS certificates considered valid. The expiry interval has to be at least 60 seconds longer then the refresh interval specified in **jwksRefreshSeconds**. Defaults to 360 seconds.
jwksIgnoreKeyUse boolean	Flag to ignore the 'use' attribute of **key** declarations in a JWKS endpoint response. Default value is **false**.
jwksMinRefreshPauseSeconds integer	The minimum pause between two consecutive refreshes. When an unknown signing key is encountered the refresh is scheduled immediately, but will always wait for this minimum pause. Defaults to 1 second.
jwksRefreshSeconds integer	Configures how often are the JWKS certificates refreshed. The refresh interval has to be at least 60 seconds shorter then the expiry interval specified in **jwksExpirySeconds**. Defaults to 300 seconds.
maxSecondsWithoutReauthentication integer	Maximum number of seconds the authenticated session remains valid without re-authentication. This enables Apache Kafka re-authentication feature, and causes sessions to expire when the access token expires. If the access token expires before max time or if max time is reached, the client has to re-authenticate, otherwise the server will drop the connection. Not set by default - the authenticated session does not expire when the access token expires. This option only applies to SASL_OAUTHBEARER authentication mechanism (when **enableOauthBearer** is **true**).

Property	Description
readTimeoutSeconds integer	The read timeout in seconds when connecting to authorization server. If not set, the effective read timeout is 60 seconds.
tlsTrustedCertificates **CertSecretSource** array	Trusted certificates for TLS connection to the OAuth server.
tokenEndpointUri string	URI of the Token Endpoint to use with SASL_PLAIN mechanism when the client authenticates with **clientId** and a **secret**. If set, the client can authenticate over SASL_PLAIN by either setting **username** to **clientId**, and setting **password** to client **secret**, or by setting **username** to account username, and **password** to access token prefixed with **$accessToken:**. If this option is not set, the **password** is always interpreted as an access token (without a prefix), and **username** as the account username (a so called 'no-client-credentials' mode).
type string	Must be **oauth**.
userInfoEndpointUri string	URI of the User Info Endpoint to use as a fallback to obtaining the user id when the Introspection Endpoint does not return information that can be used for the user id.
userNameClaim string	Name of the claim from the JWT authentication token, Introspection Endpoint response or User Info Endpoint response which will be used to extract the user id. Defaults to **sub**.
validIssuerUri string	URI of the token issuer used for authentication.

Property	Description
validTokenType	Valid value for the **token_type** attribute returned by the Introspection Endpoint. No default value, and not checked by default.
string	

6.2.8. GenericSecretSource schema reference

Used in: **KafkaClientAuthenticationOAuth**, **KafkaListenerAuthenticationCustom**, **KafkaListenerAuthenticationOAuth**

Property	Description
key	The key under which the secret value is stored in the OpenShift Secret.
string	
secretName	The name of the OpenShift Secret containing the secret value.
string	

6.2.9. CertSecretSource schema reference

Used in: **ClientTls**, **KafkaAuthorizationKeycloak**, **KafkaAuthorizationOpa**, **KafkaClientAuthenticationOAuth**, **KafkaListenerAuthenticationOAuth**

Property	Description
certificate	The name of the file certificate in the Secret.
string	
secretName	The name of the Secret containing the certificate.
string	

6.2.10. KafkaListenerAuthenticationCustom schema reference

Used in: **GenericKafkaListener**

Full list of **KafkaListenerAuthenticationCustom** schema properties

To configure custom authentication, set the **type** property to **custom**.

Custom authentication allows for any type of kafka-supported authentication to be used.

Example custom OAuth authentication configuration

```
spec:
  kafka:
    config:
      principal.builder.class: SimplePrincipal.class
    listeners:
      - name: oauth-bespoke
        port: 9093
        type: internal
        tls: true
        authentication:
          type: custom
          sasl: true
          listenerConfig:
            oauthbearer.sasl.client.callback.handler.class: client.class
            oauthbearer.sasl.server.callback.handler.class: server.class
            oauthbearer.sasl.login.callback.handler.class: login.class
            oauthbearer.connections.max.reauth.ms: 999999999
            sasl.enabled.mechanisms: oauthbearer
            oauthbearer.sasl.jaas.config: |
              org.apache.kafka.common.security.oauthbearer.OAuthBearerLoginModule required ;
          secrets:
            - name: example
```

A protocol map is generated that uses the **sasl** and **tls** values to determine which protocol to map to the listener.

- SASL = True, TLS = True → SASL_SSL
- SASL = False, TLS = True → SSL
- SASL = True, TLS = False → SASL_PLAINTEXT
- SASL = False, TLS = False → PLAINTEXT

6.2.10.1. listenerConfig

Listener configuration specified using **listenerConfig** is prefixed with **listener.name.*<listener_name>-<port>***. For example, **sasl.enabled.mechanisms** becomes **listener.name.*<listener_name>-<port>*.sasl.enabled.mechanisms**.

6.2.10.2. secrets

Secrets are mounted to **/opt/kafka/custom-authn-secrets/custom-listener-*<listener_name>-<port>*/*<secret_name>*** in the Kafka broker nodes' containers.

For example, the mounted secret (**example**) in the example configuration would be located at **/opt/kafka/custom-authn-secrets/custom-listener-oauth-bespoke-9093/example**.

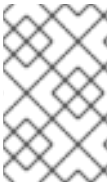
6.2.10.3. Principal builder

You can set a custom principal builder in the Kafka cluster configuration. However, the principal builder is subject to the following requirements:

- The specified principal builder class must exist on the image. *Before* building your own, check if one already exists. You'll need to rebuild the AMQ Streams images with the required classes.

- No other listener is using **oauth** type authentication. This is because an OAuth listener appends its own principle builder to the Kafka configuration.
- The specified principal builder is compatible with AMQ Streams.

Custom principal builders must support peer certificates for authentication, as AMQ Streams uses these to manage the Kafka cluster.



NOTE

Kafka's default principal builder class supports the building of principals based on the names of peer certificates. The custom principal builder should provide a principal of type **user** using the name of the SSL peer certificate.

The following example shows a custom principal builder that satisfies the OAuth requirements of AMQ Streams.

Example principal builder for custom OAuth configuration

```
public final class CustomKafkaPrincipalBuilder implements KafkaPrincipalBuilder {

    public KafkaPrincipalBuilder() {}

    @Override
    public KafkaPrincipal build(AuthenticationContext context) {
        if (context instanceof SslAuthenticationContext) {
            SSLSession sslSession = ((SslAuthenticationContext) context).session();
            try {
                return new KafkaPrincipal(
                    KafkaPrincipal.USER_TYPE, sslSession.getPeerPrincipal().getName());
            } catch (SSLPeerUnverifiedException e) {
                throw new IllegalArgumentException("Cannot use an unverified peer for authentication", e);
            }
        }

        // Create your own KafkaPrincipal here
        ...
    }
}
```

6.2.10.4. KafkaListenerAuthenticationCustom schema properties

The **type** property is a discriminator that distinguishes use of the **KafkaListenerAuthenticationCustom** type from **KafkaListenerAuthenticationTls**, **KafkaListenerAuthenticationScramSha512**, **KafkaListenerAuthenticationOAuth**. It must have the value **custom** for the type **KafkaListenerAuthenticationCustom**.

Property	Description
listenerConfig	Configuration to be used for a specific listener. All values are prefixed with listener.name.*<listener_name>*.
map	

Property	Description
sasl	Enable or disable SASL on this listener.
boolean	
secrets	Secrets to be mounted to /opt/kafka/custom-authn-secrets/custom-listener-*<listener_name>-<port>/<secret_name>*.
GenericSecretSource array	
type	Must be **custom**.
string	

6.2.11. GenericKafkaListenerConfiguration schema reference

Used in: **GenericKafkaListener**

Full list of **GenericKafkaListenerConfiguration** schema properties

Configuration for Kafka listeners.

6.2.11.1. brokerCertChainAndKey

The **brokerCertChainAndKey** property is only used with listeners that have TLS encryption enabled. You can use the property to provide your own Kafka listener certificates.

Example configuration for a loadbalancer external listener with TLS encryption enabled

```
listeners:
  #...
  - name: external
    port: 9094
    type: loadbalancer
    tls: true
    authentication:
      type: tls
    configuration:
      brokerCertChainAndKey:
        secretName: my-secret
        certificate: my-listener-certificate.crt
        key: my-listener-key.key
# ...
```

6.2.11.2. externalTrafficPolicy

The **externalTrafficPolicy** property is used with **loadbalancer** and **nodeport** listeners. When exposing Kafka outside of OpenShift you can choose **Local** or **Cluster**. **Local** avoids hops to other nodes and preserves the client IP, whereas **Cluster** does neither. The default is **Cluster**.

6.2.11.3. loadBalancerSourceRanges

The **loadBalancerSourceRanges** property is only used with **loadbalancer** listeners. When exposing Kafka outside of OpenShift use source ranges, in addition to labels and annotations, to customize how a service is created.

Example source ranges configured for a loadbalancer listener

```
listeners:
  #...
  - name: external
    port: 9094
    type: loadbalancer
    tls: false
    configuration:
      externalTrafficPolicy: Local
      loadBalancerSourceRanges:
        - 10.0.0.0/8
        - 88.208.76.87/32
      # ...
# ...
```

6.2.11.4. class

The **class** property is only used with **ingress** listeners. You can configure the **Ingress** class using the **class** property.

Example of an external listener of type ingress using Ingress class nginx-internal

```
listeners:
  #...
  - name: external
    port: 9094
    type: ingress
    tls: true
    configuration:
      class: nginx-internal
    # ...
# ...
```

6.2.11.5. preferredNodePortAddressType

The **preferredNodePortAddressType** property is only used with **nodeport** listeners.

Use the **preferredNodePortAddressType** property in your listener configuration to specify the first address type checked as the node address. This property is useful, for example, if your deployment does not have DNS support, or you only want to expose a broker internally through an internal DNS or IP address. If an address of this type is found, it is used. If the preferred address type is not found, AMQ Streams proceeds through the types in the standard order of priority:

1. ExternalDNS
2. ExternalIP

3. Hostname
4. InternalDNS
5. InternalIP

Example of an external listener configured with a preferred node port address type

```
listeners:
  #...
  - name: external
    port: 9094
    type: nodeport
    tls: false
    configuration:
      preferredNodePortAddressType: InternalDNS
      # ...
# ...
```

6.2.11.6. useServiceDnsDomain

The **useServiceDnsDomain** property is only used with **internal** and **cluster-ip** listeners. It defines whether the fully-qualified DNS names that include the cluster service suffix (usually **.cluster.local**) are used. With **useServiceDnsDomain** set as **false**, the advertised addresses are generated without the service suffix; for example, **my-cluster-kafka-0.my-cluster-kafka-brokers.myproject.svc**. With **useServiceDnsDomain** set as **true**, the advertised addresses are generated with the service suffix; for example, **my-cluster-kafka-0.my-cluster-kafka-brokers.myproject.svc.cluster.local**. Default is **false**.

Example of an internal listener configured to use the Service DNS domain

```
listeners:
  #...
  - name: plain
    port: 9092
    type: internal
    tls: false
    configuration:
      useServiceDnsDomain: true
      # ...
# ...
```

If your OpenShift cluster uses a different service suffix than **.cluster.local**, you can configure the suffix using the **KUBERNETES_SERVICE_DNS_DOMAIN** environment variable in the Cluster Operator configuration.

6.2.11.7. GenericKafkaListenerConfiguration schema properties

Property	Description

Property	Description
brokerCertChainAndKey **CertAndKeySecretSource**	Reference to the **Secret** which holds the certificate and private key pair which will be used for this listener. The certificate can optionally contain the whole chain. This field can be used only with listeners with enabled TLS encryption.
externalTrafficPolicy string (one of [Local, Cluster])	Specifies whether the service routes external traffic to node-local or cluster-wide endpoints. **Cluster** may cause a second hop to another node and obscures the client source IP. **Local** avoids a second hop for LoadBalancer and Nodeport type services and preserves the client source IP (when supported by the infrastructure). If unspecified, OpenShift will use **Cluster** as the default.This field can be used only with **loadbalancer** or **nodeport** type listener.
loadBalancerSourceRanges string array	A list of CIDR ranges (for example **10.0.0.0/8** or **130.211.204.1/32**) from which clients can connect to load balancer type listeners. If supported by the platform, traffic through the loadbalancer is restricted to the specified CIDR ranges. This field is applicable only for loadbalancer type services and is ignored if the cloud provider does not support the feature. This field can be used only with **loadbalancer** type listener.
bootstrap **GenericKafkaListenerConfigurationBootstrap**	Bootstrap configuration.
brokers **GenericKafkaListenerConfigurationBroker** array	Per-broker configurations.
ipFamilyPolicy string (one of [RequireDualStack, SingleStack, PreferDualStack])	Specifies the IP Family Policy used by the service. Available options are **SingleStack**, **PreferDualStack** and **RequireDualStack**. **SingleStack** is for a single IP family. **PreferDualStack** is for two IP families on dual-stack configured clusters or a single IP family on single-stack clusters. **RequireDualStack** fails unless there are two IP families on dual-stack configured clusters. If unspecified, OpenShift will choose the default value based on the service type. Available on OpenShift 1.20 and newer.

Property	Description
ipFamilies string (one or more of [IPv6, IPv4]) array	Specifies the IP Families used by the service. Available options are **IPv4** and **IPv6. If unspecified, OpenShift will choose the default value based on the `ipFamilyPolicy** setting. Available on OpenShift 1.20 and newer.
createBootstrapService boolean	Whether to create the bootstrap service or not. The bootstrap service is created by default (if not specified differently). This field can be used with the **loadBalancer** type listener.
class string	Configures a specific class for **Ingress** and **LoadBalancer** that defines which controller will be used. This field can only be used with **ingress** and **loadbalancer** type listeners. If not specified, the default controller is used. For an **ingress** listener, set the **ingressClassName** property in the **Ingress** resources. For a **loadbalancer** listener, set the **loadBalancerClass** property in the **Service** resources.
finalizers string array	A list of finalizers which will be configured for the **LoadBalancer** type Services created for this listener. If supported by the platform, the finalizer **service.kubernetes.io/load-balancer-cleanup** to make sure that the external load balancer is deleted together with the service.For more information, see https://kubernetes.io/docs/tasks/access-application-cluster/create-external-load-balancer/#garbage-collecting-load-balancers. This field can be used only with **loadbalancer** type listeners.
maxConnectionCreationRate integer	The maximum connection creation rate we allow in this listener at any time. New connections will be throttled if the limit is reached.
maxConnections integer	The maximum number of connections we allow for this listener in the broker at any time. New connections are blocked if the limit is reached.

Property	Description
preferredNodePortAddressType string (one of [ExternalDNS, ExternalIP, Hostname, InternalIP, InternalDNS])	Defines which address type should be used as the node address. Available types are: **ExternalDNS**, **ExternalIP**, **InternalDNS**, **InternalIP** and **Hostname**. By default, the addresses will be used in the following order (the first one found will be used): • **ExternalDNS** • **ExternalIP** • **InternalDNS** • **InternalIP** • **Hostname** This field is used to select the preferred address type, which is checked first. If no address is found for this address type, the other types are checked in the default order. This field can only be used with **nodeport** type listener.
useServiceDnsDomain boolean	Configures whether the OpenShift service DNS domain should be used or not. If set to **true**, the generated addresses will contain the service DNS domain suffix (by default **.cluster.local**, can be configured using environment variable **KUBERNETES_SERVICE_DNS_DOMAIN**). Defaults to **false**.This field can be used only with **internal** and **cluster-ip** type listeners.

6.2.12. CertAndKeySecretSource schema reference

Used in: GenericKafkaListenerConfiguration, KafkaClientAuthenticationTls

Property	Description
certificate string	The name of the file certificate in the Secret.
key string	The name of the private key in the Secret.
secretName string	The name of the Secret containing the certificate.

6.2.13. GenericKafkaListenerConfigurationBootstrap schema reference

Used in: **GenericKafkaListenerConfiguration**

Full list of **GenericKafkaListenerConfigurationBootstrap** schema properties

Broker service equivalents of **nodePort**, **host**, **loadBalancerIP** and **annotations** properties are configured in the **GenericKafkaListenerConfigurationBroker** schema.

6.2.13.1. alternativeNames

You can specify alternative names for the bootstrap service. The names are added to the broker certificates and can be used for TLS hostname verification. The **alternativeNames** property is applicable to all types of listeners.

Example of an external route listener configured with an additional bootstrap address

```
listeners:
  #...
  - name: external
    port: 9094
    type: route
    tls: true
    authentication:
      type: tls
    configuration:
      bootstrap:
        alternativeNames:
          - example.hostname1
          - example.hostname2
# ...
```

6.2.13.2. host

The **host** property is used with **route** and **ingress** listeners to specify the hostnames used by the bootstrap and per-broker services.

A **host** property value is mandatory for **ingress** listener configuration, as the Ingress controller does not assign any hostnames automatically. Make sure that the hostnames resolve to the Ingress endpoints. AMQ Streams will not perform any validation that the requested hosts are available and properly routed to the Ingress endpoints.

Example of host configuration for an ingress listener

```
listeners:
  #...
  - name: external
    port: 9094
    type: ingress
    tls: true
    authentication:
      type: tls
    configuration:
      bootstrap:
        host: bootstrap.myingress.com
```

```
      brokers:
      - broker: 0
        host: broker-0.myingress.com
      - broker: 1
        host: broker-1.myingress.com
      - broker: 2
        host: broker-2.myingress.com
# ...
```

By default, **route** listener hosts are automatically assigned by OpenShift. However, you can override the assigned route hosts by specifying hosts.

AMQ Streams does not perform any validation that the requested hosts are available. You must ensure that they are free and can be used.

Example of host configuration for a route listener

```
# ...
listeners:
  #...
  - name: external
    port: 9094
    type: route
    tls: true
    authentication:
      type: tls
    configuration:
      bootstrap:
        host: bootstrap.myrouter.com
      brokers:
      - broker: 0
        host: broker-0.myrouter.com
      - broker: 1
        host: broker-1.myrouter.com
      - broker: 2
        host: broker-2.myrouter.com
# ...
```

6.2.13.3. nodePort

By default, the port numbers used for the bootstrap and broker services are automatically assigned by OpenShift. You can override the assigned node ports for **nodeport** listeners by specifying the requested port numbers.

AMQ Streams does not perform any validation on the requested ports. You must ensure that they are free and available for use.

Example of an external listener configured with overrides for node ports

```
# ...
listeners:
  #...
  - name: external
    port: 9094
    type: nodeport
```

```
    tls: true
    authentication:
      type: tls
    configuration:
      bootstrap:
        nodePort: 32100
      brokers:
      - broker: 0
        nodePort: 32000
      - broker: 1
        nodePort: 32001
      - broker: 2
        nodePort: 32002
# ...
```

6.2.13.4. loadBalancerIP

Use the **loadBalancerIP** property to request a specific IP address when creating a loadbalancer. Use this property when you need to use a loadbalancer with a specific IP address. The **loadBalancerIP** field is ignored if the cloud provider does not support the feature.

Example of an external listener of type loadbalancer with specific loadbalancer IP address requests

```
# ...
listeners:
  #...
  - name: external
    port: 9094
    type: loadbalancer
    tls: true
    authentication:
      type: tls
    configuration:
      bootstrap:
        loadBalancerIP: 172.29.3.10
      brokers:
      - broker: 0
        loadBalancerIP: 172.29.3.1
      - broker: 1
        loadBalancerIP: 172.29.3.2
      - broker: 2
        loadBalancerIP: 172.29.3.3
# ...
```

6.2.13.5. annotations

Use the **annotations** property to add annotations to OpenShift resources related to the listeners. You can use these annotations, for example, to instrument DNS tooling such as External DNS, which automatically assigns DNS names to the loadbalancer services.

Example of an external listener of type loadbalancer using annotations

```
# ...
```

```
listeners:
  #...
  - name: external
    port: 9094
    type: loadbalancer
    tls: true
    authentication:
      type: tls
    configuration:
      bootstrap:
        annotations:
          external-dns.alpha.kubernetes.io/hostname: kafka-bootstrap.mydomain.com.
          external-dns.alpha.kubernetes.io/ttl: "60"
      brokers:
      - broker: 0
        annotations:
          external-dns.alpha.kubernetes.io/hostname: kafka-broker-0.mydomain.com.
          external-dns.alpha.kubernetes.io/ttl: "60"
      - broker: 1
        annotations:
          external-dns.alpha.kubernetes.io/hostname: kafka-broker-1.mydomain.com.
          external-dns.alpha.kubernetes.io/ttl: "60"
      - broker: 2
        annotations:
          external-dns.alpha.kubernetes.io/hostname: kafka-broker-2.mydomain.com.
          external-dns.alpha.kubernetes.io/ttl: "60"
# ...
```

6.2.13.6. **GenericKafkaListenerConfigurationBootstrap** schema properties

Property	Description
alternativeNames string array	Additional alternative names for the bootstrap service. The alternative names will be added to the list of subject alternative names of the TLS certificates.
host string	The bootstrap host. This field will be used in the Ingress resource or in the Route resource to specify the desired hostname. This field can be used only with **route** (optional) or **ingress** (required) type listeners.
nodePort integer	Node port for the bootstrap service. This field can be used only with **nodeport** type listener.

Property	Description
loadBalancerIP string	The loadbalancer is requested with the IP address specified in this field. This feature depends on whether the underlying cloud provider supports specifying the **loadBalancerIP** when a load balancer is created. This field is ignored if the cloud provider does not support the feature.This field can be used only with **loadbalancer** type listener.
annotations map	Annotations that will be added to the **Ingress**, **Route**, or **Service** resource. You can use this field to configure DNS providers such as External DNS. This field can be used only with **loadbalancer**, **nodeport**, **route**, or **ingress** type listeners.
labels map	Labels that will be added to the **Ingress**, **Route**, or **Service** resource. This field can be used only with **loadbalancer**, **nodeport**, **route**, or **ingress** type listeners.

6.2.14. GenericKafkaListenerConfigurationBroker schema reference

Used in: **GenericKafkaListenerConfiguration**

Full list of **GenericKafkaListenerConfigurationBroker** schema properties

You can see example configuration for the **nodePort**, **host**, **loadBalancerIP** and **annotations** properties in the **GenericKafkaListenerConfigurationBootstrap** schema, which configures bootstrap service overrides.

Advertised addresses for brokers

By default, AMQ Streams tries to automatically determine the hostnames and ports that your Kafka cluster advertises to its clients. This is not sufficient in all situations, because the infrastructure on which AMQ Streams is running might not provide the right hostname or port through which Kafka can be accessed.

You can specify a broker ID and customize the advertised hostname and port in the **configuration** property of the listener. AMQ Streams will then automatically configure the advertised address in the Kafka brokers and add it to the broker certificates so it can be used for TLS hostname verification. Overriding the advertised host and ports is available for all types of listeners.

Example of an external route listener configured with overrides for advertised addresses

```
listeners:
  #...
  - name: external
    port: 9094
    type: route
```

```
    tls: true
    authentication:
      type: tls
    configuration:
      brokers:
      - broker: 0
        advertisedHost: example.hostname.0
        advertisedPort: 12340
      - broker: 1
        advertisedHost: example.hostname.1
        advertisedPort: 12341
      - broker: 2
        advertisedHost: example.hostname.2
        advertisedPort: 12342
  # ...
```

6.2.14.1. GenericKafkaListenerConfigurationBroker schema properties

Property	Description
broker integer	ID of the kafka broker (broker identifier). Broker IDs start from 0 and correspond to the number of broker replicas.
advertisedHost string	The host name which will be used in the brokers' **advertised.brokers**.
advertisedPort integer	The port number which will be used in the brokers' **advertised.brokers**.
host string	The broker host. This field will be used in the Ingress resource or in the Route resource to specify the desired hostname. This field can be used only with **route** (optional) or**ingress** (required) type listeners.
nodePort integer	Node port for the per-broker service. This field can be used only with **nodeport** type listener.
loadBalancerIP string	The loadbalancer is requested with the IP address specified in this field. This feature depends on whether the underlying cloud provider supports specifying the **loadBalancerIP** when a load balancer is created. This field is ignored if the cloud provider does not support the feature.This field can be used only with **loadbalancer** type listener.

Property	Description
annotations map	Annotations that will be added to the **Ingress** or **Service** resource. You can use this field to configure DNS providers such as External DNS. This field can be used only with **loadbalancer**, **nodeport**, or **ingress** type listeners.
labels map	Labels that will be added to the **Ingress**, **Route**, or **Service** resource. This field can be used only with **loadbalancer**, **nodeport**, **route**, or **ingress** type listeners.

6.2.15. EphemeralStorage schema reference

Used in: JbodStorage, KafkaClusterSpec, ZookeeperClusterSpec

The **type** property is a discriminator that distinguishes use of the **EphemeralStorage** type from PersistentClaimStorage. It must have the value **ephemeral** for the type **EphemeralStorage**.

Property	Description
id integer	Storage identification number. It is mandatory only for storage volumes defined in a storage of type 'jbod'.
sizeLimit string	When type=ephemeral, defines the total amount of local storage required for this EmptyDir volume (for example 1Gi).
type string	Must be **ephemeral**.

6.2.16. PersistentClaimStorage schema reference

Used in: JbodStorage, KafkaClusterSpec, ZookeeperClusterSpec

The **type** property is a discriminator that distinguishes use of the **PersistentClaimStorage** type from EphemeralStorage. It must have the value **persistent-claim** for the type **PersistentClaimStorage**.

Property	Description
type	Must be **persistent-claim**.

Property	Description
string	
size	When type=persistent-claim, defines the size of the persistent volume claim (i.e 1Gi). Mandatory when type=persistent-claim.
string	
selector	Specifies a specific persistent volume to use. It contains key:value pairs representing labels for selecting such a volume.
map	
deleteClaim	Specifies if the persistent volume claim has to be deleted when the cluster is un-deployed.
boolean	
class	The storage class to use for dynamic volume allocation.
string	
id	Storage identification number. It is mandatory only for storage volumes defined in a storage of type 'jbod'.
integer	
overrides	Overrides for individual brokers. The **overrides** field allows to specify a different configuration for different brokers.
PersistentClaimStorageOverride array	

6.2.17. PersistentClaimStorageOverride schema reference

Used in: **PersistentClaimStorage**

Property	Description
class	The storage class to use for dynamic volume allocation for this broker.
string	
broker	Id of the kafka broker (broker identifier).
integer	

6.2.18. JbodStorage schema reference

Used in: **KafkaClusterSpec**

The **type** property is a discriminator that distinguishes use of the **JbodStorage** type from **EphemeralStorage**, **PersistentClaimStorage**. It must have the value **jbod** for the type **JbodStorage**.

Property	Description
type	Must be **jbod**.
string	
volumes	List of volumes as Storage objects representing the JBOD disks array.
EphemeralStorage, **PersistentClaimStorage** array	

6.2.19. KafkaAuthorizationSimple schema reference

Used in: **KafkaClusterSpec**

Full list of **KafkaAuthorizationSimple** schema properties

Simple authorization in AMQ Streams uses the **AclAuthorizer** plugin, the default Access Control Lists (ACLs) authorization plugin provided with Apache Kafka. ACLs allow you to define which users have access to which resources at a granular level.

Configure the **Kafka** custom resource to use simple authorization. Set the **type** property in the **authorization** section to the value **simple**, and configure a list of super users.

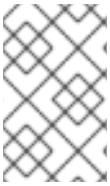
Access rules are configured for the **KafkaUser**, as described in the ACLRule schema reference.

6.2.19.1. superUsers

A list of user principals treated as super users, so that they are always allowed without querying ACL rules.

An example of simple authorization configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
  namespace: myproject
spec:
  kafka:
    # ...
    authorization:
      type: simple
      superUsers:
        - CN=client_1
        - user_2
        - CN=client_3
    # ...
```



NOTE

The **super.user** configuration option in the **config** property in **Kafka.spec.kafka** is ignored. Designate super users in the **authorization** property instead. For more information, see Kafka broker configuration.

6.2.19.2. KafkaAuthorizationSimple schema properties

The **type** property is a discriminator that distinguishes use of the **KafkaAuthorizationSimple** type from **KafkaAuthorizationOpa**, **KafkaAuthorizationKeycloak**, **KafkaAuthorizationCustom**. It must have the value **simple** for the type **KafkaAuthorizationSimple**.

Property	Description
type	Must be **simple**.
string	
superUsers	List of super users. Should contain list of user principals which should get unlimited access rights.
string array	

6.2.20. KafkaAuthorizationOpa schema reference

Used in: **KafkaClusterSpec**

Full list of **KafkaAuthorizationOpa** schema properties

To use Open Policy Agent authorization, set the **type** property in the **authorization** section to the value **opa**, and configure OPA properties as required. AMQ Streams uses Open Policy Agent plugin for Kafka authorization as the authorizer. For more information about the format of the input data and policy examples, see Open Policy Agent plugin for Kafka authorization .

6.2.20.1. url

The URL used to connect to the Open Policy Agent server. The URL has to include the policy which will be queried by the authorizer. **Required.**

6.2.20.2. allowOnError

Defines whether a Kafka client should be allowed or denied by default when the authorizer fails to query the Open Policy Agent, for example, when it is temporarily unavailable. Defaults to **false** - all actions will be denied.

6.2.20.3. initialCacheCapacity

Initial capacity of the local cache used by the authorizer to avoid querying the Open Policy Agent for every request. Defaults to **5000**.

6.2.20.4. maximumCacheSize

Maximum capacity of the local cache used by the authorizer to avoid querying the Open Policy Agent for every request. Defaults to **50000**.

6.2.20.5. expireAfterMs

The expiration of the records kept in the local cache to avoid querying the Open Policy Agent for every request. Defines how often the cached authorization decisions are reloaded from the Open Policy Agent server. In milliseconds. Defaults to **3600000** milliseconds (1 hour).

6.2.20.6. tlsTrustedCertificates

Trusted certificates for TLS connection to the OPA server.

6.2.20.7. superUsers

A list of user principals treated as super users, so that they are always allowed without querying the open Policy Agent policy.

An example of Open Policy Agent authorizer configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
  namespace: myproject
spec:
  kafka:
    # ...
    authorization:
      type: opa
      url: http://opa:8181/v1/data/kafka/allow
      allowOnError: false
      initialCacheCapacity: 1000
      maximumCacheSize: 10000
      expireAfterMs: 60000
      superUsers:
        - CN=fred
        - sam
        - CN=edward
    # ...
```

6.2.20.8. KafkaAuthorizationOpa schema properties

The **type** property is a discriminator that distinguishes use of the **KafkaAuthorizationOpa** type from **KafkaAuthorizationSimple**, **KafkaAuthorizationKeycloak**, **KafkaAuthorizationCustom**. It must have the value **opa** for the type **KafkaAuthorizationOpa**.

Property	Description
type	Must be **opa**.
string	

Property	Description
url	The URL used to connect to the Open Policy Agent server. The URL has to include the policy which will be queried by the authorizer. This option is required.
string	
allowOnError	Defines whether a Kafka client should be allowed or denied by default when the authorizer fails to query the Open Policy Agent, for example, when it is temporarily unavailable). Defaults to **false** - all actions will be denied.
boolean	
initialCacheCapacity	Initial capacity of the local cache used by the authorizer to avoid querying the Open Policy Agent for every request Defaults to **5000**.
integer	
maximumCacheSize	Maximum capacity of the local cache used by the authorizer to avoid querying the Open Policy Agent for every request. Defaults to **50000**.
integer	
expireAfterMs	The expiration of the records kept in the local cache to avoid querying the Open Policy Agent for every request. Defines how often the cached authorization decisions are reloaded from the Open Policy Agent server. In milliseconds. Defaults to **3600000**.
integer	
tlsTrustedCertificates	Trusted certificates for TLS connection to the OPA server.
CertSecretSource array	
superUsers	List of super users, which is specifically a list of user principals that have unlimited access rights.
string array	
enableMetrics	Defines whether the Open Policy Agent authorizer plugin should provide metrics. Defaults to **false**.
boolean	

6.2.21. KafkaAuthorizationKeycloak schema reference

Used in: **KafkaClusterSpec**

The **type** property is a discriminator that distinguishes use of the **KafkaAuthorizationKeycloak** type from **KafkaAuthorizationSimple**, **KafkaAuthorizationOpa**, **KafkaAuthorizationCustom**. It must have the value **keycloak** for the type **KafkaAuthorizationKeycloak**.

Property	Description
type string	Must be **keycloak**.
clientId string	OAuth Client ID which the Kafka client can use to authenticate against the OAuth server and use the token endpoint URI.
tokenEndpointUri string	Authorization server token endpoint URI.
tlsTrustedCertificates **CertSecretSource** array	Trusted certificates for TLS connection to the OAuth server.
disableTlsHostnameVerification boolean	Enable or disable TLS hostname verification. Default value is **false**.
delegateToKafkaAcls boolean	Whether authorization decision should be delegated to the 'Simple' authorizer if DENIED by Red Hat Single Sign-On Authorization Services policies. Default value is **false**.
grantsRefreshPeriodSeconds integer	The time between two consecutive grants refresh runs in seconds. The default value is 60.
grantsRefreshPoolSize integer	The number of threads to use to refresh grants for active sessions. The more threads, the more parallelism, so the sooner the job completes. However, using more threads places a heavier load on the authorization server. The default value is 5.
superUsers string array	List of super users. Should contain list of user principals which should get unlimited access rights.
connectTimeoutSeconds integer	The connect timeout in seconds when connecting to authorization server. If not set, the effective connect timeout is 60 seconds.
readTimeoutSeconds	The read timeout in seconds when connecting to authorization server. If not set, the effective read timeout is 60 seconds.

Property	Description
integer	
httpRetries	The maximum number of retries to attempt if an initial HTTP request fails. If not set, the default is to not attempt any retries.
integer	
enableMetrics	Enable or disable OAuth metrics. Default value is **false**.
boolean	

6.2.22. KafkaAuthorizationCustom schema reference

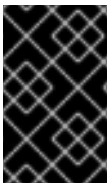
Used in: **KafkaClusterSpec**

Full list of **KafkaAuthorizationCustom** schema properties

To use custom authorization in AMQ Streams, you can configure your own **Authorizer** plugin to define Access Control Lists (ACLs).

ACLs allow you to define which users have access to which resources at a granular level.

Configure the **Kafka** custom resource to use custom authorization. Set the **type** property in the **authorization** section to the value **custom**, and the set following properties.



IMPORTANT

The custom authorizer must implement the **org.apache.kafka.server.authorizer.Authorizer** interface, and support configuration of **super.users** using the super.users configuration property.

6.2.22.1. authorizerClass

(Required) Java class that implements the **org.apache.kafka.server.authorizer.Authorizer** interface to support custom ACLs.

6.2.22.2. superUsers

A list of user principals treated as super users, so that they are always allowed without querying ACL rules.

You can add configuration for initializing the custom authorizer using **Kafka.spec.kafka.config**.

An example of custom authorization configuration under Kafka.spec

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
  namespace: myproject
```

```
spec:
  kafka:
    # ...
    authorization:
      type: custom
      authorizerClass: io.mycompany.CustomAuthorizer
      superUsers:
        - CN=client_1
        - user_2
        - CN=client_3
    # ...
    config:
      authorization.custom.property1=value1
      authorization.custom.property2=value2
    # ...
```

In addition to the **Kafka** custom resource configuration, the JAR file containing the custom authorizer class along with its dependencies must be available on the classpath of the Kafka broker.

The AMQ Streams Maven build process provides a mechanism to add custom third-party libraries to the generated Kafka broker container image by adding them as dependencies in the **pom.xml** file under the **docker-images/kafka/kafka-thirdparty-libs** directory. The directory contains different folders for different Kafka versions. Choose the appropriate folder. Before modifying the **pom.xml** file, the third-party library must be available in a Maven repository, and that Maven repository must be accessible to the AMQ Streams build process.

NOTE

The **super.user** configuration option in the **config** property in **Kafka.spec.kafka** is ignored. Designate super users in the **authorization** property instead. For more information, see Kafka broker configuration.

Custom authorization can make use of group membership information extracted from the JWT token during authentication when using **oauth** authentication and configuring **groupsClaim** configuration attribute. Groups are available on the **OAuthKafkaPrincipal** object during authorize() call as follows:

```
    public List<AuthorizationResult> authorize(AuthorizableRequestContext requestContext,
List<Action> actions) {

        KafkaPrincipal principal = requestContext.principal();
        if (principal instanceof OAuthKafkaPrincipal) {
            OAuthKafkaPrincipal p = (OAuthKafkaPrincipal) principal;

            for (String group: p.getGroups()) {
                System.out.println("Group: " + group);
            }
        }
    }
```

6.2.22.3. KafkaAuthorizationCustom schema properties

The **type** property is a discriminator that distinguishes use of the **KafkaAuthorizationCustom** type from **KafkaAuthorizationSimple**, **KafkaAuthorizationOpa**, **KafkaAuthorizationKeycloak**. It must have the value **custom** for the type **KafkaAuthorizationCustom**.

Property	Description
type	Must be **custom**.
string	
authorizerClass	Authorization implementation class, which must be available in classpath.
string	
superUsers	List of super users, which are user principals with unlimited access rights.
string array	
supportsAdminApi	Indicates whether the custom authorizer supports the APIs for managing ACLs using the Kafka Admin API. Defaults to **false**.
boolean	

6.2.23. Rack schema reference

Used in: **KafkaBridgeSpec**, **KafkaClusterSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2Spec**

Full list of **Rack** schema properties

The **rack** option configures rack awareness. A *rack* can represent an availability zone, data center, or an actual rack in your data center. The *rack* is configured through a **topologyKey**. **topologyKey** identifies a label on OpenShift nodes that contains the name of the topology in its value. An example of such a label is **topology.kubernetes.io/zone** (or **failure-domain.beta.kubernetes.io/zone** on older OpenShift versions), which contains the name of the availability zone in which the OpenShift node runs. You can configure your Kafka cluster to be aware of the *rack* in which it runs, and enable additional features such as spreading partition replicas across different racks or consuming messages from the closest replicas.

For more information about OpenShift node labels, see Well-Known Labels, Annotations and Taints . Consult your OpenShift administrator regarding the node label that represents the zone or rack into which the node is deployed.

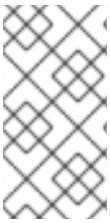
6.2.23.1. Spreading partition replicas across racks

When rack awareness is configured, AMQ Streams will set **broker.rack** configuration for each Kafka broker. The **broker.rack** configuration assigns a rack ID to each broker. When **broker.rack** is configured, Kafka brokers will spread partition replicas across as many different racks as possible. When replicas are spread across multiple racks, the probability that multiple replicas will fail at the same time is lower than if they would be in the same rack. Spreading replicas improves resiliency, and is important for availability and reliability. To enable rack awareness in Kafka, add the **rack** option to the **.spec.kafka** section of the **Kafka** custom resource as shown in the example below.

Example rack configuration for Kafka

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
```

```
  name: my-cluster
spec:
  kafka:
    # ...
    rack:
      topologyKey: topology.kubernetes.io/zone
    # ...
```



NOTE

The *rack* in which brokers are running can change in some cases when the pods are deleted or restarted. As a result, the replicas running in different racks might then share the same rack. Use Cruise Control and the **KafkaRebalance** resource with the **RackAwareGoal** to make sure that replicas remain distributed across different racks.

When rack awareness is enabled in the **Kafka** custom resource, AMQ Streams will automatically add the OpenShift **preferredDuringSchedulingIgnoredDuringExecution** affinity rule to distribute the Kafka brokers across the different racks. However, the *preferred* rule does not guarantee that the brokers will be spread. Depending on your exact OpenShift and Kafka configurations, you should add additional **affinity** rules or configure **topologySpreadConstraints** for both ZooKeeper and Kafka to make sure the nodes are properly distributed accross as many racks as possible. For more information see Section 2.8, "Configuring pod scheduling".

6.2.23.2. Consuming messages from the closest replicas

Rack awareness can also be used in consumers to fetch data from the closest replica. This is useful for reducing the load on your network when a Kafka cluster spans multiple datacenters and can also reduce costs when running Kafka in public clouds. However, it can lead to increased latency.

In order to be able to consume from the closest replica, rack awareness has to be configured in the Kafka cluster, and the **RackAwareReplicaSelector** has to be enabled. The replica selector plugin provides the logic that enables clients to consume from the nearest replica. The default implementation uses **LeaderSelector** to always select the leader replica for the client. Specify **RackAwareReplicaSelector** for the **replica.selector.class** to switch from the default implementation.

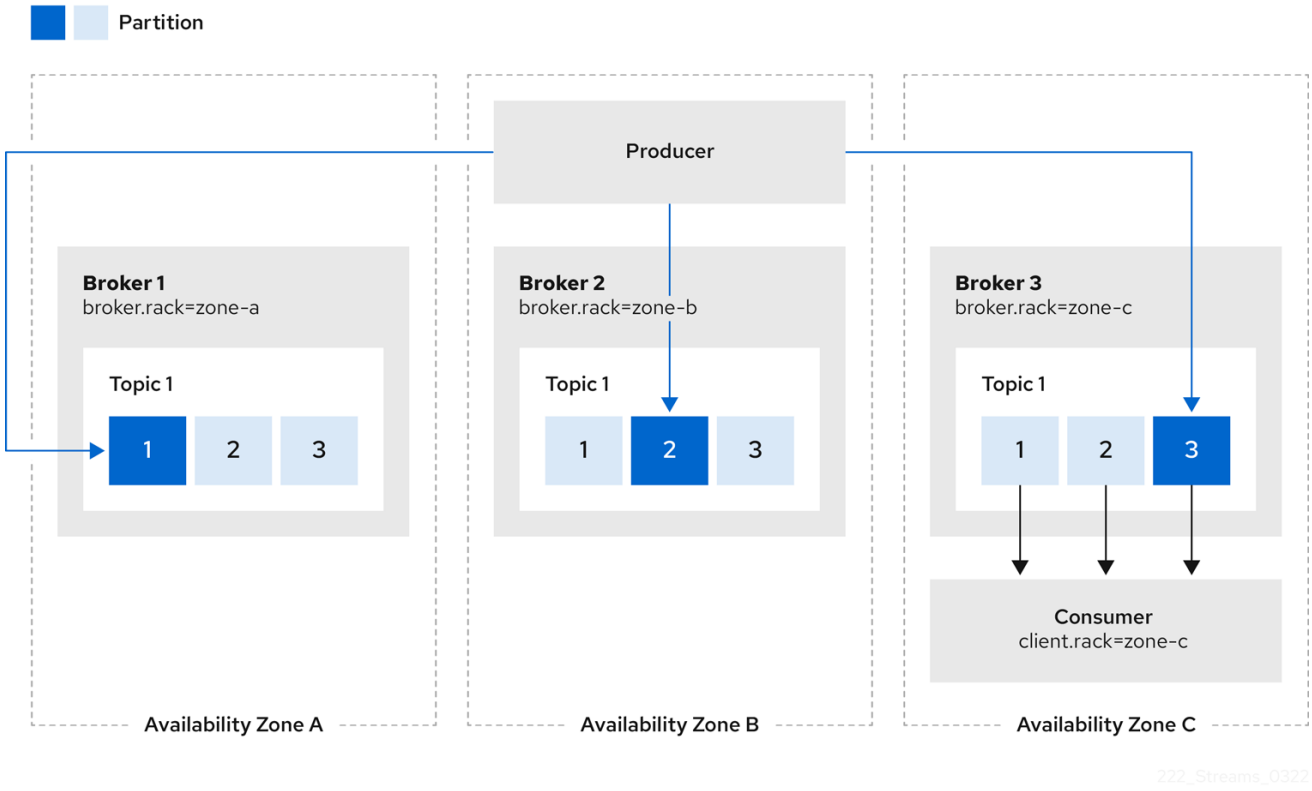
Example rack configuration with enabled replica-aware selector

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
    rack:
      topologyKey: topology.kubernetes.io/zone
    config:
      # ...
      replica.selector.class: org.apache.kafka.common.replica.RackAwareReplicaSelector
    # ...
```

In addition to the Kafka broker configuration, you also need to specify the **client.rack** option in your consumers. The **client.rack** option should specify the *rack ID* in which the consumer is running. **RackAwareReplicaSelector** associates matching **broker.rack** and **client.rack** IDs, to find the nearest

replica and consume from it. If there are multiple replicas in the same rack, **RackAwareReplicaSelector** always selects the most up-to-date replica. If the rack ID is not specified, or if it cannot find a replica with the same rack ID, it will fall back to the leader replica.

Figure 6.1. Example showing client consuming from replicas in the same availability zone



You can also configure Kafka Connect, MirrorMaker 2 and Kafka Bridge so that connectors consume messages from the closest replicas. You enable rack awareness in the **KafkaConnect**, **KafkaMirrorMaker2**, and **KafkaBridge** custom resources. The configuration does does not set affinity rules, but you can also configure **affinity** or **topologySpreadConstraints**. For more information see Section 2.8, "Configuring pod scheduling".

When deploying Kafka Connect using AMQ Streams, you can use the **rack** section in the **KafkaConnect** custom resource to automatically configure the **client.rack** option.

Example rack configuration for Kafka Connect

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
# ...
spec:
  # ...
  rack:
    topologyKey: topology.kubernetes.io/zone
  # ...
```

When deploying MirrorMaker 2 using AMQ Streams, you can use the **rack** section in the **KafkaMirrorMaker2** custom resource to automatically configure the **client.rack** option.

Example rack configuration for MirrorMaker 2

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaMirrorMaker2
# ...
spec:
  # ...
  rack:
    topologyKey: topology.kubernetes.io/zone
  # ...
```

When deploying Kafka Bridge using AMQ Streams, you can use the **rack** section in the **KafkaBridge** custom resource to automatically configure the **client.rack** option.

Example rack configuration for Kafka Bridge

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaBridge
# ...
spec:
  # ...
  rack:
    topologyKey: topology.kubernetes.io/zone
  # ...
```

6.2.23.3. Rack schema properties

Property	Description
topologyKey	A key that matches labels assigned to the OpenShift cluster nodes. The value of the label is used to set a broker's **broker.rack** config, and the **client.rack** config for Kafka Connect or MirrorMaker 2.
string	

6.2.24. Probe schema reference

Used in: **CruiseControlSpec**, **EntityTopicOperatorSpec**, **EntityUserOperatorSpec**, **KafkaBridgeSpec**, **KafkaClusterSpec**, **KafkaConnectSpec**, **KafkaExporterSpec**, **KafkaMirrorMaker2Spec**, **KafkaMirrorMakerSpec**, **TlsSidecar**, **ZookeeperClusterSpec**

Property	Description
failureThreshold	Minimum consecutive failures for the probe to be considered failed after having succeeded. Defaults to 3. Minimum value is 1.
integer	
initialDelaySeconds	The initial delay before first the health is first checked. Default to 15 seconds. Minimum value is 0.
integer	

Property	Description
periodSeconds integer	How often (in seconds) to perform the probe. Default to 10 seconds. Minimum value is 1.
successThreshold integer	Minimum consecutive successes for the probe to be considered successful after having failed. Defaults to 1. Must be 1 for liveness. Minimum value is 1.
timeoutSeconds integer	The timeout for each attempted health check. Default to 5 seconds. Minimum value is 1.

6.2.25. JvmOptions schema reference

Used in: **CruiseControlSpec**, **EntityTopicOperatorSpec**, **EntityUserOperatorSpec**, **KafkaBridgeSpec**, **KafkaClusterSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2Spec**, **KafkaMirrorMakerSpec**, **ZookeeperClusterSpec**

Property	Description
-XX map	A map of -XX options to the JVM.
-Xms string	-Xms option to to the JVM.
-Xmx string	-Xmx option to to the JVM.
gcLoggingEnabled boolean	Specifies whether the Garbage Collection logging is enabled. The default is false.
javaSystemProperties **SystemProperty** array	A map of additional system properties which will be passed using the **-D** option to the JVM.

6.2.26. SystemProperty schema reference

Used in: **JvmOptions**

Property	Description
name	The system property name.
string	
value	The system property value.
string	

6.2.27. KafkaJmxOptions schema reference

Used in: **KafkaClusterSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2Spec**, **ZookeeperClusterSpec**

Full list of **KafkaJmxOptions** schema properties

Configures JMX connection options.

Get JMX metrics from Kafka brokers, ZooKeeper nodes, Kafka Connect, and MirrorMaker 2. by connecting to port 9999. Use the **jmxOptions** property to configure a password-protected or an unprotected JMX port. Using password protection prevents unauthorized pods from accessing the port.

You can then obtain metrics about the component.

For example, for each Kafka broker you can obtain bytes-per-second usage data from clients, or the request rate of the network of the broker.

To enable security for the JMX port, set the **type** parameter in the **authentication** field to **password**.

Example password-protected JMX configuration for Kafka brokers and ZooKeeper nodes

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
    jmxOptions:
      authentication:
        type: "password"
    # ...
  zookeeper:
    # ...
    jmxOptions:
      authentication:
        type: "password"
    #...
```

You can then deploy a pod into a cluster and obtain JMX metrics using the headless service by specifying which broker you want to address.

For example, to get JMX metrics from broker *0* you specify:

```
"CLUSTER-NAME-kafka-0.CLUSTER-NAME-kafka-brokers"
```

***CLUSTER-NAME*-kafka-0** is name of the broker pod, and ***CLUSTER-NAME*-kafka-brokers** is the name of the headless service to return the IPs of the broker pods.

If the JMX port is secured, you can get the username and password by referencing them from the JMX Secret in the deployment of your pod.

For an unprotected JMX port, use an empty object **{}** to open the JMX port on the headless service. You deploy a pod and obtain metrics in the same way as for the protected port, but in this case any pod can read from the JMX port.

Example open port JMX configuration for Kafka brokers and ZooKeeper nodes

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
    jmxOptions: {}
    # ...
  zookeeper:
    # ...
    jmxOptions: {}
    # ...
```

Additional resources

- For more information on the Kafka component metrics exposed using JMX, see the Apache Kafka documentation.

6.2.27.1. KafkaJmxOptions schema properties

Property	Description
authentication	Authentication configuration for connecting to the JMX port. The type depends on the value of the **authentication.type** property within the given object, which must be one of [password].
KafkaJmxAuthenticationPassword	

6.2.28. KafkaJmxAuthenticationPassword schema reference

Used in: **KafkaJmxOptions**

The **type** property is a discriminator that distinguishes use of the **KafkaJmxAuthenticationPassword** type from other subtypes which may be added in the future. It must have the value **password** for the type **KafkaJmxAuthenticationPassword**.

Property	Description
type	Must be **password**.
string	

6.2.29. JmxPrometheusExporterMetrics schema reference

Used in: **CruiseControlSpec**, **KafkaClusterSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2Spec**, **KafkaMirrorMakerSpec**, **ZookeeperClusterSpec**

The **type** property is a discriminator that distinguishes use of the **JmxPrometheusExporterMetrics** type from other subtypes which may be added in the future. It must have the value **jmxPrometheusExporter** for the type **JmxPrometheusExporterMetrics**.

Property	Description
type	Must be **jmxPrometheusExporter**.
string	
valueFrom	ConfigMap entry where the Prometheus JMX Exporter configuration is stored. For details of the structure of this configuration, see the Prometheus JMX Exporter.
ExternalConfigurationReference	

6.2.30. ExternalConfigurationReference schema reference

Used in: **ExternalLogging**, **JmxPrometheusExporterMetrics**

Property	Description
configMapKeyRef	Reference to the key in the ConfigMap containing the configuration. For more information, see the external documentation for core/v1 configmapkeyselector.
ConfigMapKeySelector	

6.2.31. InlineLogging schema reference

Used in: **CruiseControlSpec**, **EntityTopicOperatorSpec**, **EntityUserOperatorSpec**, **KafkaBridgeSpec**, **KafkaClusterSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2Spec**, **KafkaMirrorMakerSpec**, **ZookeeperClusterSpec**

The **type** property is a discriminator that distinguishes use of the **InlineLogging** type from **ExternalLogging**. It must have the value **inline** for the type **InlineLogging**.

Property	Description
type	Must be **inline**.
string	
loggers	A Map from logger name to logger level.
map	

6.2.32. ExternalLogging schema reference

Used in: **CruiseControlSpec**, **EntityTopicOperatorSpec**, **EntityUserOperatorSpec**, **KafkaBridgeSpec**, **KafkaClusterSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2Spec**, **KafkaMirrorMakerSpec**, **ZookeeperClusterSpec**

The **type** property is a discriminator that distinguishes use of the **ExternalLogging** type from **InlineLogging**. It must have the value **external** for the type **ExternalLogging**.

Property	Description
type	Must be **external**.
string	
valueFrom	**ConfigMap** entry where the logging configuration is stored.
ExternalConfigurationReference	

6.2.33. KafkaClusterTemplate schema reference

Used in: **KafkaClusterSpec**

Property	Description
statefulset	Template for Kafka **StatefulSet**.
StatefulSetTemplate	
pod	Template for Kafka **Pods**.
PodTemplate	
bootstrapService	Template for Kafka bootstrap **Service**.
InternalServiceTemplate	

Property	Description
brokersService	Template for Kafka broker **Service**.
InternalServiceTemplate	
externalBootstrapService	Template for Kafka external bootstrap **Service**.
ResourceTemplate	
perPodService	Template for Kafka per-pod **Services** used for access from outside of OpenShift.
ResourceTemplate	
externalBootstrapRoute	Template for Kafka external bootstrap **Route**.
ResourceTemplate	
perPodRoute	Template for Kafka per-pod **Routes** used for access from outside of OpenShift.
ResourceTemplate	
externalBootstrapIngress	Template for Kafka external bootstrap **Ingress**.
ResourceTemplate	
perPodIngress	Template for Kafka per-pod **Ingress** used for access from outside of OpenShift.
ResourceTemplate	
persistentVolumeClaim	Template for all Kafka **PersistentVolumeClaims**.
ResourceTemplate	
podDisruptionBudget	Template for Kafka **PodDisruptionBudget**.
PodDisruptionBudgetTemplate	
kafkaContainer	Template for the Kafka broker container.
ContainerTemplate	
initContainer	Template for the Kafka init container.
ContainerTemplate	

Property	Description
clusterCaCert	Template for Secret with Kafka Cluster certificate public key.
ResourceTemplate	
serviceAccount	Template for the Kafka service account.
ResourceTemplate	
jmxSecret	Template for Secret of the Kafka Cluster JMX authentication.
ResourceTemplate	
clusterRoleBinding	Template for the Kafka ClusterRoleBinding.
ResourceTemplate	
podSet	Template for Kafka **StrimziPodSet** resource.
ResourceTemplate	

6.2.34. StatefulSetTemplate schema reference

Used in: **KafkaClusterTemplate**, **ZookeeperClusterTemplate**

Property	Description
metadata	Metadata applied to the resource.
MetadataTemplate	
podManagementPolicy	PodManagementPolicy which will be used for this StatefulSet. Valid values are **Parallel** and **OrderedReady**. Defaults to **Parallel**.
string (one of [OrderedReady, Parallel])	

6.2.35. MetadataTemplate schema reference

Used in: **BuildConfigTemplate**, **DeploymentTemplate**, **InternalServiceTemplate**, **PodDisruptionBudgetTemplate**, **PodTemplate**, **ResourceTemplate**, **StatefulSetTemplate**

Full list of **MetadataTemplate** schema properties

Labels and **Annotations** are used to identify and organize resources, and are configured in the **metadata** property.

For example:

```
# ...
template:
  pod:
    metadata:
      labels:
        label1: value1
        label2: value2
      annotations:
        annotation1: value1
        annotation2: value2
# ...
```

The **labels** and **annotations** fields can contain any labels or annotations that do not contain the reserved string **strimzi.io**. Labels and annotations containing **strimzi.io** are used internally by AMQ Streams and cannot be configured.

6.2.35.1. MetadataTemplate schema properties

Property	Description
labels	Labels added to the resource template. Can be applied to different resources such as **StatefulSets**, **Deployments**, **Pods**, and **Services**.
map	
annotations	Annotations added to the resource template. Can be applied to different resources such as **StatefulSets**, **Deployments**, **Pods**, and **Services**.
map	

6.2.36. PodTemplate schema reference

Used in: **CruiseControlTemplate**, **EntityOperatorTemplate**, **KafkaBridgeTemplate**, **KafkaClusterTemplate**, **KafkaConnectTemplate**, **KafkaExporterTemplate**, **KafkaMirrorMakerTemplate**, **ZookeeperClusterTemplate**

Full list of **PodTemplate** schema properties

Configures the template for Kafka pods.

Example PodTemplate configuration

```
# ...
template:
  pod:
    metadata:
      labels:
        label1: value1
      annotations:
        anno1: value1
    imagePullSecrets:
      - name: my-docker-credentials
    securityContext:
      runAsUser: 1000001
```

```
      fsGroup: 0
    terminationGracePeriodSeconds: 120
  # ...
```

6.2.36.1. hostAliases

Use the **hostAliases** property to a specify a list of hosts and IP addresses, which are injected into the **/etc/hosts** file of the pod.

This configuration is especially useful for Kafka Connect or MirrorMaker when a connection outside of the cluster is also requested by users.

Example hostAliases configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
#...
spec:
  # ...
  template:
    pod:
      hostAliases:
      - ip: "192.168.1.86"
        hostnames:
        - "my-host-1"
        - "my-host-2"
      #...
```

6.2.36.2. PodTemplate schema properties

Property	Description
metadata	Metadata applied to the resource.
MetadataTemplate	
imagePullSecrets	List of references to secrets in the same namespace to use for pulling any of the images used by this Pod. When the **STRIMZI_IMAGE_PULL_SECRETS** environment variable in Cluster Operator and the **imagePullSecrets** option are specified, only the **imagePullSecrets** variable is used and the **STRIMZI_IMAGE_PULL_SECRETS** variable is ignored. For more information, see the external documentation for core/v1 localobjectreference.
LocalObjectReference array	
securityContext	Configures pod-level security attributes and common container settings. For more information, see the external documentation for core/v1 podsecuritycontext.
PodSecurityContext	

Property	Description
terminationGracePeriodSeconds integer	The grace period is the duration in seconds after the processes running in the pod are sent a termination signal, and the time when the processes are forcibly halted with a kill signal. Set this value to longer than the expected cleanup time for your process. Value must be a non-negative integer. A zero value indicates delete immediately. You might need to increase the grace period for very large Kafka clusters, so that the Kafka brokers have enough time to transfer their work to another broker before they are terminated. Defaults to 30 seconds.
affinity Affinity	The pod's affinity rules. For more information, see the external documentation for core/v1 affinity.
tolerations Toleration array	The pod's tolerations. For more information, see the external documentation for core/v1 toleration.
priorityClassName string	The name of the priority class used to assign priority to the pods. For more information about priority classes, see Pod Priority and Preemption.
schedulerName string	The name of the scheduler used to dispatch this **Pod**. If not specified, the default scheduler will be used.
hostAliases HostAlias array	The pod's HostAliases. HostAliases is an optional list of hosts and IPs that will be injected into the Pod's hosts file if specified. For more information, see the external documentation for core/v1 hostalias.
tmpDirSizeLimit string	Defines the total amount (for example **1Gi**) of local storage required for temporary EmptyDir volume (/**tmp**). Default value is **5Mi**.
enableServiceLinks boolean	Indicates whether information about services should be injected into Pod's environment variables.
topologySpreadConstraints TopologySpreadConstraint array	The pod's topology spread constraints. For more information, see the external documentation for core/v1 topologyspreadconstraint.

6.2.37. InternalServiceTemplate schema reference

Used in: **CruiseControlTemplate**, **KafkaBridgeTemplate**, **KafkaClusterTemplate**, **KafkaConnectTemplate**, **ZookeeperClusterTemplate**

Property	Description
metadata	Metadata applied to the resource.
MetadataTemplate	
ipFamilyPolicy	Specifies the IP Family Policy used by the service. Available options are **SingleStack**, **PreferDualStack** and **RequireDualStack**. **SingleStack** is for a single IP family. **PreferDualStack** is for two IP families on dual-stack configured clusters or a single IP family on single-stack clusters. **RequireDualStack** fails unless there are two IP families on dual-stack configured clusters. If unspecified, OpenShift will choose the default value based on the service type. Available on OpenShift 1.20 and newer.
string (one of [RequireDualStack, SingleStack, PreferDualStack])	
ipFamilies	Specifies the IP Families used by the service. Available options are **IPv4** and **IPv6. If unspecified, OpenShift will choose the default value based on the `ipFamilyPolicy** setting. Available on OpenShift 1.20 and newer.
string (one or more of [IPv6, IPv4]) array	

6.2.38. ResourceTemplate schema reference

Used in: **CruiseControlTemplate**, **EntityOperatorTemplate**, **KafkaBridgeTemplate**, **KafkaClusterTemplate**, **KafkaConnectTemplate**, **KafkaExporterTemplate**, **KafkaMirrorMakerTemplate**, **KafkaUserTemplate**, **ZookeeperClusterTemplate**

Property	Description
metadata	Metadata applied to the resource.
MetadataTemplate	

6.2.39. PodDisruptionBudgetTemplate schema reference

Used in: **CruiseControlTemplate**, **KafkaBridgeTemplate**, **KafkaClusterTemplate**, **KafkaConnectTemplate**, **KafkaMirrorMakerTemplate**, **ZookeeperClusterTemplate**

Full list of **PodDisruptionBudgetTemplate** schema properties

AMQ Streams creates a **PodDisruptionBudget** for every new **StrimziPodSet**, **StatefulSet**, or **Deployment**. By default, pod disruption budgets only allow a single pod to be unavailable at a given time. You can increase the amount of unavailable pods allowed by changing the default value of the **maxUnavailable** property.

An example of **PodDisruptionBudget** template

```
# ...
template:
  podDisruptionBudget:
    metadata:
      labels:
        key1: label1
        key2: label2
      annotations:
        key1: label1
        key2: label2
    maxUnavailable: 1
# ...
```

6.2.39.1. PodDisruptionBudgetTemplate schema properties

Property	Description
metadata	Metadata to apply to the **PodDisruptionBudgetTemplate** resource.
MetadataTemplate	
maxUnavailable	Maximum number of unavailable pods to allow automatic Pod eviction. A Pod eviction is allowed when the **maxUnavailable** number of pods or fewer are unavailable after the eviction. Setting this value to 0 prevents all voluntary evictions, so the pods must be evicted manually. Defaults to 1.
integer	

6.2.40. ContainerTemplate schema reference

Used in: **CruiseControlTemplate**, **EntityOperatorTemplate**, **KafkaBridgeTemplate**, **KafkaClusterTemplate**, **KafkaConnectTemplate**, **KafkaExporterTemplate**, **KafkaMirrorMakerTemplate**, **ZookeeperClusterTemplate**

Full list of **ContainerTemplate** schema properties

You can set custom security context and environment variables for a container.

The environment variables are defined under the **env** property as a list of objects with **name** and **value** fields. The following example shows two custom environment variables and a custom security context set for the Kafka broker containers:

```
# ...
template:
  kafkaContainer:
    env:
    - name: EXAMPLE_ENV_1
      value: example.env.one
    - name: EXAMPLE_ENV_2
      value: example.env.two
```

```
    securityContext:
      runAsUser: 2000
  # ...
```

Environment variables prefixed with **KAFKA_** are internal to AMQ Streams and should be avoided. If you set a custom environment variable that is already in use by AMQ Streams, it is ignored and a warning is recorded in the log.

6.2.40.1. ContainerTemplate schema properties

Property	Description
env	Environment variables which should be applied to the container.
ContainerEnvVar array	
securityContext	Security context for the container. For more information, see the external documentation for core/v1 securitycontext.
SecurityContext	

6.2.41. ContainerEnvVar schema reference

Used in: **ContainerTemplate**

Property	Description
name	The environment variable key.
string	
value	The environment variable value.
string	

6.2.42. ZookeeperClusterSpec schema reference

Used in: **KafkaSpec**

Full list of **ZookeeperClusterSpec** schema properties

Configures a ZooKeeper cluster.

6.2.42.1. config

Use the **config** properties to configure ZooKeeper options as keys.

Standard Apache ZooKeeper configuration may be provided, restricted to those properties not managed directly by AMQ Streams.

Configuration options that cannot be configured relate to:

- Security (Encryption, Authentication, and Authorization)
- Listener configuration
- Configuration of data directories
- ZooKeeper cluster composition

The values can be one of the following JSON types:

- String
- Number
- Boolean

You can specify and configure the options listed in the ZooKeeper documentation with the exception of those managed directly by AMQ Streams. Specifically, all configuration options with keys equal to or starting with one of the following strings are forbidden:

- **server.**
- **dataDir**
- **dataLogDir**
- **clientPort**
- **authProvider**
- **quorum.auth**
- **requireClientAuthScheme**

When a forbidden option is present in the **config** property, it is ignored and a warning message is printed to the Cluster Operator log file. All other supported options are passed to ZooKeeper.

There are exceptions to the forbidden options. For client connection using a specific *cipher suite* for a TLS version, you can configure allowed **ssl** properties.

Example ZooKeeper configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
spec:
  kafka:
    # ...
  zookeeper:
    # ...
    config:
      autopurge.snapRetainCount: 3
      autopurge.purgeInterval: 1
      ssl.cipher.suites: TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
```

```
    ssl.enabled.protocols: TLSv1.2
    ssl.protocol: TLSv1.2
  # ...
```

6.2.42.2. logging

ZooKeeper has a configurable logger:

- **zookeeper.root.logger**

ZooKeeper uses the Apache **log4j** logger implementation.

Use the **logging** property to configure loggers and logger levels.

You can set the log levels by specifying the logger and level directly (inline) or use a custom (external) ConfigMap. If a ConfigMap is used, you set **logging.valueFrom.configMapKeyRef.name** property to the name of the ConfigMap containing the external logging configuration. Inside the ConfigMap, the logging configuration is described using **log4j.properties**. Both **logging.valueFrom.configMapKeyRef.name** and **logging.valueFrom.configMapKeyRef.key** properties are mandatory. A ConfigMap using the exact logging configuration specified is created with the custom resource when the Cluster Operator is running, then recreated after each reconciliation. If you do not specify a custom ConfigMap, default logging settings are used. If a specific logger value is not set, upper-level logger settings are inherited for that logger. For more information about log levels, see Apache logging services.

Here we see examples of **inline** and **external** logging.

Inline logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
spec:
  # ...
  zookeeper:
    # ...
    logging:
      type: inline
      loggers:
        zookeeper.root.logger: "INFO"
    # ...
```

External logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
spec:
  # ...
  zookeeper:
    # ...
    logging:
      type: external
      valueFrom:
        configMapKeyRef:
```

```
        name: customConfigMap
        key: zookeeper-log4j.properties
# ...
```

Garbage collector (GC)

Garbage collector logging can also be enabled (or disabled) using the **jvmOptions** property.

6.2.42.3. ZookeeperClusterSpec schema properties

Property	Description
replicas	The number of pods in the cluster.
integer	
image	The docker image for the pods.
string	
storage	Storage configuration (disk). Cannot be updated. The type depends on the value of the **storage.type** property within the given object, which must be one of [ephemeral, persistent-claim].
EphemeralStorage, **PersistentClaimStorage**	
config	The ZooKeeper broker config. Properties with the following prefixes cannot be set: server., dataDir, dataLogDir, clientPort, authProvider, quorum.auth, requireClientAuthScheme, snapshot.trust.empty, standaloneEnabled, reconfigEnabled, 4lw.commands.whitelist, secureClientPort, ssl., serverCnxnFactory, sslQuorum (with the exception of: ssl.protocol, ssl.quorum.protocol, ssl.enabledProtocols, ssl.quorum.enabledProtocols, ssl.ciphersuites, ssl.quorum.ciphersuites, ssl.hostnameVerification, ssl.quorum.hostnameVerification).
map	
livenessProbe	Pod liveness checking.
Probe	
readinessProbe	Pod readiness checking.
Probe	
jvmOptions	JVM Options for pods.
JvmOptions	

Property	Description
jmxOptions **KafkaJmxOptions**	JMX Options for Zookeeper nodes.
resources ResourceRequirements	CPU and memory resources to reserve. For more information, see the external documentation for core/v1 resourcerequirements.
metricsConfig **JmxPrometheusExporterMetrics**	Metrics configuration. The type depends on the value of the **metricsConfig.type** property within the given object, which must be one of [jmxPrometheusExporter].
logging **InlineLogging**, **ExternalLogging**	Logging configuration for ZooKeeper. The type depends on the value of the **logging.type** property within the given object, which must be one of [inline, external].
template **ZookeeperClusterTemplate**	Template for ZooKeeper cluster resources. The template allows users to specify how the **StatefulSet**, **Pods**, and **Services** are generated.

6.2.43. ZookeeperClusterTemplate schema reference

Used in: **ZookeeperClusterSpec**

Property	Description
statefulset **StatefulSetTemplate**	Template for ZooKeeper **StatefulSet**.
pod **PodTemplate**	Template for ZooKeeper **Pods**.
clientService **InternalServiceTemplate**	Template for ZooKeeper client **Service**.
nodesService **InternalServiceTemplate**	Template for ZooKeeper nodes **Service**.

Property	Description
persistentVolumeClaim	Template for all ZooKeeper **PersistentVolumeClaims**.
ResourceTemplate	
podDisruptionBudget	Template for ZooKeeper **PodDisruptionBudget**.
PodDisruptionBudgetTemplate	
zookeeperContainer	Template for the ZooKeeper container.
ContainerTemplate	
serviceAccount	Template for the ZooKeeper service account.
ResourceTemplate	
jmxSecret	Template for Secret of the Zookeeper Cluster JMX authentication.
ResourceTemplate	
podSet	Template for ZooKeeper **StrimziPodSet** resource.
ResourceTemplate	

6.2.44. EntityOperatorSpec schema reference

Used in: **KafkaSpec**

Property	Description
topicOperator	Configuration of the Topic Operator.
EntityTopicOperatorSpec	
userOperator	Configuration of the User Operator.
EntityUserOperatorSpec	
tlsSidecar	TLS sidecar configuration.
TlsSidecar	

Property	Description
template **EntityOperatorTemplate**	Template for Entity Operator resources. The template allows users to specify how a **Deployment** and **Pod** is generated.

6.2.45. EntityTopicOperatorSpec schema reference

Used in: **EntityOperatorSpec**

Full list of **EntityTopicOperatorSpec** schema properties

Configures the Topic Operator.

6.2.45.1. logging

The Topic Operator has a configurable logger:

- **rootLogger.level**

The Topic Operator uses the Apache **log4j2** logger implementation.

Use the **logging** property in the **entityOperator.topicOperator** field of the Kafka resource **Kafka** resource to configure loggers and logger levels.

You can set the log levels by specifying the logger and level directly (inline) or use a custom (external) ConfigMap. If a ConfigMap is used, you set **logging.valueFrom.configMapKeyRef.name** property to the name of the ConfigMap containing the external logging configuration. Inside the ConfigMap, the logging configuration is described using **log4j2.properties**. Both **logging.valueFrom.configMapKeyRef.name** and **logging.valueFrom.configMapKeyRef.key** properties are mandatory. A ConfigMap using the exact logging configuration specified is created with the custom resource when the Cluster Operator is running, then recreated after each reconciliation. If you do not specify a custom ConfigMap, default logging settings are used. If a specific logger value is not set, upper-level logger settings are inherited for that logger. For more information about log levels, see Apache logging services.

Here we see examples of **inline** and **external** logging.

Inline logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
  zookeeper:
    # ...
  entityOperator:
    # ...
    topicOperator:
      watchedNamespace: my-topic-namespace
```

```
    reconciliationIntervalSeconds: 60
    logging:
      type: inline
      loggers:
        rootLogger.level: INFO
  # ...
```

External logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
  zookeeper:
    # ...
  entityOperator:
    # ...
    topicOperator:
      watchedNamespace: my-topic-namespace
      reconciliationIntervalSeconds: 60
      logging:
        type: external
        valueFrom:
          configMapKeyRef:
            name: customConfigMap
            key: topic-operator-log4j2.properties
  # ...
```

Garbage collector (GC)

Garbage collector logging can also be enabled (or disabled) using the **jvmOptions** property.

6.2.45.2. **EntityTopicOperatorSpec** schema properties

Property	Description
watchedNamespace	The namespace the Topic Operator should watch.
string	
image	The image to use for the Topic Operator.
string	
reconciliationIntervalSeconds	Interval between periodic reconciliations.
integer	

Property	Description
zookeeperSessionTimeoutSeconds integer	Timeout for the ZooKeeper session.
startupProbe **Probe**	Pod startup checking.
livenessProbe **Probe**	Pod liveness checking.
readinessProbe **Probe**	Pod readiness checking.
resources ResourceRequirements	CPU and memory resources to reserve. For more information, see the external documentation for core/v1 resourcerequirements.
topicMetadataMaxAttempts integer	The number of attempts at getting topic metadata.
logging **InlineLogging**, **ExternalLogging**	Logging configuration. The type depends on the value of the **logging.type** property within the given object, which must be one of [inline, external].
jvmOptions **JvmOptions**	JVM Options for pods.

6.2.46. EntityUserOperatorSpec schema reference

Used in: **EntityOperatorSpec**

Full list of **EntityUserOperatorSpec** schema properties

Configures the User Operator.

6.2.46.1. logging

The User Operator has a configurable logger:

- **rootLogger.level**

The User Operator uses the Apache **log4j2** logger implementation.

Use the **logging** property in the **entityOperator.userOperator** field of the **Kafka** resource to configure loggers and logger levels.

You can set the log levels by specifying the logger and level directly (inline) or use a custom (external) ConfigMap. If a ConfigMap is used, you set **logging.valueFrom.configMapKeyRef.name** property to the name of the ConfigMap containing the external logging configuration. Inside the ConfigMap, the logging configuration is described using **log4j2.properties**. Both **logging.valueFrom.configMapKeyRef.name** and **logging.valueFrom.configMapKeyRef.key** properties are mandatory. A ConfigMap using the exact logging configuration specified is created with the custom resource when the Cluster Operator is running, then recreated after each reconciliation. If you do not specify a custom ConfigMap, default logging settings are used. If a specific logger value is not set, upper-level logger settings are inherited for that logger. For more information about log levels, see Apache logging services.

Here we see examples of **inline** and **external** logging.

Inline logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
  zookeeper:
    # ...
  entityOperator:
    # ...
    userOperator:
      watchedNamespace: my-topic-namespace
      reconciliationIntervalSeconds: 60
      logging:
        type: inline
        loggers:
          rootLogger.level: INFO
  # ...
```

External logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  kafka:
    # ...
  zookeeper:
    # ...
  entityOperator:
    # ...
    userOperator:
      watchedNamespace: my-topic-namespace
```

```
    reconciliationIntervalSeconds: 60
    logging:
      type: external
      valueFrom:
        configMapKeyRef:
          name: customConfigMap
          key: user-operator-log4j2.properties
  # ...
```

Garbage collector (GC)

Garbage collector logging can also be enabled (or disabled) using the **jvmOptions** property.

6.2.46.2. **EntityUserOperatorSpec** schema properties

Property	Description
watchedNamespace	The namespace the User Operator should watch.
string	
image	The image to use for the User Operator.
string	
reconciliationIntervalSeconds	Interval between periodic reconciliations.
integer	
zookeeperSessionTimeoutSeconds	**The zookeeperSessionTimeoutSeconds property has been deprecated.** This property has been deprecated because ZooKeeper is not used anymore by the User Operator. Timeout for the ZooKeeper session.
integer	
secretPrefix	The prefix that will be added to the KafkaUser name to be used as the Secret name.
string	
livenessProbe	Pod liveness checking.
Probe	
readinessProbe	Pod readiness checking.
Probe	
resources	CPU and memory resources to reserve. For more information, see the external documentation for core/v1 resourcerequirements.

Property	Description
ResourceRequirements	
logging	Logging configuration. The type depends on the value of the **logging.type** property within the given object, which must be one of [inline, external].
InlineLogging, **ExternalLogging**	
jvmOptions	JVM Options for pods.
JvmOptions	

6.2.47. TlsSidecar schema reference

Used in: **CruiseControlSpec**, **EntityOperatorSpec**

Full list of **TlsSidecar** schema properties

Configures a TLS sidecar, which is a container that runs in a pod, but serves a supporting purpose. In AMQ Streams, the TLS sidecar uses TLS to encrypt and decrypt communication between components and ZooKeeper.

The TLS sidecar is used in the Entity Operator.

The TLS sidecar is configured using the **tlsSidecar** property in **Kafka.spec.entityOperator**.

The TLS sidecar supports the following additional options:

- **image**
- **resources**
- **logLevel**
- **readinessProbe**
- **livenessProbe**

The **resources** property specifies the memory and CPU resources allocated for the TLS sidecar.

The **image** property configures the container image which will be used.

The **readinessProbe** and **livenessProbe** properties configure healthcheck probes for the TLS sidecar.

The **logLevel** property specifies the logging level. The following logging levels are supported:

- emerg
- alert
- crit
- err

- warning
- notice
- info
- debug

The default value is *notice*.

Example TLS sidecar configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  # ...
  entityOperator:
    # ...
    tlsSidecar:
      resources:
        requests:
          cpu: 200m
          memory: 64Mi
        limits:
          cpu: 500m
          memory: 128Mi
    # ...
```

6.2.47.1. TlsSidecar schema properties

Property	Description
image	The docker image for the container.
string	
livenessProbe	Pod liveness checking.
Probe	
logLevel	The log level for the TLS sidecar. Default value is **notice**.
string (one of [emerg, debug, crit, err, alert, warning, notice, info])	
readinessProbe	Pod readiness checking.
Probe	

Property	Description
resources ResourceRequirements	CPU and memory resources to reserve. For more information, see the external documentation for core/v1 resourcerequirements.

6.2.48. EntityOperatorTemplate schema reference

Used in: **EntityOperatorSpec**

Property	Description
deployment **DeploymentTemplate**	Template for Entity Operator **Deployment**.
pod **PodTemplate**	Template for Entity Operator **Pods**.
topicOperatorContainer **ContainerTemplate**	Template for the Entity Topic Operator container.
userOperatorContainer **ContainerTemplate**	Template for the Entity User Operator container.
tlsSidecarContainer **ContainerTemplate**	Template for the Entity Operator TLS sidecar container.
serviceAccount **ResourceTemplate**	Template for the Entity Operator service account.
entityOperatorRole **ResourceTemplate**	Template for the Entity Operator Role.
topicOperatorRoleBinding **ResourceTemplate**	Template for the Entity Topic Operator RoleBinding.
userOperatorRoleBinding	Template for the Entity Topic Operator RoleBinding.

Property	Description
ResourceTemplate	

6.2.49. DeploymentTemplate schema reference

Used in: **CruiseControlTemplate**, **EntityOperatorTemplate**, **KafkaBridgeTemplate**, **KafkaConnectTemplate**, **KafkaExporterTemplate**, **KafkaMirrorMakerTemplate**

Full list of **DeploymentTemplate** schema properties

Use **deploymentStrategy** to specify the strategy used to replace old pods with new ones when deployment configuration changes.

Use one of the following values:

- **RollingUpdate**: Pods are restarted with zero downtime.
- **Recreate**: Pods are terminated before new ones are created.

Using the **Recreate** deployment strategy has the advantage of not requiring spare resources, but the disadvantage is the application downtime.

Example showing the deployment strategy set to Recreate.

```
# ...
template:
  deployment:
    deploymentStrategy: Recreate
# ...
```

This configuration change does not cause a rolling update.

6.2.49.1. DeploymentTemplate schema properties

Property	Description
metadata	Metadata applied to the resource.
MetadataTemplate	
deploymentStrategy	Pod replacement strategy for deployment configuration changes. Valid values are **RollingUpdate** and **Recreate**. Defaults to **RollingUpdate**.
string (one of [RollingUpdate, Recreate])	

6.2.50. CertificateAuthority schema reference

Used in: **KafkaSpec**

Configuration of how TLS certificates are used within the cluster. This applies to certificates used for both internal communication within the cluster and to certificates used for client access via **Kafka.spec.kafka.listeners.tls**.

Property	Description
generateCertificateAuthority boolean	If true then Certificate Authority certificates will be generated automatically. Otherwise the user will need to provide a Secret with the CA certificate. Default is true.
generateSecretOwnerReference boolean	If **true**, the Cluster and Client CA Secrets are configured with the **ownerReference** set to the **Kafka** resource. If the **Kafka** resource is deleted when **true**, the CA Secrets are also deleted. If **false**, the **ownerReference** is disabled. If the **Kafka** resource is deleted when **false**, the CA Secrets are retained and available for reuse. Default is **true**.
validityDays integer	The number of days generated certificates should be valid for. The default is 365.
renewalDays integer	The number of days in the certificate renewal period. This is the number of days before the a certificate expires during which renewal actions may be performed. When **generateCertificateAuthority** is true, this will cause the generation of a new certificate. When **generateCertificateAuthority** is true, this will cause extra logging at WARN level about the pending certificate expiry. Default is 30.
certificateExpirationPolicy string (one of [replace-key, renew-certificate])	How should CA certificate expiration be handled when **generateCertificateAuthority=true**. The default is for a new CA certificate to be generated reusing the existing private key.

6.2.51. CruiseControlSpec schema reference

Used in: **KafkaSpec**

Full list of **CruiseControlSpec** schema properties

Configures a Cruise Control cluster.

Configuration options relate to:

- Goals configuration
- Capacity limits for resource distribution goals

6.2.51.1. config

Use the **config** properties to configure Cruise Control options as keys.

Standard Cruise Control configuration may be provided, restricted to those properties not managed directly by AMQ Streams.

Configuration options that cannot be configured relate to the following:

- Security (Encryption, Authentication, and Authorization)
- Connection to the Kafka cluster
- Client ID configuration
- ZooKeeper connectivity
- Web server configuration
- Self healing

The values can be one of the following JSON types:

- String
- Number
- Boolean

You can specify and configure the options listed in the Cruise Control documentation with the exception of those options that are managed directly by AMQ Streams. See the description of the **config** property for a list of forbidden prefixes.

When a forbidden option is present in the **config** property, it is ignored and a warning message is printed to the Cluster Operator log file. All other supported options are passed to Cruise Control.

There are exceptions to the forbidden options. For client connection using a specific *cipher suite* for a TLS version, you can configure allowed **ssl** properties. You can also configure **webserver** properties to enable Cross-Origin Resource Sharing (CORS).

Example Cruise Control configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  # ...
  cruiseControl:
    # ...
    config:
      # Note that `default.goals` (superset) must also include all `hard.goals` (subset)
      default.goals: >
        com.linkedin.kafka.cruisecontrol.analyzer.goals.RackAwareGoal,
        com.linkedin.kafka.cruisecontrol.analyzer.goals.ReplicaCapacityGoal
      hard.goals: >
        com.linkedin.kafka.cruisecontrol.analyzer.goals.RackAwareGoal
      cpu.balance.threshold: 1.1
      metadata.max.age.ms: 300000
```

```
    send.buffer.bytes: 131072
    webserver.http.cors.enabled: true
    webserver.http.cors.origin: "*"
    webserver.http.cors.exposeheaders: "User-Task-ID,Content-Type"
  # ...
```

6.2.51.2. Cross-Origin Resource Sharing (CORS)

Cross-Origin Resource Sharing (CORS) is a HTTP mechanism for controlling access to REST APIs. Restrictions can be on access methods or originating URLs of client applications. You can enable CORS with Cruise Control using the **webserver.http.cors.enabled** property in the **config**. When enabled, CORS permits read access to the Cruise Control REST API from applications that have different originating URLs than AMQ Streams. This allows applications from specified origins to use **GET** requests to fetch information about the Kafka cluster through the Cruise Control API. For example, applications can fetch information on the current cluster load or the most recent optimization proposal. **POST** requests are not permitted.

NOTE

For more information on using CORS with Cruise Control, see REST APIs in the Cruise Control Wiki.

Enabling CORS for Cruise Control

You enable and configure CORS in **Kafka.spec.cruiseControl.config**.

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  # ...
  cruiseControl:
    # ...
    config:
      webserver.http.cors.enabled: true (1)
      webserver.http.cors.origin: "*" (2)
      webserver.http.cors.exposeheaders: "User-Task-ID,Content-Type" (3)

    # ...
```

1. Enables CORS.
2. Specifies permitted origins for the **Access-Control-Allow-Origin** HTTP response header. You can use a wildcard or specify a single origin as a URL. If you use a wildcard, a response is returned following requests from any origin.
3. Exposes specified header names for the **Access-Control-Expose-Headers** HTTP response header. Applications in permitted origins can read responses with the specified headers.

6.2.51.3. Cruise Control REST API security

The Cruise Control REST API is secured with HTTP Basic authentication and SSL to protect the cluster against potentially destructive Cruise Control operations, such as decommissioning Kafka brokers. We recommend that Cruise Control in AMQ Streams is **only used with these settings enabled**.

However, it is possible to disable these settings by specifying the following Cruise Control configuration:

- To disable the built-in HTTP Basic authentication, set **webserver.security.enable** to **false**.
- To disable the built-in SSL, set **webserver.ssl.enable** to **false**.

Cruise Control configuration to disable API authorization, authentication, and SSL

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  # ...
  cruiseControl:
    config:
      webserver.security.enable: false
      webserver.ssl.enable: false
# ...
```

6.2.51.4. brokerCapacity

Cruise Control uses capacity limits to determine if optimization goals for resource distribution are being broken. There are four goals of this type:

- **DiskUsageDistributionGoal** - Disk utilization distribution
- **CpuUsageDistributionGoal** - CPU utilization distribution
- **NetworkInboundUsageDistributionGoal** - Network inbound utilization distribution
- **NetworkOutboundUsageDistributionGoal** - Network outbound utilization distribution

You specify capacity limits for Kafka broker resources in the **brokerCapacity** property in **Kafka.spec.cruiseControl** . They are enabled by default and you can change their default values. Capacity limits can be set for the following broker resources:

- **cpu** - CPU resource in millicores or CPU cores (Default: 1)
- **inboundNetwork** - Inbound network throughput in byte units per second (Default: 10000KiB/s)
- **outboundNetwork** - Outbound network throughput in byte units per second (Default: 10000KiB/s)

For network throughput, use an integer value with standard OpenShift byte units (K, M, G) or their bibyte (power of two) equivalents (Ki, Mi, Gi) per second.

NOTE

Disk and CPU capacity limits are automatically generated by AMQ Streams, so you do not need to set them. In order to guarantee accurate rebalance proposals when using CPU goals, you can set CPU requests equal to CPU limits in **Kafka.spec.kafka.resources**. That way, all CPU resources are reserved upfront and are always available. This configuration allows Cruise Control to properly evaluate the CPU utilization when preparing the rebalance proposals based on CPU goals. In cases where you cannot set CPU requests equal to CPU limits in **Kafka.spec.kafka.resources**, you can set the CPU capacity manually for the same accuracy.

Example Cruise Control brokerCapacity configuration using bibyte units

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  # ...
  cruiseControl:
    # ...
    brokerCapacity:
      cpu: "2"
      inboundNetwork: 10000KiB/s
      outboundNetwork: 10000KiB/s
    # ...
```

6.2.51.5. Capacity overrides

Brokers might be running on nodes with heterogeneous network or CPU resources. If that's the case, specify **overrides** that set the network capacity and CPU limits for each broker. The overrides ensure an accurate rebalance between the brokers. Override capacity limits can be set for the following broker resources:

- **cpu** - CPU resource in millicores or CPU cores (Default: 1)
- **inboundNetwork** - Inbound network throughput in byte units per second (Default: 10000KiB/s)
- **outboundNetwork** - Outbound network throughput in byte units per second (Default: 10000KiB/s)

An example of Cruise Control capacity overrides configuration using bibyte units

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
metadata:
  name: my-cluster
spec:
  # ...
  cruiseControl:
    # ...
    brokerCapacity:
      cpu: "1"
      inboundNetwork: 10000KiB/s
      outboundNetwork: 10000KiB/s
```

```
    overrides:
    - brokers: [0]
      cpu: "2.755"
      inboundNetwork: 20000KiB/s
      outboundNetwork: 20000KiB/s
    - brokers: [1, 2]
      cpu: 3000m
      inboundNetwork: 30000KiB/s
      outboundNetwork: 30000KiB/s
```

For more information, refer to the BrokerCapacity schema reference.

6.2.51.6. Logging configuration

Cruise Control has its own configurable logger:

- **rootLogger.level**

Cruise Control uses the Apache **log4j2** logger implementation.

Use the **logging** property to configure loggers and logger levels.

You can set the log levels by specifying the logger and level directly (inline) or use a custom (external) ConfigMap. If a ConfigMap is used, you set **logging.valueFrom.configMapKeyRef.name** property to the name of the ConfigMap containing the external logging configuration. Inside the ConfigMap, the logging configuration is described using **log4j.properties**. Both **logging.valueFrom.configMapKeyRef.name** and **logging.valueFrom.configMapKeyRef.key** properties are mandatory. A ConfigMap using the exact logging configuration specified is created with the custom resource when the Cluster Operator is running, then recreated after each reconciliation. If you do not specify a custom ConfigMap, default logging settings are used. If a specific logger value is not set, upper-level logger settings are inherited for that logger. Here we see examples of **inline** and **external** logging.

Inline logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
# ...
spec:
  cruiseControl:
    # ...
    logging:
      type: inline
      loggers:
        rootLogger.level: "INFO"
    # ...
```

External logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: Kafka
# ...
spec:
  cruiseControl:
    # ...
```

```
logging:
  type: external
  valueFrom:
    configMapKeyRef:
      name: customConfigMap
      key: cruise-control-log4j.properties
# ...
```

Garbage collector (GC)

Garbage collector logging can also be enabled (or disabled) using the **jvmOptions** property.

6.2.51.7. CruiseControlSpec schema properties

Property	Description
image string	The docker image for the pods.
tlsSidecar **TlsSidecar**	**The tlsSidecar property has been deprecated.** TLS sidecar configuration.
resources ResourceRequirements	CPU and memory resources to reserve for the Cruise Control container. For more information, see the external documentation for core/v1 resourcerequirements.
livenessProbe **Probe**	Pod liveness checking for the Cruise Control container.
readinessProbe **Probe**	Pod readiness checking for the Cruise Control container.
jvmOptions **JvmOptions**	JVM Options for the Cruise Control container.
logging **InlineLogging**, **ExternalLogging**	Logging configuration (Log4j 2) for Cruise Control. The type depends on the value of the **logging.type** property within the given object, which must be one of [inline, external].
template **CruiseControlTemplate**	Template to specify how Cruise Control resources, **Deployments** and **Pods**, are generated.

Property	Description
brokerCapacity	The Cruise Control **brokerCapacity** configuration.
BrokerCapacity	
config	The Cruise Control configuration. For a full list of configuration options refer to https://github.com/linkedin/cruise-control/wiki/Configurations. Note that properties with the following prefixes cannot be set: bootstrap.servers, client.id, zookeeper., network., security., failed.brokers.zk.path,webserver.http., webserver.api.urlprefix, webserver.session.path, webserver.accesslog., two.step., request.reason.required,metric.reporter.sampler.bootstrap.servers, capacity.config.file, self.healing., ssl., kafka.broker.failure.detection.enable, topic.config.provider.class (with the exception of: ssl.cipher.suites, ssl.protocol, ssl.enabled.protocols, webserver.http.cors.enabled, webserver.http.cors.origin, webserver.http.cors.exposeheaders, webserver.security.enable, webserver.ssl.enable).
map	
metricsConfig	Metrics configuration. The type depends on the value of the **metricsConfig.type** property within the given object, which must be one of [jmxPrometheusExporter].
JmxPrometheusExporterMetrics	

6.2.52. CruiseControlTemplate schema reference

Used in: **CruiseControlSpec**

Property	Description
deployment	Template for Cruise Control **Deployment**.
DeploymentTemplate	
pod	Template for Cruise Control **Pods**.
PodTemplate	
apiService	Template for Cruise Control API **Service**.
InternalServiceTemplate	

Property	Description
podDisruptionBudget **PodDisruptionBudgetTemplate**	Template for Cruise Control **PodDisruptionBudget**.
cruiseControlContainer **ContainerTemplate**	Template for the Cruise Control container.
tlsSidecarContainer **ContainerTemplate**	**The tlsSidecarContainer property has been deprecated.** Template for the Cruise Control TLS sidecar container.
serviceAccount **ResourceTemplate**	Template for the Cruise Control service account.

6.2.53. BrokerCapacity schema reference

Used in: **CruiseControlSpec**

Property	Description
disk string	**The disk property has been deprecated.** The Cruise Control disk capacity setting has been deprecated, is ignored, and will be removed in the future Broker capacity for disk in bytes. Use a number value with either standard OpenShift byte units (K, M, G, or T), their bibyte (power of two) equivalents (Ki, Mi, Gi, or Ti), or a byte value with or without E notation. For example, 100000M, 100000Mi, 104857600000, or 1e+11.
cpuUtilization integer	**The cpuUtilization property has been deprecated.** The Cruise Control CPU capacity setting has been deprecated, is ignored, and will be removed in the future Broker capacity for CPU resource utilization as a percentage (0 - 100).
cpu string	Broker capacity for CPU resource in cores or millicores. For example, 1, 1.500, 1500m. For more information on valid CPU resource units see https://kubernetes.io/docs/concepts/configuration/manage-resources-containers/#meaning-of-cpu.

Property	Description
inboundNetwork string	Broker capacity for inbound network throughput in bytes per second. Use an integer value with standard OpenShift byte units (K, M, G) or their bibyte (power of two) equivalents (Ki, Mi, Gi) per second. For example, 10000KiB/s.
outboundNetwork string	Broker capacity for outbound network throughput in bytes per second. Use an integer value with standard OpenShift byte units (K, M, G) or their bibyte (power of two) equivalents (Ki, Mi, Gi) per second. For example, 10000KiB/s.
overrides **BrokerCapacityOverride** array	Overrides for individual brokers. The **overrides** property lets you specify a different capacity configuration for different brokers.

6.2.54. BrokerCapacityOverride schema reference

Used in: **BrokerCapacity**

Property	Description
brokers integer array	List of Kafka brokers (broker identifiers).
cpu string	Broker capacity for CPU resource in cores or millicores. For example, 1, 1.500, 1500m. For more information on valid CPU resource units see https://kubernetes.io/docs/concepts/configuration/manage-resources-containers/#meaning-of-cpu.
inboundNetwork string	Broker capacity for inbound network throughput in bytes per second. Use an integer value with standard OpenShift byte units (K, M, G) or their bibyte (power of two) equivalents (Ki, Mi, Gi) per second. For example, 10000KiB/s.
outboundNetwork string	Broker capacity for outbound network throughput in bytes per second. Use an integer value with standard OpenShift byte units (K, M, G) or their bibyte (power of two) equivalents (Ki, Mi, Gi) per second. For example, 10000KiB/s.

6.2.55. KafkaExporterSpec schema reference

Used in: **KafkaSpec**

Property	Description
image string	The docker image for the pods.
groupRegex string	Regular expression to specify which consumer groups to collect. Default value is **.***.
topicRegex string	Regular expression to specify which topics to collect. Default value is **.***.
resources ResourceRequirements	CPU and memory resources to reserve. For more information, see the external documentation for core/v1 resourcerequirements.
logging string	Only log messages with the given severity or above. Valid levels: [**info**, **debug**, **trace**]. Default log level is **info**.
enableSaramaLogging boolean	Enable Sarama logging, a Go client library used by the Kafka Exporter.
template **KafkaExporterTemplate**	Customization of deployment templates and pods.
livenessProbe **Probe**	Pod liveness check.
readinessProbe **Probe**	Pod readiness check.

6.2.56. KafkaExporterTemplate schema reference

Used in: **KafkaExporterSpec**

Property	Description
deployment	Template for Kafka Exporter **Deployment**.
DeploymentTemplate	
pod	Template for Kafka Exporter **Pods**.
PodTemplate	
service	**The service property has been deprecated.** The Kafka Exporter service has been removed. Template for Kafka Exporter **Service**.
ResourceTemplate	
container	Template for the Kafka Exporter container.
ContainerTemplate	
serviceAccount	Template for the Kafka Exporter service account.
ResourceTemplate	

6.2.57. KafkaStatus schema reference

Used in: **Kafka**

Property	Description
conditions	List of status conditions.
Condition array	
observedGeneration	The generation of the CRD that was last reconciled by the operator.
integer	
listeners	Addresses of the internal and external listeners.
ListenerStatus array	
clusterId	Kafka cluster Id.
string	

6.2.58. Condition schema reference

Used in: **KafkaBridgeStatus**, **KafkaConnectorStatus**, **KafkaConnectStatus**, **KafkaMirrorMaker2Status**, **KafkaMirrorMakerStatus**, **KafkaRebalanceStatus**, **KafkaStatus**, **KafkaTopicStatus**, **KafkaUserStatus**

Property	Description
type	The unique identifier of a condition, used to distinguish between other conditions in the resource.
string	
status	The status of the condition, either True, False or Unknown.
string	
lastTransitionTime	Last time the condition of a type changed from one status to another. The required format is 'yyyy-MM-ddTHH:mm:ssZ', in the UTC time zone.
string	
reason	The reason for the condition's last transition (a single word in CamelCase).
string	
message	Human-readable message indicating details about the condition's last transition.
string	

6.2.59. ListenerStatus schema reference

Used in: **KafkaStatus**

Property	Description
type	**The type property has been deprecated, and should now be configured using name.** The name of the listener.
string	
name	The name of the listener.
string	
addresses	A list of the addresses for this listener.
ListenerAddress array	
bootstrapServers	A comma-separated list of **host:port** pairs for connecting to the Kafka cluster using this listener.
string	

Property	Description
certificates string array	A list of TLS certificates which can be used to verify the identity of the server when connecting to the given listener. Set only for **tls** and **external** listeners.

6.2.60. ListenerAddress schema reference

Used in: **ListenerStatus**

Property	Description
host string	The DNS name or IP address of the Kafka bootstrap service.
port integer	The port of the Kafka bootstrap service.

6.2.61. KafkaConnect schema reference

Property	Description
spec **KafkaConnectSpec**	The specification of the Kafka Connect cluster.
status **KafkaConnectStatus**	The status of the Kafka Connect cluster.

6.2.62. KafkaConnectSpec schema reference

Used in: **KafkaConnect**

Full list of **KafkaConnectSpec** schema properties

Configures a Kafka Connect cluster.

6.2.62.1. config

Use the **config** properties to configure Kafka options as keys.

Standard Apache Kafka Connect configuration may be provided, restricted to those properties not managed directly by AMQ Streams.

Configuration options that cannot be configured relate to:

- Kafka cluster bootstrap address
- Security (Encryption, Authentication, and Authorization)
- Listener / REST interface configuration
- Plugin path configuration

The values can be one of the following JSON types:

- String
- Number
- Boolean

You can specify and configure the options listed in the Apache Kafka documentation with the exception of those options that are managed directly by AMQ Streams. Specifically, configuration options with keys equal to or starting with one of the following strings are forbidden:

- **ssl.**
- **sasl.**
- **security.**
- **listeners**
- **plugin.path**
- **rest.**
- **bootstrap.servers**

When a forbidden option is present in the **config** property, it is ignored and a warning message is printed to the Cluster Operator log file. All other options are passed to Kafka Connect.

IMPORTANT

The Cluster Operator does not validate keys or values in the **config** object provided. When an invalid configuration is provided, the Kafka Connect cluster might not start or might become unstable. In this circumstance, fix the configuration in the **KafkaConnect.spec.config** object, then the Cluster Operator can roll out the new configuration to all Kafka Connect nodes.

Certain options have default values:

- **group.id** with default value **connect-cluster**
- **offset.storage.topic** with default value **connect-cluster-offsets**
- **config.storage.topic** with default value **connect-cluster-configs**
- **status.storage.topic** with default value **connect-cluster-status**

- **key.converter** with default value **org.apache.kafka.connect.json.JsonConverter**
- **value.converter** with default value **org.apache.kafka.connect.json.JsonConverter**

These options are automatically configured in case they are not present in the **KafkaConnect.spec.config** properties.

There are exceptions to the forbidden options. You can use three allowed **ssl** configuration options for client connection using a specific *cipher suite* for a TLS version. A cipher suite combines algorithms for secure connection and data transfer. You can also configure the **ssl.endpoint.identification.algorithm** property to enable or disable hostname verification.

Example Kafka Connect configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect
spec:
  # ...
  config:
    group.id: my-connect-cluster
    offset.storage.topic: my-connect-cluster-offsets
    config.storage.topic: my-connect-cluster-configs
    status.storage.topic: my-connect-cluster-status
    key.converter: org.apache.kafka.connect.json.JsonConverter
    value.converter: org.apache.kafka.connect.json.JsonConverter
    key.converter.schemas.enable: true
    value.converter.schemas.enable: true
    config.storage.replication.factor: 3
    offset.storage.replication.factor: 3
    status.storage.replication.factor: 3
    ssl.cipher.suites: TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
    ssl.enabled.protocols: TLSv1.2
    ssl.protocol: TLSv1.2
    ssl.endpoint.identification.algorithm: HTTPS
  # ...
```

For client connection using a specific *cipher suite* for a TLS version, you can configure allowed **ssl** properties. You can also configure the **ssl.endpoint.identification.algorithm** property to enable or disable hostname verification.

6.2.62.2. logging

Kafka Connect has its own configurable loggers:

- **connect.root.logger.level**
- **log4j.logger.org.reflections**

Further loggers are added depending on the Kafka Connect plugins running.

Use a curl request to get a complete list of Kafka Connect loggers running from any Kafka broker pod:

```
curl -s http://<connect-cluster-name>-connect-api:8083/admin/loggers/
```

Kafka Connect uses the Apache **log4j** logger implementation.

Use the **logging** property to configure loggers and logger levels.

You can set the log levels by specifying the logger and level directly (inline) or use a custom (external) ConfigMap. If a ConfigMap is used, you set **logging.valueFrom.configMapKeyRef.name** property to the name of the ConfigMap containing the external logging configuration. Inside the ConfigMap, the logging configuration is described using **log4j.properties**. Both **logging.valueFrom.configMapKeyRef.name** and **logging.valueFrom.configMapKeyRef.key** properties are mandatory. A ConfigMap using the exact logging configuration specified is created with the custom resource when the Cluster Operator is running, then recreated after each reconciliation. If you do not specify a custom ConfigMap, default logging settings are used. If a specific logger value is not set, upper-level logger settings are inherited for that logger. For more information about log levels, see Apache logging services.

Here we see examples of **inline** and **external** logging.

Inline logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
spec:
  # ...
  logging:
    type: inline
    loggers:
      connect.root.logger.level: "INFO"
  # ...
```

External logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
spec:
  # ...
  logging:
    type: external
    valueFrom:
      configMapKeyRef:
        name: customConfigMap
        key: connect-logging.log4j
  # ...
```

Any available loggers that are not configured have their level set to **OFF**.

If Kafka Connect was deployed using the Cluster Operator, changes to Kafka Connect logging levels are applied dynamically.

If you use external logging, a rolling update is triggered when logging appenders are changed.

Garbage collector (GC)

Garbage collector logging can also be enabled (or disabled) using the **jvmOptions** property.

6.2.62.3. KafkaConnectSpec schema properties

Property	Description
version string	The Kafka Connect version. Defaults to 3.4.0. Consult the user documentation to understand the process required to upgrade or downgrade the version.
replicas integer	The number of pods in the Kafka Connect group.
image string	The docker image for the pods.
bootstrapServers string	Bootstrap servers to connect to. This should be given as a comma separated list of *<hostname>*:_<port>_ pairs.
tls **ClientTls**	TLS configuration.
authentication **KafkaClientAuthenticationTls**, **KafkaClientAuthenticationScramSha256**, **KafkaClientAuthenticationScramSha512**, **KafkaClientAuthenticationPlain**, **KafkaClientAuthenticationOAuth**	Authentication configuration for Kafka Connect. The type depends on the value of the **authentication.type** property within the given object, which must be one of [tls, scram-sha-256, scram-sha-512, plain, oauth].
config map	The Kafka Connect configuration. Properties with the following prefixes cannot be set: ssl., sasl., security., listeners, plugin.path, rest., bootstrap.servers, consumer.interceptor.classes, producer.interceptor.classes (with the exception of: ssl.endpoint.identification.algorithm, ssl.cipher.suites, ssl.protocol, ssl.enabled.protocols).
resources ResourceRequirements	The maximum limits for CPU and memory resources and the requested initial resources. For more information, see the external documentation for core/v1 resourcerequirements.
livenessProbe **Probe**	Pod liveness checking.
readinessProbe	Pod readiness checking.

Property	Description
Probe	
jvmOptions	JVM Options for pods.
JvmOptions	
jmxOptions	JMX Options.
KafkaJmxOptions	
logging	Logging configuration for Kafka Connect. The type depends on the value of the **logging.type** property within the given object, which must be one of [inline, external].
InlineLogging, **ExternalLogging**	
clientRackInitImage	The image of the init container used for initializing the **client.rack**.
string	
rack	Configuration of the node label which will be used as the **client.rack** consumer configuration.
Rack	
tracing	The configuration of tracing in Kafka Connect. The type depends on the value of the **tracing.type** property within the given object, which must be one of [jaeger, opentelemetry].
JaegerTracing, **OpenTelemetryTracing**	
template	Template for Kafka Connect and Kafka Mirror Maker 2 resources. The template allows users to specify how the **Deployment**, **Pods** and **Service** are generated.
KafkaConnectTemplate	
externalConfiguration	Pass data from Secrets or ConfigMaps to the Kafka Connect pods and use them to configure connectors.
ExternalConfiguration	
build	Configures how the Connect container image should be built. Optional.
Build	
metricsConfig	Metrics configuration. The type depends on the value of the **metricsConfig.type** property within the given object, which must be one of [jmxPrometheusExporter].
JmxPrometheusExporterMetrics	

6.2.63. ClientTls schema reference

Used in: **KafkaBridgeSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2ClusterSpec**, **KafkaMirrorMakerConsumerSpec**, **KafkaMirrorMakerProducerSpec**

Full list of **ClientTls** schema properties

Configures TLS trusted certificates for connecting KafkaConnect, KafkaBridge, KafkaMirror, KafkaMirrorMaker2 to the cluster.

6.2.63.1. trustedCertificates

Provide a list of secrets using the **trustedCertificates** property.

6.2.63.2. ClientTls schema properties

Property	Description
trustedCertificates	Trusted certificates for TLS connection.
CertSecretSource array	

6.2.64. KafkaClientAuthenticationTls schema reference

Used in: **KafkaBridgeSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2ClusterSpec**, **KafkaMirrorMakerConsumerSpec**, **KafkaMirrorMakerProducerSpec**

Full list of **KafkaClientAuthenticationTls** schema properties

To configure mTLS authentication, set the **type** property to the value **tls**. mTLS uses a TLS certificate to authenticate.

6.2.64.1. certificateAndKey

The certificate is specified in the **certificateAndKey** property and is always loaded from an OpenShift secret. In the secret, the certificate must be stored in X509 format under two different keys: public and private.

You can use the secrets created by the User Operator, or you can create your own TLS certificate file, with the keys used for authentication, then create a **Secret** from the file:

```
oc create secret generic MY-SECRET \
--from-file=MY-PUBLIC-TLS-CERTIFICATE-FILE.crt \
--from-file=MY-PRIVATE.key
```

NOTE

mTLS authentication can only be used with TLS connections.

Example mTLS configuration

```
authentication:
  type: tls
  certificateAndKey:
    secretName: my-secret
    certificate: my-public-tls-certificate-file.crt
    key: private.key
```

6.2.64.2. KafkaClientAuthenticationTls schema properties

The **type** property is a discriminator that distinguishes use of the **KafkaClientAuthenticationTls** type from **KafkaClientAuthenticationScramSha256**, **KafkaClientAuthenticationScramSha512**, **KafkaClientAuthenticationPlain**, **KafkaClientAuthenticationOAuth**. It must have the value **tls** for the type **KafkaClientAuthenticationTls**.

Property	Description
certificateAndKey **CertAndKeySecretSource**	Reference to the **Secret** which holds the certificate and private key pair.
type string	Must be **tls**.

6.2.65. KafkaClientAuthenticationScramSha256 schema reference

Used in: **KafkaBridgeSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2ClusterSpec**, **KafkaMirrorMakerConsumerSpec**, **KafkaMirrorMakerProducerSpec**

Full list of **KafkaClientAuthenticationScramSha256** schema properties

To configure SASL-based SCRAM-SHA-256 authentication, set the **type** property to **scram-sha-256**. The SCRAM-SHA-256 authentication mechanism requires a username and password.

6.2.65.1. username

Specify the username in the **username** property.

6.2.65.2. passwordSecret

In the **passwordSecret** property, specify a link to a **Secret** containing the password.

You can use the secrets created by the User Operator.

If required, you can create a text file that contains the password, in cleartext, to use for authentication:

```
echo -n PASSWORD > MY-PASSWORD.txt
```

You can then create a **Secret** from the text file, setting your own field name (key) for the password:

```
oc create secret generic MY-CONNECT-SECRET-NAME --from-file=MY-PASSWORD-FIELD-NAME=./MY-PASSWORD.txt
```

Example Secret for SCRAM-SHA-256 client authentication for Kafka Connect

```
apiVersion: v1
kind: Secret
metadata:
  name: my-connect-secret-name
type: Opaque
data:
  my-connect-password-field: LFTIyFRFlMmU2N2Tm
```

The **secretName** property contains the name of the **Secret**, and the **password** property contains the name of the key under which the password is stored inside the **Secret**.

IMPORTANT

Do not specify the actual password in the **password** property.

Example SASL-based SCRAM-SHA-256 client authentication configuration for Kafka Connect

```
authentication:
  type: scram-sha-256
  username: my-connect-username
  passwordSecret:
    secretName: my-connect-secret-name
    password: my-connect-password-field
```

6.2.65.3. KafkaClientAuthenticationScramSha256 schema properties

Property	Description
passwordSecret	Reference to the **Secret** which holds the password.
PasswordSecretSource	
type	Must be **scram-sha-256**.
string	
username	Username used for the authentication.
string	

6.2.66. PasswordSecretSource schema reference

Used in: **KafkaClientAuthenticationOAuth**, **KafkaClientAuthenticationPlain**, **KafkaClientAuthenticationScramSha256**, **KafkaClientAuthenticationScramSha512**

Property	Description
password	The name of the key in the Secret under which the password is stored.
string	
secretName	The name of the Secret containing the password.
string	

6.2.67. KafkaClientAuthenticationScramSha512 schema reference

Used in: **KafkaBridgeSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2ClusterSpec**, **KafkaMirrorMakerConsumerSpec**, **KafkaMirrorMakerProducerSpec**

Full list of **KafkaClientAuthenticationScramSha512** schema properties

To configure SASL-based SCRAM-SHA-512 authentication, set the **type** property to **scram-sha-512**. The SCRAM-SHA-512 authentication mechanism requires a username and password.

6.2.67.1. username

Specify the username in the **username** property.

6.2.67.2. passwordSecret

In the **passwordSecret** property, specify a link to a **Secret** containing the password.

You can use the secrets created by the User Operator.

If required, you can create a text file that contains the password, in cleartext, to use for authentication:

```
echo -n PASSWORD > MY-PASSWORD.txt
```

You can then create a **Secret** from the text file, setting your own field name (key) for the password:

```
oc create secret generic MY-CONNECT-SECRET-NAME --from-file=MY-PASSWORD-FIELD-NAME=./MY-PASSWORD.txt
```

Example Secret for SCRAM-SHA-512 client authentication for Kafka Connect

```
apiVersion: v1
kind: Secret
metadata:
  name: my-connect-secret-name
type: Opaque
data:
  my-connect-password-field: LFTIyFRFlMmU2N2Tm
```

The **secretName** property contains the name of the **Secret**, and the **password** property contains the name of the key under which the password is stored inside the **Secret**.

IMPORTANT

Do not specify the actual password in the **password** property.

Example SASL-based SCRAM-SHA-512 client authentication configuration for Kafka Connect

```
authentication:
  type: scram-sha-512
  username: my-connect-username
  passwordSecret:
    secretName: my-connect-secret-name
    password: my-connect-password-field
```

6.2.67.3. KafkaClientAuthenticationScramSha512 schema properties

Property	Description
passwordSecret **PasswordSecretSource**	Reference to the **Secret** which holds the password.
type string	Must be **scram-sha-512**.
username string	Username used for the authentication.

6.2.68. KafkaClientAuthenticationPlain schema reference

Used in: **KafkaBridgeSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2ClusterSpec**, **KafkaMirrorMakerConsumerSpec**, **KafkaMirrorMakerProducerSpec**

Full list of **KafkaClientAuthenticationPlain** schema properties

To configure SASL-based PLAIN authentication, set the **type** property to **plain**. SASL PLAIN authentication mechanism requires a username and password.

WARNING

The SASL PLAIN mechanism will transfer the username and password across the network in cleartext. Only use SASL PLAIN authentication if TLS encryption is enabled.

6.2.68.1. username

Specify the username in the **username** property.

6.2.68.2. passwordSecret

In the **passwordSecret** property, specify a link to a **Secret** containing the password.

You can use the secrets created by the User Operator.

If required, create a text file that contains the password, in cleartext, to use for authentication:

```
echo -n PASSWORD > MY-PASSWORD.txt
```

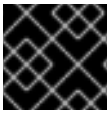
You can then create a **Secret** from the text file, setting your own field name (key) for the password:

```
oc create secret generic MY-CONNECT-SECRET-NAME --from-file=MY-PASSWORD-FIELD-NAME=./MY-PASSWORD.txt
```

Example Secret for PLAIN client authentication for Kafka Connect

```
apiVersion: v1
kind: Secret
metadata:
  name: my-connect-secret-name
type: Opaque
data:
  my-password-field-name: LFTIyFRFlMmU2N2Tm
```

The **secretName** property contains the name of the **Secret** and the **password** property contains the name of the key under which the password is stored inside the **Secret**.



IMPORTANT

Do not specify the actual password in the **password** property.

An example SASL based PLAIN client authentication configuration

```
authentication:
  type: plain
  username: my-connect-username
```

```
passwordSecret:
  secretName: my-connect-secret-name
  password: my-password-field-name
```

6.2.68.3. KafkaClientAuthenticationPlain schema properties

The **type** property is a discriminator that distinguishes use of the **KafkaClientAuthenticationPlain** type from **KafkaClientAuthenticationTls**, **KafkaClientAuthenticationScramSha256**, **KafkaClientAuthenticationScramSha512**, **KafkaClientAuthenticationOAuth**. It must have the value **plain** for the type **KafkaClientAuthenticationPlain**.

Property	Description
passwordSecret	Reference to the **Secret** which holds the password.
PasswordSecretSource	
type	Must be **plain**.
string	
username	Username used for the authentication.
string	

6.2.69. KafkaClientAuthenticationOAuth schema reference

Used in: **KafkaBridgeSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2ClusterSpec**, **KafkaMirrorMakerConsumerSpec**, **KafkaMirrorMakerProducerSpec**

Full list of **KafkaClientAuthenticationOAuth** schema properties

To configure OAuth client authentication, set the **type** property to **oauth**.

OAuth authentication can be configured using one of the following options:

- Client ID and secret
- Client ID and refresh token
- Access token
- Username and password
- TLS

Client ID and secret

You can configure the address of your authorization server in the **tokenEndpointUri** property together with the client ID and client secret used in authentication. The OAuth client will connect to the OAuth server, authenticate using the client ID and secret and get an access token which it will use to

authenticate with the Kafka broker. In the **clientSecret** property, specify a link to a **Secret** containing the client secret.

An example of OAuth client authentication using client ID and client secret

```
authentication:
  type: oauth
  tokenEndpointUri: https://sso.myproject.svc:8443/auth/realms/internal/protocol/openid-connect/token
  clientId: my-client-id
  clientSecret:
    secretName: my-client-oauth-secret
    key: client-secret
```

Optionally, **scope** and **audience** can be specified if needed.

Client ID and refresh token

You can configure the address of your OAuth server in the **tokenEndpointUri** property together with the OAuth client ID and refresh token. The OAuth client will connect to the OAuth server, authenticate using the client ID and refresh token and get an access token which it will use to authenticate with the Kafka broker. In the **refreshToken** property, specify a link to a **Secret** containing the refresh token.

An example of OAuth client authentication using client ID and refresh token

```
authentication:
  type: oauth
  tokenEndpointUri: https://sso.myproject.svc:8443/auth/realms/internal/protocol/openid-connect/token
  clientId: my-client-id
  refreshToken:
    secretName: my-refresh-token-secret
    key: refresh-token
```

Access token

You can configure the access token used for authentication with the Kafka broker directly. In this case, you do not specify the **tokenEndpointUri**. In the **accessToken** property, specify a link to a **Secret** containing the access token.

An example of OAuth client authentication using only an access token

```
authentication:
  type: oauth
  accessToken:
    secretName: my-access-token-secret
    key: access-token
```

Username and password

OAuth username and password configuration uses the OAuth *Resource Owner Password Grant* mechanism. The mechanism is deprecated, and is only supported to enable integration in environments where client credentials (ID and secret) cannot be used. You might need to use user accounts if your access management system does not support another approach or user accounts are required for authentication.

A typical approach is to create a special user account in your authorization server that represents your client application. You then give the account a long randomly generated password and a very limited set

of permissions. For example, the account can only connect to your Kafka cluster, but is not allowed to use any other services or login to the user interface.

Consider using a refresh token mechanism first.

You can configure the address of your authorization server in the **tokenEndpointUri** property together with the client ID, username and the password used in authentication. The OAuth client will connect to the OAuth server, authenticate using the username, the password, the client ID, and optionally even the client secret to obtain an access token which it will use to authenticate with the Kafka broker.

In the **passwordSecret** property, specify a link to a **Secret** containing the password.

Normally, you also have to configure a **clientId** using a public OAuth client. If you are using a confidential OAuth client, you also have to configure a **clientSecret**.

An example of OAuth client authentication using username and a password with a public client

```
authentication:
  type: oauth
  tokenEndpointUri: https://sso.myproject.svc:8443/auth/realms/internal/protocol/openid-connect/token
  username: my-username
  passwordSecret:
    secretName: my-password-secret-name
    password: my-password-field-name
  clientId: my-public-client-id
```

An example of OAuth client authentication using a username and a password with a confidential client

```
authentication:
  type: oauth
  tokenEndpointUri: https://sso.myproject.svc:8443/auth/realms/internal/protocol/openid-connect/token
  username: my-username
  passwordSecret:
    secretName: my-password-secret-name
    password: my-password-field-name
  clientId: my-confidential-client-id
  clientSecret:
    secretName: my-confidential-client-oauth-secret
    key: client-secret
```

Optionally, **scope** and **audience** can be specified if needed.

TLS

Accessing the OAuth server using the HTTPS protocol does not require any additional configuration as long as the TLS certificates used by it are signed by a trusted certification authority and its hostname is listed in the certificate.

If your OAuth server is using certificates which are self-signed or are signed by a certification authority which is not trusted, you can configure a list of trusted certificates in the custom resource. The **tlsTrustedCertificates** property contains a list of secrets with key names under which the certificates are stored. The certificates must be stored in X509 format.

An example of TLS certificates provided

```
authentication:
  type: oauth
  tokenEndpointUri: https://sso.myproject.svc:8443/auth/realms/internal/protocol/openid-connect/token
  clientId: my-client-id
  refreshToken:
    secretName: my-refresh-token-secret
    key: refresh-token
  tlsTrustedCertificates:
    - secretName: oauth-server-ca
      certificate: tls.crt
```

The OAuth client will by default verify that the hostname of your OAuth server matches either the certificate subject or one of the alternative DNS names. If it is not required, you can disable the hostname verification.

An example of disabled TLS hostname verification

```
authentication:
  type: oauth
  tokenEndpointUri: https://sso.myproject.svc:8443/auth/realms/internal/protocol/openid-connect/token
  clientId: my-client-id
  refreshToken:
    secretName: my-refresh-token-secret
    key: refresh-token
  disableTlsHostnameVerification: true
```

6.2.69.1. KafkaClientAuthenticationOAuth schema properties

The **type** property is a discriminator that distinguishes use of the **KafkaClientAuthenticationOAuth** type from **KafkaClientAuthenticationTls**, **KafkaClientAuthenticationScramSha256**, **KafkaClientAuthenticationScramSha512**, **KafkaClientAuthenticationPlain**. It must have the value **oauth** for the type **KafkaClientAuthenticationOAuth**.

Property	Description
accessToken **GenericSecretSource**	Link to OpenShift Secret containing the access token which was obtained from the authorization server.
accessTokenIsJwt boolean	Configure whether access token should be treated as JWT. This should be set to **false** if the authorization server returns opaque tokens. Defaults to **true**.
audience string	OAuth audience to use when authenticating against the authorization server. Some authorization servers require the audience to be explicitly set. The possible values depend on how the authorization server is configured. By default, **audience** is not specified when performing the token endpoint request.
clientId	

Property	Description
string	OAuth Client ID which the Kafka client can use to authenticate against the OAuth server and use the token endpoint URI.
clientSecret **GenericSecretSource**	Link to OpenShift Secret containing the OAuth client secret which the Kafka client can use to authenticate against the OAuth server and use the token endpoint URI.
connectTimeoutSeconds integer	The connect timeout in seconds when connecting to authorization server. If not set, the effective connect timeout is 60 seconds.
disableTlsHostnameVerification boolean	Enable or disable TLS hostname verification. Default value is **false**.
enableMetrics boolean	Enable or disable OAuth metrics. Default value is **false**.
httpRetries integer	The maximum number of retries to attempt if an initial HTTP request fails. If not set, the default is to not attempt any retries.
httpRetryPauseMs integer	The pause to take before retrying a failed HTTP request. If not set, the default is to not pause at all but to immediately repeat a request.
maxTokenExpirySeconds integer	Set or limit time-to-live of the access tokens to the specified number of seconds. This should be set if the authorization server returns opaque tokens.
passwordSecret **PasswordSecretSource**	Reference to the **Secret** which holds the password.
readTimeoutSeconds integer	The read timeout in seconds when connecting to authorization server. If not set, the effective read timeout is 60 seconds.
refreshToken **GenericSecretSource**	Link to OpenShift Secret containing the refresh token which can be used to obtain access token from the authorization server.

Property	Description
scope string	OAuth scope to use when authenticating against the authorization server. Some authorization servers require this to be set. The possible values depend on how authorization server is configured. By default **scope** is not specified when doing the token endpoint request.
tlsTrustedCertificates **CertSecretSource** array	Trusted certificates for TLS connection to the OAuth server.
tokenEndpointUri string	Authorization server token endpoint URI.
type string	Must be **oauth**.
username string	Username used for the authentication.

6.2.70. JaegerTracing schema reference

The type JaegerTracing has been deprecated.

Used in: **KafkaBridgeSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2Spec**, **KafkaMirrorMakerSpec**

The **type** property is a discriminator that distinguishes use of the **JaegerTracing** type from **OpenTelemetryTracing**. It must have the value **jaeger** for the type **JaegerTracing**.

Property	Description
type string	Must be **jaeger**.

6.2.71. OpenTelemetryTracing schema reference

Used in: **KafkaBridgeSpec**, **KafkaConnectSpec**, **KafkaMirrorMaker2Spec**, **KafkaMirrorMakerSpec**

The **type** property is a discriminator that distinguishes use of the **OpenTelemetryTracing** type from **JaegerTracing**. It must have the value **opentelemetry** for the type **OpenTelemetryTracing**.

Property	Description
type	Must be **opentelemetry**.
string	

6.2.72. KafkaConnectTemplate schema reference

Used in: **KafkaConnectSpec**, **KafkaMirrorMaker2Spec**

Property	Description
deployment	Template for Kafka Connect **Deployment**.
DeploymentTemplate	
podSet	Template for Kafka Connect **StrimziPodSet** resource.
ResourceTemplate	
pod	Template for Kafka Connect **Pods**.
PodTemplate	
apiService	Template for Kafka Connect API **Service**.
InternalServiceTemplate	
headlessService	Template for Kafka Connect headless **Service**.
InternalServiceTemplate	
connectContainer	Template for the Kafka Connect container.
ContainerTemplate	
initContainer	Template for the Kafka init container.
ContainerTemplate	
podDisruptionBudget	Template for Kafka Connect **PodDisruptionBudget**.
PodDisruptionBudgetTemplate	
serviceAccount	Template for the Kafka Connect service account.

Property	Description
ResourceTemplate	
clusterRoleBinding	Template for the Kafka Connect ClusterRoleBinding.
ResourceTemplate	
buildPod	Template for Kafka Connect Build **Pods**. The build pod is used only on OpenShift.
PodTemplate	
buildContainer	Template for the Kafka Connect Build container. The build container is used only on OpenShift.
ContainerTemplate	
buildConfig	Template for the Kafka Connect BuildConfig used to build new container images. The BuildConfig is used only on OpenShift.
BuildConfigTemplate	
buildServiceAccount	Template for the Kafka Connect Build service account.
ResourceTemplate	
jmxSecret	Template for Secret of the Kafka Connect Cluster JMX authentication.
ResourceTemplate	

6.2.73. BuildConfigTemplate schema reference

Used in: **KafkaConnectTemplate**

Property	Description
metadata	Metadata to apply to the **PodDisruptionBudgetTemplate** resource.
MetadataTemplate	
pullSecret	Container Registry Secret with the credentials for pulling the base image.
string	

6.2.74. ExternalConfiguration schema reference

Used in: **KafkaConnectSpec**, **KafkaMirrorMaker2Spec**

Full list of **ExternalConfiguration** schema properties

Configures external storage properties that define configuration options for Kafka Connect connectors.

You can mount ConfigMaps or Secrets into a Kafka Connect pod as environment variables or volumes. Volumes and environment variables are configured in the **externalConfiguration** property in **KafkaConnect.spec**.

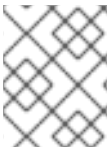
When applied, the environment variables and volumes are available for use when developing your connectors.

6.2.74.1. env

Use the **env** property to specify one or more environment variables. These variables can contain a value from either a ConfigMap or a Secret.

Example Secret containing values for environment variables

```
apiVersion: v1
kind: Secret
metadata:
  name: aws-creds
type: Opaque
data:
  awsAccessKey: QUtJQVhYWFhYWFhYWFhYWFg=
  awsSecretAccessKey: Ylhsd1lYTnpkMjl5WkE=
```



NOTE

The names of user-defined environment variables cannot start with **KAFKA_** or **STRIMZI_**.

To mount a value from a Secret to an environment variable, use the **valueFrom** property and the **secretKeyRef**.

Example environment variables set to values from a Secret

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect
spec:
  # ...
  externalConfiguration:
    env:
      - name: AWS_ACCESS_KEY_ID
        valueFrom:
          secretKeyRef:
            name: aws-creds
            key: awsAccessKey
      - name: AWS_SECRET_ACCESS_KEY
        valueFrom:
```

```
      secretKeyRef:
        name: aws-creds
        key: awsSecretAccessKey
```

A common use case for mounting Secrets is for a connector to communicate with Amazon AWS. The connector needs to be able to read the **AWS_ACCESS_KEY_ID** and **AWS_SECRET_ACCESS_KEY**.

To mount a value from a ConfigMap to an environment variable, use **configMapKeyRef** in the **valueFrom** property as shown in the following example.

Example environment variables set to values from a ConfigMap

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect
spec:
  # ...
  externalConfiguration:
    env:
      - name: MY_ENVIRONMENT_VARIABLE
        valueFrom:
          configMapKeyRef:
            name: my-config-map
            key: my-key
```

6.2.74.2. volumes

Use volumes to mount ConfigMaps or Secrets to a Kafka Connect pod.

Using volumes instead of environment variables is useful in the following scenarios:

- Mounting a properties file that is used to configure Kafka Connect connectors
- Mounting truststores or keystores with TLS certificates

Volumes are mounted inside the Kafka Connect containers on the path **/opt/kafka/external-configuration/*<volume-name>***. For example, the files from a volume named **connector-config** will appear in the directory **/opt/kafka/external-configuration/connector-config**.

Configuration *providers* load values from outside the configuration. Use a provider mechanism to avoid passing restricted information over the Kafka Connect REST interface.

- **FileConfigProvider** loads configuration values from properties in a file.
- **DirectoryConfigProvider** loads configuration values from separate files within a directory structure.

Use a comma-separated list if you want to add more than one provider, including custom providers. You can use custom providers to load values from other file locations.

Using FileConfigProvider to load property values

In this example, a Secret named **mysecret** contains connector properties that specify a database name and password:

Example Secret with database properties

```
apiVersion: v1
kind: Secret
metadata:
  name: mysecret
type: Opaque
stringData:
  connector.properties: |- 1
    dbUsername: my-username 2
    dbPassword: my-password
```

1. The connector configuration in properties file format.
2. Database username and password properties used in the configuration.

The Secret and the **FileConfigProvider** configuration provider are specified in the Kafka Connect configuration.

- The Secret is mounted to a volume named **connector-config**.
- **FileConfigProvider** is given the alias **file**.

Example external volumes set to values from a Secret

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect
spec:
  # ...
  config:
    config.providers: file 1
    config.providers.file.class: org.apache.kafka.common.config.provider.FileConfigProvider 2
  #...
  externalConfiguration:
    volumes:
      - name: connector-config 3
        secret:
          secretName: mysecret 4
```

1. The alias for the configuration provider is used to define other configuration parameters.
2. **FileConfigProvider** provides values from properties files. The parameter uses the alias from **config.providers**, taking the form **config.providers.${alias}.class**.
3. The name of the volume containing the Secret. Each volume must specify a name in the **name** property and a reference to a ConfigMap or Secret.
4. The name of the Secret.

Placeholders for the property values in the Secret are referenced in the connector configuration. The placeholder structure is **file:*PATH-AND-FILE-NAME*:*PROPERTY***. **FileConfigProvider** reads and

extracts the database *username* and *password* property values from the mounted Secret in connector configurations.

Example connector configuration showing placeholders for external values

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnector
metadata:
  name: my-source-connector
  labels:
    strimzi.io/cluster: my-connect-cluster
spec:
  class: io.debezium.connector.mysql.MySqlConnector
  tasksMax: 2
  config:
    database.hostname: 192.168.99.1
    database.port: "3306"
    database.user: "${file:/opt/kafka/external-configuration/connector-config/mysecret:dbUsername}"
    database.password: "${file:/opt/kafka/external-configuration/connector-
config/mysecret:dbPassword}"
    database.server.id: "184054"
    #...
```

Using DirectoryConfigProvider to load property values from separate files

In this example, a **Secret** contains TLS truststore and keystore user credentials in separate files.

Example Secret with user credentials

```
apiVersion: v1
kind: Secret
metadata:
  name: my-user
  labels:
    strimzi.io/kind: KafkaUser
    strimzi.io/cluster: my-cluster
type: Opaque
data:
  ca.crt: <public_key> # Public key of the clients CA
  user.crt: <user_certificate> # Public key of the user
  user.key: <user_private_key> # Private key of the user
  user.p12: <store> # PKCS #12 store for user certificates and keys
  user.password: <password_for_store> # Protects the PKCS #12 store
```

The Secret and the **DirectoryConfigProvider** configuration provider are specified in the Kafka Connect configuration.

- The Secret is mounted to a volume named **connector-config**.
- **DirectoryConfigProvider** is given the alias **directory**.

Example external volumes set for user credentials files

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
```

```
metadata:
  name: my-connect
spec:
  # ...
  config:
    config.providers: directory
    config.providers.directory.class: org.apache.kafka.common.config.provider.DirectoryConfigProvider
1
  #...
  externalConfiguration:
    volumes:
      - name: cluster-ca
        secret:
          secretName: my-cluster-cluster-ca-cert
      - name: my-user
        secret:
          secretName: my-user
```

1 The **DirectoryConfigProvider** provides values from files in a directory. The parameter uses the alias from **config.providers**, taking the form **config.providers.${alias}.class**.

Placeholders for the credentials are referenced in the connector configuration. The placeholder structure is **directory:*PATH*:*FILE-NAME***. **DirectoryConfigProvider** reads and extracts the credentials from the mounted Secret in connector configurations.

Example connector configuration showing placeholders for external values

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnector
metadata:
  name: my-source-connector
  labels:
    strimzi.io/cluster: my-connect-cluster
spec:
  class: io.debezium.connector.mysql.MySqlConnector
  tasksMax: 2
  config:
    # ...
    database.history.producer.security.protocol: SSL
    database.history.producer.ssl.truststore.type: PEM
    database.history.producer.ssl.truststore.certificates: "${directory:/opt/kafka/external-configuration/cluster-ca:ca.crt}"
    database.history.producer.ssl.keystore.type: PEM
    database.history.producer.ssl.keystore.certificate.chain: "${directory:/opt/kafka/external-configuration/my-user:user.crt}"
    database.history.producer.ssl.keystore.key: "${directory:/opt/kafka/external-configuration/my-user:user.key}"
    #...
```

6.2.74.3. **ExternalConfiguration** schema properties

Property	Description
env **ExternalConfigurationEnv** array	Makes data from a Secret or ConfigMap available in the Kafka Connect pods as environment variables.
volumes **ExternalConfigurationVolumeSource** array	Makes data from a Secret or ConfigMap available in the Kafka Connect pods as volumes.

6.2.75. ExternalConfigurationEnv schema reference

Used in: **ExternalConfiguration**

Property	Description
name string	Name of the environment variable which will be passed to the Kafka Connect pods. The name of the environment variable cannot start with **KAFKA_** or **STRIMZI_**.
valueFrom **ExternalConfigurationEnvVarSource**	Value of the environment variable which will be passed to the Kafka Connect pods. It can be passed either as a reference to Secret or ConfigMap field. The field has to specify exactly one Secret or ConfigMap.

6.2.76. ExternalConfigurationEnvVarSource schema reference

Used in: **ExternalConfigurationEnv**

Property	Description
configMapKeyRef ConfigMapKeySelector	Reference to a key in a ConfigMap. For more information, see the external documentation for core/v1 configmapkeyselector.
secretKeyRef SecretKeySelector	Reference to a key in a Secret. For more information, see the external documentation for core/v1 secretkeyselector.

6.2.77. ExternalConfigurationVolumeSource schema reference

Used in: **ExternalConfiguration**

Property	Description
configMap	Reference to a key in a ConfigMap. Exactly one Secret or ConfigMap has to be specified. For more information, see the external documentation for core/v1 configmapvolumesource.
ConfigMapVolumeSource	
name	Name of the volume which will be added to the Kafka Connect pods.
string	
secret	Reference to a key in a Secret. Exactly one Secret or ConfigMap has to be specified. For more information, see the external documentation for core/v1 secretvolumesource.
SecretVolumeSource	

6.2.78. Build schema reference

Used in: **KafkaConnectSpec**

Full list of **Build** schema properties

Configures additional connectors for Kafka Connect deployments.

6.2.78.1. output

To build new container images with additional connector plugins, AMQ Streams requires a container registry where the images can be pushed to, stored, and pulled from. AMQ Streams does not run its own container registry, so a registry must be provided. AMQ Streams supports private container registries as well as public registries such as Quay or Docker Hub. The container registry is configured in the **.spec.build.output** section of the **KafkaConnect** custom resource. The **output** configuration, which is required, supports two types: **docker** and **imagestream**.

Using Docker registry

To use a Docker registry, you have to specify the **type** as **docker**, and the **image** field with the full name of the new container image. The full name must include:

- The address of the registry
- Port number (if listening on a non-standard port)
- The tag of the new container image

Example valid container image names:

- **docker.io/my-org/my-image/my-tag**
- **quay.io/my-org/my-image/my-tag**
- **image-registry.image-registry.svc:5000/myproject/kafka-connect-build:latest**

Each Kafka Connect deployment must use a separate image, which can mean different tags at the most basic level.

If the registry requires authentication, use the **pushSecret** to set a name of the Secret with the registry credentials. For the Secret, use the **kubernetes.io/dockerconfigjson** type and a **.dockerconfigjson** file to contain the Docker credentials. For more information on pulling an image from a private registry, see Create a Secret based on existing Docker credentials .

Example output configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect-cluster
spec:
  #...
  build:
    output:
      type: docker 1
      image: my-registry.io/my-org/my-connect-cluster:latest 2
      pushSecret: my-registry-credentials 3
  #...
```

1 (Required) Type of output used by AMQ Streams.

2 (Required) Full name of the image used, including the repository and tag.

3 (Optional) Name of the secret with the container registry credentials.

Using OpenShift ImageStream

Instead of Docker, you can use OpenShift ImageStream to store a new container image. The ImageStream has to be created manually before deploying Kafka Connect. To use ImageStream, set the **type** to **imagestream**, and use the **image** property to specify the name of the ImageStream and the tag used. For example, **my-connect-image-stream:latest**.

Example output configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect-cluster
spec:
  #...
  build:
    output:
      type: imagestream 1
      image: my-connect-build:latest 2
  #...
```

1 (Required) Type of output used by AMQ Streams.

2 (Required) Name of the ImageStream and tag.

6.2.78.2. plugins

Connector plugins are a set of files that define the implementation required to connect to certain types of external system. The connector plugins required for a container image must be configured using the **.spec.build.plugins** property of the **KafkaConnect** custom resource. Each connector plugin must have a name which is unique within the Kafka Connect deployment. Additionally, the plugin artifacts must be listed. These artifacts are downloaded by AMQ Streams, added to the new container image, and used in the Kafka Connect deployment. The connector plugin artifacts can also include additional components, such as (de)serializers. Each connector plugin is downloaded into a separate directory so that the different connectors and their dependencies are properly *sandboxed*. Each plugin must be configured with at least one **artifact**.

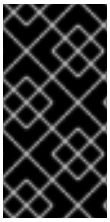
Example plugins configuration with two connector plugins

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect-cluster
spec:
  #...
  build:
    output:
      #...
    plugins: 1
      - name: debezium-postgres-connector
        artifacts:
          - type: tgz
            url: https://repo1.maven.org/maven2/io/debezium/debezium-connector-
postgres/2.1.3.Final/debezium-connector-postgres-2.1.3.Final-plugin.tar.gz
            sha512sum:
c4ddc97846de561755dc0b021a62aba656098829c70eb3ade3b817ce06d852ca12ae50c0281cc791a5a
131cb7fc21fb15f4b8ee76c6cae5dd07f9c11cb7c6e79
      - name: camel-telegram
        artifacts:
          - type: tgz
            url: https://repo.maven.apache.org/maven2/org/apache/camel/kafkaconnector/camel-
telegram-kafka-connector/0.11.5/camel-telegram-kafka-connector-0.11.5-package.tar.gz
            sha512sum:
d6d9f45e0d1dbfcc9f6d1c7ca2046168c764389c78bc4b867dab32d24f710bb74ccf2a007d7d7a8af2dfca0
9d9a52ccbc2831fc715c195a3634cca055185bd91
  #...
```

1 (Required) List of connector plugins and their artifacts.

AMQ Streams supports the following types of artifacts:

- JAR files, which are downloaded and used directly
- TGZ archives, which are downloaded and unpacked
- ZIP archives, which are downloaded and unpacked
- Maven artifacts, which uses Maven coordinates
- Other artifacts, which are downloaded and used directly



IMPORTANT

AMQ Streams does not perform any security scanning of the downloaded artifacts. For security reasons, you should first verify the artifacts manually, and configure the checksum verification to make sure the same artifact is used in the automated build and in the Kafka Connect deployment.

Using JAR artifacts

JAR artifacts represent a JAR file that is downloaded and added to a container image. To use a JAR artifacts, set the **type** property to **jar**, and specify the download location using the **url** property.

Additionally, you can specify a SHA-512 checksum of the artifact. If specified, AMQ Streams will verify the checksum of the artifact while building the new container image.

Example JAR artifact

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect-cluster
spec:
  #...
  build:
    output:
      #...
    plugins:
      - name: my-plugin
        artifacts:
          - type: jar 1
            url: https://my-domain.tld/my-jar.jar 2
            sha512sum: 589...ab4 3
          - type: jar
            url: https://my-domain.tld/my-jar2.jar
  #...
```

1. (Required) Type of artifact.
2. (Required) URL from which the artifact is downloaded.
3. (Optional) SHA-512 checksum to verify the artifact.

Using TGZ artifacts

TGZ artifacts are used to download TAR archives that have been compressed using Gzip compression. The TGZ artifact can contain the whole Kafka Connect connector, even when comprising multiple different files. The TGZ artifact is automatically downloaded and unpacked by AMQ Streams while building the new container image. To use TGZ artifacts, set the **type** property to **tgz**, and specify the download location using the **url** property.

Additionally, you can specify a SHA-512 checksum of the artifact. If specified, AMQ Streams will verify the checksum before unpacking it and building the new container image.

Example TGZ artifact

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect-cluster
spec:
  #...
  build:
    output:
      #...
    plugins:
      - name: my-plugin
        artifacts:
          - type: tgz (1)
            url: https://my-domain.tld/my-connector-archive.tgz (2)
            sha512sum: 158...jg10 (3)
  #...
```

(1) (Required) Type of artifact.

(2) (Required) URL from which the archive is downloaded.

(3) (Optional) SHA-512 checksum to verify the artifact.

Using ZIP artifacts

ZIP artifacts are used to download ZIP compressed archives. Use ZIP artifacts in the same way as the TGZ artifacts described in the previous section. The only difference is you specify **type: zip** instead of **type: tgz**.

Using Maven artifacts

maven artifacts are used to specify connector plugin artifacts as Maven coordinates. The Maven coordinates identify plugin artifacts and dependencies so that they can be located and fetched from a Maven repository.

NOTE

The Maven repository must be accessible for the connector build process to add the artifacts to the container image.

Example Maven artifact

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect-cluster
spec:
  #...
  build:
    output:
      #...
    plugins:
      - name: my-plugin
        artifacts:
```

```
      - type: maven 1
        repository: https://mvnrepository.com 2
        group: org.apache.camel.kafkaconnector 3
        artifact: camel-kafka-connector 4
        version: 0.11.0 5
  #...
```

1 (Required) Type of artifact.

2 (Optional) Maven repository to download the artifacts from. If you do not specify a repository, Maven Central repository is used by default.

3 (Required) Maven group ID.

4 (Required) Maven artifact type.

5 (Required) Maven version number.

Using other artifacts

other artifacts represent any kind of file that is downloaded and added to a container image. If you want to use a specific name for the artifact in the resulting container image, use the **fileName** field. If a file name is not specified, the file is named based on the URL hash.

Additionally, you can specify a SHA-512 checksum of the artifact. If specified, AMQ Streams will verify the checksum of the artifact while building the new container image.

Example other artifact

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnect
metadata:
  name: my-connect-cluster
spec:
  #...
  build:
    output:
      #...
    plugins:
      - name: my-plugin
        artifacts:
          - type: other 1
            url: https://my-domain.tld/my-other-file.ext 2
            sha512sum: 589...ab4 3
            fileName: name-the-file.ext 4
  #...
```

1 (Required) Type of artifact.

2 (Required) URL from which the artifact is downloaded.

3 (Optional) SHA-512 checksum to verify the artifact.

4 (Optional) The name under which the file is stored in the resulting container image.

6.2.78.3. Build schema properties

Property	Description
output **DockerOutput**, **ImageStreamOutput**	Configures where should the newly built image be stored. Required. The type depends on the value of the **output.type** property within the given object, which must be one of [docker, imagestream].
resources ResourceRequirements	CPU and memory resources to reserve for the build. For more information, see the external documentation for core/v1 resourcerequirements.
plugins **Plugin** array	List of connector plugins which should be added to the Kafka Connect. Required.

6.2.79. DockerOutput schema reference

Used in: **Build**

The **type** property is a discriminator that distinguishes use of the **DockerOutput** type from **ImageStreamOutput**. It must have the value **docker** for the type **DockerOutput**.

Property	Description
image string	The full name which should be used for tagging and pushing the newly built image. For example **quay.io/my-organization/my-custom-connect:latest**. Required.
pushSecret string	Container Registry Secret with the credentials for pushing the newly built image.
additionalKanikoOptions string array	Configures additional options which will be passed to the Kaniko executor when building the new Connect image. Allowed options are: --customPlatform, --insecure, --insecure-pull, --insecure-registry, --log-format, --log-timestamp, --registry-mirror, --reproducible, --single-snapshot, --skip-tls-verify, --skip-tls-verify-pull, --skip-tls-verify-registry, --verbosity, --snapshotMode, --use-new-run. These options will be used only on OpenShift where the Kaniko executor is used. They will be ignored on OpenShift. The options are described in the Kaniko GitHub repository. Changing this field does not trigger new build of the Kafka Connect image.
type	Must be **docker**.

Property	Description
string	

6.2.80. ImageStreamOutput schema reference

Used in: **Build**

The **type** property is a discriminator that distinguishes use of the **ImageStreamOutput** type from **DockerOutput**. It must have the value **imagestream** for the type **ImageStreamOutput**.

Property	Description
image	The name and tag of the ImageStream where the newly built image will be pushed. For example **my-custom-connect:latest**. Required.
string	
type	Must be **imagestream**.
string	

6.2.81. Plugin schema reference

Used in: **Build**

Property	Description
name	The unique name of the connector plugin. Will be used to generate the path where the connector artifacts will be stored. The name has to be unique within the KafkaConnect resource. The name has to follow the following pattern: **^[a-z][-_a-z0-9]*[a-z]$**. Required.
string	
artifacts	List of artifacts which belong to this connector plugin. Required.
JarArtifact, **TgzArtifact**, **ZipArtifact**, **MavenArtifact**, **OtherArtifact** array	

6.2.82. JarArtifact schema reference

Used in: **Plugin**

Property	Description
url string	URL of the artifact which will be downloaded. AMQ Streams does not do any security scanning of the downloaded artifacts. For security reasons, you should first verify the artifacts manually and configure the checksum verification to make sure the same artifact is used in the automated build. Required for **jar**, **zip**, **tgz** and **other** artifacts. Not applicable to the **maven** artifact type.
sha512sum string	SHA512 checksum of the artifact. Optional. If specified, the checksum will be verified while building the new container. If not specified, the downloaded artifact will not be verified. Not applicable to the **maven** artifact type.
insecure boolean	By default, connections using TLS are verified to check they are secure. The server certificate used must be valid, trusted, and contain the server name. By setting this option to **true**, all TLS verification is disabled and the artifact will be downloaded, even when the server is considered insecure.
type string	Must be **jar**.

6.2.83. TgzArtifact schema reference

Used in: **Plugin**

Property	Description
url string	URL of the artifact which will be downloaded. AMQ Streams does not do any security scanning of the downloaded artifacts. For security reasons, you should first verify the artifacts manually and configure the checksum verification to make sure the same artifact is used in the automated build. Required for **jar**, **zip**, **tgz** and **other** artifacts. Not applicable to the **maven** artifact type.
sha512sum string	SHA512 checksum of the artifact. Optional. If specified, the checksum will be verified while building the new container. If not specified, the downloaded artifact will not be verified. Not applicable to the **maven** artifact type.

Property	Description
insecure boolean	By default, connections using TLS are verified to check they are secure. The server certificate used must be valid, trusted, and contain the server name. By setting this option to **true**, all TLS verification is disabled and the artifact will be downloaded, even when the server is considered insecure.
type string	Must be **tgz**.

6.2.84. ZipArtifact schema reference

Used in: **Plugin**

Property	Description
url string	URL of the artifact which will be downloaded. AMQ Streams does not do any security scanning of the downloaded artifacts. For security reasons, you should first verify the artifacts manually and configure the checksum verification to make sure the same artifact is used in the automated build. Required for **jar**, **zip**, **tgz** and **other** artifacts. Not applicable to the **maven** artifact type.
sha512sum string	SHA512 checksum of the artifact. Optional. If specified, the checksum will be verified while building the new container. If not specified, the downloaded artifact will not be verified. Not applicable to the **maven** artifact type.
insecure boolean	By default, connections using TLS are verified to check they are secure. The server certificate used must be valid, trusted, and contain the server name. By setting this option to **true**, all TLS verification is disabled and the artifact will be downloaded, even when the server is considered insecure.
type string	Must be **zip**.

6.2.85. MavenArtifact schema reference

Used in: **Plugin**

The **type** property is a discriminator that distinguishes use of the **MavenArtifact** type from **JarArtifact**, **TgzArtifact**, **ZipArtifact**, **OtherArtifact**. It must have the value **maven** for the type **MavenArtifact**.

Property	Description
repository	Maven repository to download the artifact from. Applicable to the **maven** artifact type only.
string	
group	Maven group id. Applicable to the **maven** artifact type only.
string	
artifact	Maven artifact id. Applicable to the **maven** artifact type only.
string	
version	Maven version number. Applicable to the **maven** artifact type only.
string	
type	Must be **maven**.
string	

6.2.86. OtherArtifact schema reference

Used in: **Plugin**

Property	Description
url	URL of the artifact which will be downloaded. AMQ Streams does not do any security scanning of the downloaded artifacts. For security reasons, you should first verify the artifacts manually and configure the checksum verification to make sure the same artifact is used in the automated build. Required for **jar**, **zip**, **tgz** and **other** artifacts. Not applicable to the **maven** artifact type.
string	
sha512sum	SHA512 checksum of the artifact. Optional. If specified, the checksum will be verified while building the new container. If not specified, the downloaded artifact will not be verified. Not applicable to the **maven** artifact type.
string	

Property	Description
fileName string	Name under which the artifact will be stored.
insecure boolean	By default, connections using TLS are verified to check they are secure. The server certificate used must be valid, trusted, and contain the server name. By setting this option to **true**, all TLS verification is disabled and the artifact will be downloaded, even when the server is considered insecure.
type string	Must be **other**.

6.2.87. KafkaConnectStatus schema reference

Used in: **KafkaConnect**

Property	Description
conditions **Condition** array	List of status conditions.
observedGeneration integer	The generation of the CRD that was last reconciled by the operator.
url string	The URL of the REST API endpoint for managing and monitoring Kafka Connect connectors.
connectorPlugins **ConnectorPlugin** array	The list of connector plugins available in this Kafka Connect deployment.
labelSelector string	Label selector for pods providing this resource.
replicas integer	The current number of pods being used to provide this resource.

6.2.88. ConnectorPlugin schema reference

Used in: KafkaConnectStatus, KafkaMirrorMaker2Status

Property	Description
type	The type of the connector plugin. The available types are **sink** and **source**.
string	
version	The version of the connector plugin.
string	
class	The class of the connector plugin.
string	

6.2.89. KafkaTopic schema reference

Property	Description
spec	The specification of the topic.
KafkaTopicSpec	
status	The status of the topic.
KafkaTopicStatus	

6.2.90. KafkaTopicSpec schema reference

Used in: KafkaTopic

Property	Description
partitions	The number of partitions the topic should have. This cannot be decreased after topic creation. It can be increased after topic creation, but it is important to understand the consequences that has, especially for topics with semantic partitioning. When absent this will default to the broker configuration for **num.partitions**.
integer	
replicas	The number of replicas the topic should have. When absent this will default to the broker configuration for **default.replication.factor**.

Property	Description
integer	
config	The topic configuration.
map	
topicName	The name of the topic. When absent this will default to the metadata.name of the topic. It is recommended to not set this unless the topic name is not a valid OpenShift resource name.
string	

6.2.91. KafkaTopicStatus schema reference

Used in: **KafkaTopic**

Property	Description
conditions	List of status conditions.
Condition array	
observedGeneration	The generation of the CRD that was last reconciled by the operator.
integer	
topicName	Topic name.
string	

6.2.92. KafkaUser schema reference

Property	Description
spec	The specification of the user.
KafkaUserSpec	
status	The status of the Kafka User.
KafkaUserStatus	

6.2.93. KafkaUserSpec schema reference

Used in: **KafkaUser**

Property	Description
authentication **KafkaUserTlsClientAuthentication**, **KafkaUserTlsExternalClientAuthentication**, **KafkaUserScramSha512ClientAuthentication**	Authentication mechanism enabled for this Kafka user. The supported authentication mechanisms are **scram-sha-512**, **tls**, and **tls-external**. • **scram-sha-512** generates a secret with SASL SCRAM-SHA-512 credentials. • **tls** generates a secret with user certificate for mutual TLS authentication. • **tls-external** does not generate a user certificate. But prepares the user for using mutual TLS authentication using a user certificate generated outside the User Operator. ACLs and quotas set for this user are configured in the **CN=<username>** format. Authentication is optional. If authentication is not configured, no credentials are generated. ACLs and quotas set for the user are configured in the **<username>** format suitable for SASL authentication. The type depends on the value of the **authentication.type** property within the given object, which must be one of [tls, tls-external, scram-sha-512].
authorization **KafkaUserAuthorizationSimple**	Authorization rules for this Kafka user. The type depends on the value of the **authorization.type** property within the given object, which must be one of [simple].
quotas **KafkaUserQuotas**	Quotas on requests to control the broker resources used by clients. Network bandwidth and request rate quotas can be enforced.Kafka documentation for Kafka User quotas can be found at http://kafka.apache.org/documentation/#design_quotas.
template **KafkaUserTemplate**	Template to specify how Kafka User **Secrets** are generated.

6.2.94. KafkaUserTlsClientAuthentication schema reference

Used in: **KafkaUserSpec**

The **type** property is a discriminator that distinguishes use of the **KafkaUserTlsClientAuthentication** type from **KafkaUserTlsExternalClientAuthentication**, **KafkaUserScramSha512ClientAuthentication**. It must have the value **tls** for the type **KafkaUserTlsClientAuthentication**.

Property	Description
type	Must be **tls**.
string	

6.2.95. KafkaUserTlsExternalClientAuthentication schema reference

Used in: KafkaUserSpec

The **type** property is a discriminator that distinguishes use of the **KafkaUserTlsExternalClientAuthentication** type from KafkaUserTlsClientAuthentication, KafkaUserScramSha512ClientAuthentication. It must have the value **tls-external** for the type **KafkaUserTlsExternalClientAuthentication**.

Property	Description
type	Must be **tls-external**.
string	

6.2.96. KafkaUserScramSha512ClientAuthentication schema reference

Used in: KafkaUserSpec

The **type** property is a discriminator that distinguishes use of the **KafkaUserScramSha512ClientAuthentication** type from KafkaUserTlsClientAuthentication, KafkaUserTlsExternalClientAuthentication. It must have the value **scram-sha-512** for the type **KafkaUserScramSha512ClientAuthentication**.

Property	Description
password	Specify the password for the user. If not set, a new password is generated by the User Operator.
Password	
type	Must be **scram-sha-512**.
string	

6.2.97. Password schema reference

Used in: KafkaUserScramSha512ClientAuthentication

Property	Description
valueFrom	Secret from which the password should be read.
PasswordSource	

6.2.98. PasswordSource schema reference

Used in: **Password**

Property	Description
secretKeyRef	Selects a key of a Secret in the resource's namespace. For more information, see the external documentation for core/v1 secretkeyselector.
SecretKeySelector	

6.2.99. KafkaUserAuthorizationSimple schema reference

Used in: **KafkaUserSpec**

The **type** property is a discriminator that distinguishes use of the **KafkaUserAuthorizationSimple** type from other subtypes which may be added in the future. It must have the value **simple** for the type **KafkaUserAuthorizationSimple**.

Property	Description
type	Must be **simple**.
string	
acls	List of ACL rules which should be applied to this user.
AclRule array	

6.2.100. AclRule schema reference

Used in: **KafkaUserAuthorizationSimple**

Full list of **AclRule** schema properties

Configures access control rules for a **KafkaUser** when brokers are using the **AclAuthorizer**.

Example KafkaUser configuration with authorization

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaUser
metadata:
  name: my-user
```

```
  labels:
    strimzi.io/cluster: my-cluster
spec:
  # ...
  authorization:
    type: simple
    acls:
      - resource:
          type: topic
          name: my-topic
          patternType: literal
        operations:
          - Read
          - Describe
      - resource:
          type: group
          name: my-group
          patternType: prefix
        operations:
          - Read
```

6.2.100.1. resource

Use the **resource** property to specify the resource that the rule applies to.

Simple authorization supports four resource types, which are specified in the **type** property:

- Topics (**topic**)
- Consumer Groups (**group**)
- Clusters (**cluster**)
- Transactional IDs (**transactionalId**)

For Topic, Group, and Transactional ID resources you can specify the name of the resource the rule applies to in the **name** property.

Cluster type resources have no name.

A name is specified as a **literal** or a **prefix** using the **patternType** property.

- Literal names are taken exactly as they are specified in the **name** field.
- Prefix names use the **name** value as a prefix and then apply the rule to all resources with names starting with that value.

When **patternType** is set as **literal**, you can set the name to * to indicate that the rule applies to all resources.

Example ACL rule that allows the user to read messages from all topics

```
  acls:
    - resource:
        type: topic
        name: "*"
```

```
    patternType: literal
  operations:
    - Read
```

6.2.100.2. type

The **type** of rule, which is to **allow** or **deny** (not currently supported) an operations.

The **type** field is optional. If **type** is unspecified, the ACL rule is treated as an **allow** rule.

6.2.100.3. operations

Specify a list of **operations** for the rule to allow or deny.

The following operations are supported:

- Read
- Write
- Delete
- Alter
- Describe
- All
- IdempotentWrite
- ClusterAction
- Create
- AlterConfigs
- DescribeConfigs

Only certain operations work with each resource.

For more details about **AclAuthorizer**, ACLs and supported combinations of resources and operations, see Authorization and ACLs.

6.2.100.4. host

Use the **host** property to specify a remote host from which the rule is allowed or denied.

Use an asterisk (*) to allow or deny the operation from all hosts. The **host** field is optional. If **host** is unspecified, the * value is used by default.

6.2.100.5. AclRule schema properties

Property	Description
host string	The host from which the action described in the ACL rule is allowed or denied.
operation string (one of [Read, Write, Delete, Alter, Describe, All, IdempotentWrite, ClusterAction, Create, AlterConfigs, DescribeConfigs])	**The operation property has been deprecated, and should now be configured using spec.authorization.acls[*].operations.** Operation which will be allowed or denied. Supported operations are: Read, Write, Create, Delete, Alter, Describe, ClusterAction, AlterConfigs, DescribeConfigs, IdempotentWrite and All.
operations string (one or more of [Read, Write, Delete, Alter, Describe, All, IdempotentWrite, ClusterAction, Create, AlterConfigs, DescribeConfigs]) array	List of operations which will be allowed or denied. Supported operations are: Read, Write, Create, Delete, Alter, Describe, ClusterAction, AlterConfigs, DescribeConfigs, IdempotentWrite and All.
resource **AclRuleTopicResource**, **AclRuleGroupResource**, **AclRuleClusterResource**, **AclRuleTransactionalIdResource**	Indicates the resource for which given ACL rule applies. The type depends on the value of the **resource.type** property within the given object, which must be one of [topic, group, cluster, transactionalId].
type string (one of [allow, deny])	The type of the rule. Currently the only supported type is **allow**. ACL rules with type**allow** are used to allow user to execute the specified operations. Default value is **allow**.

6.2.101. AclRuleTopicResource schema reference

Used in: **AclRule**

The **type** property is a discriminator that distinguishes use of the **AclRuleTopicResource** type from **AclRuleGroupResource**, **AclRuleClusterResource**, **AclRuleTransactionalIdResource**. It must have the value **topic** for the type **AclRuleTopicResource**.

Property	Description
type string	Must be **topic**.
name string	Name of resource for which given ACL rule applies. Can be combined with **patternType** field to use prefix pattern.

Property	Description
patternType string (one of [prefix, literal])	Describes the pattern used in the resource field. The supported types are **literal** and **prefix**. With **literal** pattern type, the resource field will be used as a definition of a full topic name. With **prefix** pattern type, the resource name will be used only as a prefix. Default value is **literal**.

6.2.102. AclRuleGroupResource schema reference

Used in: **AclRule**

The **type** property is a discriminator that distinguishes use of the **AclRuleGroupResource** type from **AclRuleTopicResource**, **AclRuleClusterResource**, **AclRuleTransactionalIdResource**. It must have the value **group** for the type **AclRuleGroupResource**.

Property	Description
type string	Must be **group**.
name string	Name of resource for which given ACL rule applies. Can be combined with **patternType** field to use prefix pattern.
patternType string (one of [prefix, literal])	Describes the pattern used in the resource field. The supported types are **literal** and **prefix**. With **literal** pattern type, the resource field will be used as a definition of a full topic name. With **prefix** pattern type, the resource name will be used only as a prefix. Default value is **literal**.

6.2.103. AclRuleClusterResource schema reference

Used in: **AclRule**

The **type** property is a discriminator that distinguishes use of the **AclRuleClusterResource** type from **AclRuleTopicResource**, **AclRuleGroupResource**, **AclRuleTransactionalIdResource**. It must have the value **cluster** for the type **AclRuleClusterResource**.

Property	Description
type string	Must be **cluster**.

6.2.104. AclRuleTransactionalIdResource schema reference

Used in: **AclRule**

The **type** property is a discriminator that distinguishes use of the **AclRuleTransactionalIdResource** type from **AclRuleTopicResource**, **AclRuleGroupResource**, **AclRuleClusterResource**. It must have the value **transactionalId** for the type **AclRuleTransactionalIdResource**.

Property	Description
type string	Must be **transactionalId**.
name string	Name of resource for which given ACL rule applies. Can be combined with **patternType** field to use prefix pattern.
patternType string (one of [prefix, literal])	Describes the pattern used in the resource field. The supported types are **literal** and **prefix**. With **literal** pattern type, the resource field will be used as a definition of a full name. With **prefix** pattern type, the resource name will be used only as a prefix. Default value is **literal**.

6.2.105. KafkaUserQuotas schema reference

Used in: **KafkaUserSpec**

Full list of **KafkaUserQuotas** schema properties

Kafka allows a user to set **quotas** to control the use of resources by clients.

6.2.105.1. quotas

You can configure your clients to use the following types of quotas:

- *Network usage* quotas specify the byte rate threshold for each group of clients sharing a quota.
- *CPU utilization* quotas specify a window for broker requests from clients. The window is the percentage of time for clients to make requests. A client makes requests on the I/O threads and network threads of the broker.
- *Partition mutation* quotas limit the number of partition mutations which clients are allowed to make per second.

A partition mutation quota prevents Kafka clusters from being overwhelmed by concurrent topic operations. Partition mutations occur in response to the following types of user requests:

- Creating partitions for a new topic
- Adding partitions to an existing topic

- Deleting partitions from a topic

You can configure a partition mutation quota to control the rate at which mutations are accepted for user requests.

Using quotas for Kafka clients might be useful in a number of situations. Consider a wrongly configured Kafka producer which is sending requests at too high a rate. Such misconfiguration can cause a denial of service to other clients, so the problematic client ought to be blocked. By using a network limiting quota, it is possible to prevent this situation from significantly impacting other clients.

AMQ Streams supports user-level quotas, but not client-level quotas.

Example Kafka user quota configuration

```
spec:
  quotas:
    producerByteRate: 1048576
    consumerByteRate: 2097152
    requestPercentage: 55
    controllerMutationRate: 10
```

For more information about Kafka user quotas, refer to the Apache Kafka documentation.

6.2.105.2. KafkaUserQuotas schema properties

Property	Description
consumerByteRate integer	A quota on the maximum bytes per-second that each client group can fetch from a broker before the clients in the group are throttled. Defined on a per-broker basis.
controllerMutationRate number	A quota on the rate at which mutations are accepted for the create topics request, the create partitions request and the delete topics request. The rate is accumulated by the number of partitions created or deleted.
producerByteRate integer	A quota on the maximum bytes per-second that each client group can publish to a broker before the clients in the group are throttled. Defined on a per-broker basis.
requestPercentage integer	A quota on the maximum CPU utilization of each client group as a percentage of network and I/O threads.

6.2.106. KafkaUserTemplate schema reference

Used in: **KafkaUserSpec**

Full list of **KafkaUserTemplate** schema properties

Specify additional labels and annotations for the secret created by the User Operator.

An example showing the KafkaUserTemplate

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaUser
metadata:
  name: my-user
  labels:
    strimzi.io/cluster: my-cluster
spec:
  authentication:
    type: tls
  template:
    secret:
      metadata:
        labels:
          label1: value1
        annotations:
          anno1: value1
  # ...
```

6.2.106.1. KafkaUserTemplate schema properties

Property	Description
secret	Template for KafkaUser resources. The template allows users to specify how the **Secret** with password or TLS certificates is generated.
ResourceTemplate	

6.2.107. KafkaUserStatus schema reference

Used in: **KafkaUser**

Property	Description
conditions	List of status conditions.
Condition array	
observedGeneration	The generation of the CRD that was last reconciled by the operator.
integer	
username	Username.
string	

Property	Description
secret	The name of **Secret** where the credentials are stored.
string	

6.2.108. KafkaMirrorMaker schema reference

The type KafkaMirrorMaker has been deprecated. Please use **KafkaMirrorMaker2** instead.

Property	Description
spec	The specification of Kafka MirrorMaker.
KafkaMirrorMakerSpec	
status	The status of Kafka MirrorMaker.
KafkaMirrorMakerStatus	

6.2.109. KafkaMirrorMakerSpec schema reference

Used in: **KafkaMirrorMaker**

Full list of **KafkaMirrorMakerSpec** schema properties

Configures Kafka MirrorMaker.

6.2.109.1. include

Use the **include** property to configure a list of topics that Kafka MirrorMaker mirrors from the source to the target Kafka cluster.

The property allows any regular expression from the simplest case with a single topic name to complex patterns. For example, you can mirror topics A and B using **A|B** or all topics using ***. You can also pass multiple regular expressions separated by commas to the Kafka MirrorMaker.

6.2.109.2. KafkaMirrorMakerConsumerSpec and KafkaMirrorMakerProducerSpec

Use the **KafkaMirrorMakerConsumerSpec** and **KafkaMirrorMakerProducerSpec** to configure source (consumer) and target (producer) clusters.

Kafka MirrorMaker always works together with two Kafka clusters (source and target). To establish a connection, the bootstrap servers for the source and the target Kafka clusters are specified as comma-separated lists of ***HOSTNAME:PORT*** pairs. Each comma-separated list contains one or more Kafka brokers or a **Service** pointing to Kafka brokers specified as a ***HOSTNAME:PORT*** pair.

6.2.109.3. logging

Kafka MirrorMaker has its own configurable logger:

- **mirrormaker.root.logger**

MirrorMaker uses the Apache **log4j** logger implementation.

Use the **logging** property to configure loggers and logger levels.

You can set the log levels by specifying the logger and level directly (inline) or use a custom (external) ConfigMap. If a ConfigMap is used, you set **logging.valueFrom.configMapKeyRef.name** property to the name of the ConfigMap containing the external logging configuration. Inside the ConfigMap, the logging configuration is described using **log4j.properties**. Both **logging.valueFrom.configMapKeyRef.name** and **logging.valueFrom.configMapKeyRef.key** properties are mandatory. A ConfigMap using the exact logging configuration specified is created with the custom resource when the Cluster Operator is running, then recreated after each reconciliation. If you do not specify a custom ConfigMap, default logging settings are used. If a specific logger value is not set, upper-level logger settings are inherited for that logger. For more information about log levels, see Apache logging services.

Here we see examples of **inline** and **external** logging:

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaMirrorMaker
spec:
  # ...
  logging:
    type: inline
    loggers:
      mirrormaker.root.logger: "INFO"
  # ...
```

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaMirrorMaker
spec:
  # ...
  logging:
    type: external
    valueFrom:
      configMapKeyRef:
        name: customConfigMap
        key: mirror-maker-log4j.properties
  # ...
```

Garbage collector (GC)

Garbage collector logging can also be enabled (or disabled) using the **jvmOptions** property.

6.2.109.4. KafkaMirrorMakerSpec schema properties

Property	Description

Property	Description
version string	The Kafka MirrorMaker version. Defaults to 3.4.0. Consult the documentation to understand the process required to upgrade or downgrade the version.
replicas integer	The number of pods in the **Deployment**.
image string	The docker image for the pods.
consumer **KafkaMirrorMakerConsumerSpec**	Configuration of source cluster.
producer **KafkaMirrorMakerProducerSpec**	Configuration of target cluster.
resources ResourceRequirements	CPU and memory resources to reserve. For more information, see the external documentation for core/v1 resourcerequirements.
whitelist string	**The whitelist property has been deprecated, and should now be configured using spec.include.** List of topics which are included for mirroring. This option allows any regular expression using Java-style regular expressions. Mirroring two topics named A and B is achieved by using the expression **A|B**. Or, as a special case, you can mirror all topics using the regular expression ***. You can also specify multiple regular expressions separated by commas.
include string	List of topics which are included for mirroring. This option allows any regular expression using Java-style regular expressions. Mirroring two topics named A and B is achieved by using the expression **A|B**. Or, as a special case, you can mirror all topics using the regular expression ***. You can also specify multiple regular expressions separated by commas.
jvmOptions **JvmOptions**	JVM Options for pods.

Property	Description
logging	Logging configuration for MirrorMaker. The type depends on the value of the **logging.type** property within the given object, which must be one of [inline, external].
InlineLogging, **ExternalLogging**	
metricsConfig	Metrics configuration. The type depends on the value of the **metricsConfig.type** property within the given object, which must be one of [jmxPrometheusExporter].
JmxPrometheusExporterMetrics	
tracing	The configuration of tracing in Kafka MirrorMaker. The type depends on the value of the **tracing.type** property within the given object, which must be one of [jaeger, opentelemetry].
JaegerTracing, **OpenTelemetryTracing**	
template	Template to specify how Kafka MirrorMaker resources, **Deployments** and **Pods**, are generated.
KafkaMirrorMakerTemplate	
livenessProbe	Pod liveness checking.
Probe	
readinessProbe	Pod readiness checking.
Probe	

6.2.110. KafkaMirrorMakerConsumerSpec schema reference

Used in: **KafkaMirrorMakerSpec**

Full list of **KafkaMirrorMakerConsumerSpec** schema properties

Configures a MirrorMaker consumer.

6.2.110.1. numStreams

Use the **consumer.numStreams** property to configure the number of streams for the consumer.

You can increase the throughput in mirroring topics by increasing the number of consumer threads. Consumer threads belong to the consumer group specified for Kafka MirrorMaker. Topic partitions are assigned across the consumer threads, which consume messages in parallel.

6.2.110.2. offsetCommitInterval

Use the **consumer.offsetCommitInterval** property to configure an offset auto-commit interval for the consumer.

You can specify the regular time interval at which an offset is committed after Kafka MirrorMaker has consumed data from the source Kafka cluster. The time interval is set in milliseconds, with a default value of 60,000.

6.2.110.3. config

Use the **consumer.config** properties to configure Kafka options for the consumer.

The **config** property contains the Kafka MirrorMaker consumer configuration options as keys, with values set in one of the following JSON types:

- String
- Number
- Boolean

For client connection using a specific *cipher suite* for a TLS version, you can configure allowed **ssl** properties. You can also configure the **ssl.endpoint.identification.algorithm** property to enable or disable hostname verification.

Exceptions

You can specify and configure the options listed in the Apache Kafka configuration documentation for consumers.

However, there are exceptions for options automatically configured and managed directly by AMQ Streams related to:

- Kafka cluster bootstrap address
- Security (encryption, authentication, and authorization)
- Consumer group identifier
- Interceptors

Specifically, all configuration options with keys equal to or starting with one of the following strings are forbidden:

- **bootstrap.servers**
- **group.id**
- **interceptor.classes**
- **ssl.** (not including specific exceptions)
- **sasl.**
- **security.**

When a forbidden option is present in the **config** property, it is ignored and a warning message is printed to the Cluster Operator log file. All other options are passed to Kafka MirrorMaker.

IMPORTANT

The Cluster Operator does not validate keys or values in the provided **config** object. When an invalid configuration is provided, the Kafka MirrorMaker might not start or might become unstable. In such cases, the configuration in the **KafkaMirrorMaker.spec.consumer.config** object should be fixed and the Cluster Operator will roll out the new configuration for Kafka MirrorMaker.

6.2.110.4. groupId

Use the **consumer.groupId** property to configure a consumer group identifier for the consumer.

Kafka MirrorMaker uses a Kafka consumer to consume messages, behaving like any other Kafka consumer client. Messages consumed from the source Kafka cluster are mirrored to a target Kafka cluster. A group identifier is required, as the consumer needs to be part of a consumer group for the assignment of partitions.

6.2.110.5. KafkaMirrorMakerConsumerSpec schema properties

Property	Description
numStreams integer	Specifies the number of consumer stream threads to create.
offsetCommitInterval integer	Specifies the offset auto-commit interval in ms. Default value is 60000.
bootstrapServers string	A list of host:port pairs for establishing the initial connection to the Kafka cluster.
groupId string	A unique string that identifies the consumer group this consumer belongs to.
authentication **KafkaClientAuthenticationTls**, **KafkaClientAuthenticationScramSha256**, **KafkaClientAuthenticationScramSha512**, **KafkaClientAuthenticationPlain**, **KafkaClientAuthenticationOAuth**	Authentication configuration for connecting to the cluster. The type depends on the value of the **authentication.type** property within the given object, which must be one of [tls, scram-sha-256, scram-sha-512, plain, oauth].

Property	Description
config	The MirrorMaker consumer config. Properties with the following prefixes cannot be set: ssl., bootstrap.servers, group.id, sasl., security., interceptor.classes (with the exception of: ssl.endpoint.identification.algorithm, ssl.cipher.suites, ssl.protocol, ssl.enabled.protocols).
map	
tls	TLS configuration for connecting MirrorMaker to the cluster.
ClientTls	

6.2.111. KafkaMirrorMakerProducerSpec schema reference

Used in: **KafkaMirrorMakerSpec**

Full list of **KafkaMirrorMakerProducerSpec** schema properties

Configures a MirrorMaker producer.

6.2.111.1. abortOnSendFailure

Use the **producer.abortOnSendFailure** property to configure how to handle message send failure from the producer.

By default, if an error occurs when sending a message from Kafka MirrorMaker to a Kafka cluster:

- The Kafka MirrorMaker container is terminated in OpenShift.
- The container is then recreated.

If the **abortOnSendFailure** option is set to **false**, message sending errors are ignored.

6.2.111.2. config

Use the **producer.config** properties to configure Kafka options for the producer.

The **config** property contains the Kafka MirrorMaker producer configuration options as keys, with values set in one of the following JSON types:

- String
- Number
- Boolean

For client connection using a specific *cipher suite* for a TLS version, you can configure allowed **ssl** properties. You can also configure the **ssl.endpoint.identification.algorithm** property to enable or disable hostname verification.

Exceptions

You can specify and configure the options listed in the Apache Kafka configuration documentation for producers.

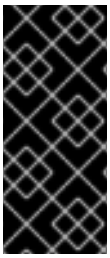
However, there are exceptions for options automatically configured and managed directly by AMQ Streams related to:

- Kafka cluster bootstrap address
- Security (encryption, authentication, and authorization)
- Interceptors

Specifically, all configuration options with keys equal to or starting with one of the following strings are forbidden:

- **bootstrap.servers**
- **interceptor.classes**
- **ssl.** (not including specific exceptions)
- **sasl.**
- **security.**

When a forbidden option is present in the **config** property, it is ignored and a warning message is printed to the Cluster Operator log file. All other options are passed to Kafka MirrorMaker.



IMPORTANT

The Cluster Operator does not validate keys or values in the provided **config** object. When an invalid configuration is provided, the Kafka MirrorMaker might not start or might become unstable. In such cases, the configuration in the **KafkaMirrorMaker.spec.producer.config** object should be fixed and the Cluster Operator will roll out the new configuration for Kafka MirrorMaker.

6.2.111.3. KafkaMirrorMakerProducerSpec schema properties

Property	Description
bootstrapServers string	A list of host:port pairs for establishing the initial connection to the Kafka cluster.
abortOnSendFailure boolean	Flag to set the MirrorMaker to exit on a failed send. Default value is **true**.
authentication	Authentication configuration for connecting to the cluster. The type depends on the value of the **authentication.type** property within the given object, which must be one of [tls, scram-sha-256, scram-sha-512, plain, oauth].

Property	Description
KafkaClientAuthenticationTls, **KafkaClientAuthenticationScramSha256**, **KafkaClientAuthenticationScramSha512**, **KafkaClientAuthenticationPlain**, **KafkaClientAuthenticationOAuth**	
config map	The MirrorMaker producer config. Properties with the following prefixes cannot be set: ssl., bootstrap.servers, sasl., security., interceptor.classes (with the exception of: ssl.endpoint.identification.algorithm, ssl.cipher.suites, ssl.protocol, ssl.enabled.protocols).
tls **ClientTls**	TLS configuration for connecting MirrorMaker to the cluster.

6.2.112. KafkaMirrorMakerTemplate schema reference

Used in: **KafkaMirrorMakerSpec**

Property	Description
deployment **DeploymentTemplate**	Template for Kafka MirrorMaker **Deployment**.
pod **PodTemplate**	Template for Kafka MirrorMaker **Pods**.
podDisruptionBudget **PodDisruptionBudgetTemplate**	Template for Kafka MirrorMaker **PodDisruptionBudget**.
mirrorMakerContainer **ContainerTemplate**	Template for Kafka MirrorMaker container.
serviceAccount **ResourceTemplate**	Template for the Kafka MirrorMaker service account.

6.2.113. KafkaMirrorMakerStatus schema reference

Used in: **KafkaMirrorMaker**

Property	Description
conditions	List of status conditions.
Condition array	
observedGeneration	The generation of the CRD that was last reconciled by the operator.
integer	
labelSelector	Label selector for pods providing this resource.
string	
replicas	The current number of pods being used to provide this resource.
integer	

6.2.114. KafkaBridge schema reference

Property	Description
spec	The specification of the Kafka Bridge.
KafkaBridgeSpec	
status	The status of the Kafka Bridge.
KafkaBridgeStatus	

6.2.115. KafkaBridgeSpec schema reference

Used in: **KafkaBridge**

Full list of **KafkaBridgeSpec** schema properties

Configures a Kafka Bridge cluster.

Configuration options relate to:

- Kafka cluster bootstrap address
- Security (Encryption, Authentication, and Authorization)
- Consumer configuration
- Producer configuration

- HTTP configuration

6.2.115.1. logging

Kafka Bridge has its own configurable loggers:

- **logger.bridge**
- **logger.*<operation-id>***

You can replace ***<operation-id>*** in the **logger.*<operation-id>*** logger to set log levels for specific operations:

- **createConsumer**
- **deleteConsumer**
- **subscribe**
- **unsubscribe**
- **poll**
- **assign**
- **commit**
- **send**
- **sendToPartition**
- **seekToBeginning**
- **seekToEnd**
- **seek**
- **healthy**
- **ready**
- **openapi**

Each operation is defined according OpenAPI specification, and has a corresponding API endpoint through which the bridge receives requests from HTTP clients. You can change the log level on each endpoint to create fine-grained logging information about the incoming and outgoing HTTP requests.

Each logger has to be configured assigning it a **name** as **http.openapi.operation.*<operation-id>***. For example, configuring the logging level for the **send** operation logger means defining the following:

```
logger.send.name = http.openapi.operation.send
logger.send.level = DEBUG
```

Kafka Bridge uses the Apache **log4j2** logger implementation. Loggers are defined in the **log4j2.properties** file, which has the following default configuration for **healthy** and **ready** endpoints:

```
logger.healthy.name = http.openapi.operation.healthy
logger.healthy.level = WARN
logger.ready.name = http.openapi.operation.ready
logger.ready.level = WARN
```

The log level of all other operations is set to **INFO** by default.

Use the **logging** property to configure loggers and logger levels.

You can set the log levels by specifying the logger and level directly (inline) or use a custom (external) ConfigMap. If a ConfigMap is used, you set **logging.valueFrom.configMapKeyRef.name** property to the name of the ConfigMap containing the external logging configuration. The **logging.valueFrom.configMapKeyRef.name** and **logging.valueFrom.configMapKeyRef.key** properties are mandatory. Default logging is used if the **name** or **key** is not set. Inside the ConfigMap, the logging configuration is described using **log4j.properties**. For more information about log levels, see Apache logging services.

Here we see examples of **inline** and **external** logging.

Inline logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaBridge
spec:
  # ...
  logging:
    type: inline
    loggers:
      logger.bridge.level: "INFO"
      # enabling DEBUG just for send operation
      logger.send.name: "http.openapi.operation.send"
      logger.send.level: "DEBUG"
  # ...
```

External logging

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaBridge
spec:
  # ...
  logging:
    type: external
    valueFrom:
      configMapKeyRef:
        name: customConfigMap
        key: bridge-logj42.properties
  # ...
```

Any available loggers that are not configured have their level set to **OFF**.

If the Kafka Bridge was deployed using the Cluster Operator, changes to Kafka Bridge logging levels are applied dynamically.

If you use external logging, a rolling update is triggered when logging appenders are changed.

Garbage collector (GC)

Garbage collector logging can also be enabled (or disabled) using the **jvmOptions** property.

6.2.115.2. KafkaBridgeSpec schema properties

Property	Description
replicas integer	The number of pods in the **Deployment**.
image string	The docker image for the pods.
bootstrapServers string	A list of host:port pairs for establishing the initial connection to the Kafka cluster.
tls **ClientTls**	TLS configuration for connecting Kafka Bridge to the cluster.
authentication **KafkaClientAuthenticationTls**, **KafkaClientAuthenticationScramSha256**, **KafkaClientAuthenticationScramSha512**, **KafkaClientAuthenticationPlain**, **KafkaClientAuthenticationOAuth**	Authentication configuration for connecting to the cluster. The type depends on the value of the **authentication.type** property within the given object, which must be one of [tls, scram-sha-256, scram-sha-512, plain, oauth].
http **KafkaBridgeHttpConfig**	The HTTP related configuration.
adminClient **KafkaBridgeAdminClientSpec**	Kafka AdminClient related configuration.
consumer **KafkaBridgeConsumerSpec**	Kafka consumer related configuration.
producer **KafkaBridgeProducerSpec**	Kafka producer related configuration.

Property	Description
resources ResourceRequirements	CPU and memory resources to reserve. For more information, see the external documentation for core/v1 resourcerequirements.
jvmOptions **JvmOptions**	**Currently not supported** JVM Options for pods.
logging **InlineLogging**, **ExternalLogging**	Logging configuration for Kafka Bridge. The type depends on the value of the **logging.type** property within the given object, which must be one of [inline, external].
clientRackInitImage string	The image of the init container used for initializing the **client.rack**.
rack **Rack**	Configuration of the node label which will be used as the client.rack consumer configuration.
enableMetrics boolean	Enable the metrics for the Kafka Bridge. Default is false.
livenessProbe **Probe**	Pod liveness checking.
readinessProbe **Probe**	Pod readiness checking.
template **KafkaBridgeTemplate**	Template for Kafka Bridge resources. The template allows users to specify how a **Deployment** and **Pod** is generated.
tracing **JaegerTracing**, **OpenTelemetryTracing**	The configuration of tracing in Kafka Bridge. The type depends on the value of the **tracing.type** property within the given object, which must be one of [jaeger, opentelemetry].

6.2.116. KafkaBridgeHttpConfig schema reference

Used in: **KafkaBridgeSpec**

Full list of **KafkaBridgeHttpConfig** schema properties

Configures HTTP access to a Kafka cluster for the Kafka Bridge.

The default HTTP configuration is for the Kafka Bridge to listen on port 8080.

6.2.116.1. cors

As well as enabling HTTP access to a Kafka cluster, HTTP properties provide the capability to enable and define access control for the Kafka Bridge through Cross-Origin Resource Sharing (CORS). CORS is a HTTP mechanism that allows browser access to selected resources from more than one origin. To configure CORS, you define a list of allowed resource origins and HTTP access methods. For the origins, you can use a URL or a Java regular expression.

Example Kafka Bridge HTTP configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaBridge
metadata:
  name: my-bridge
spec:
  # ...
  http:
    port: 8080
    cors:
      allowedOrigins: "https://strimzi.io"
      allowedMethods: "GET,POST,PUT,DELETE,OPTIONS,PATCH"
  # ...
```

6.2.116.2. KafkaBridgeHttpConfig schema properties

Property	Description
port integer	The port which is the server listening on.
cors **KafkaBridgeHttpCors**	CORS configuration for the HTTP Bridge.

6.2.117. KafkaBridgeHttpCors schema reference

Used in: **KafkaBridgeHttpConfig**

Property	Description
allowedOrigins string array	List of allowed origins. Java regular expressions can be used.

Property	Description
allowedMethods	List of allowed HTTP methods.
string array	

6.2.118. KafkaBridgeAdminClientSpec schema reference

Used in: **KafkaBridgeSpec**

Property	Description
config	The Kafka AdminClient configuration used for AdminClient instances created by the bridge.
map	

6.2.119. KafkaBridgeConsumerSpec schema reference

Used in: **KafkaBridgeSpec**

Full list of **KafkaBridgeConsumerSpec** schema properties

Configures consumer options for the Kafka Bridge as keys.

The values can be one of the following JSON types:

- String
- Number
- Boolean

You can specify and configure the options listed in the Apache Kafka configuration documentation for consumers with the exception of those options which are managed directly by AMQ Streams. Specifically, all configuration options with keys equal to or starting with one of the following strings are forbidden:

- **ssl.**
- **sasl.**
- **security.**
- **bootstrap.servers**
- **group.id**

When one of the forbidden options is present in the **config** property, it is ignored and a warning message will be printed to the Cluster Operator log file. All other options will be passed to Kafka

IMPORTANT

The Cluster Operator does not validate keys or values in the **config** object. If an invalid configuration is provided, the Kafka Bridge cluster might not start or might become unstable. Fix the configuration so that the Cluster Operator can roll out the new configuration to all Kafka Bridge nodes.

There are exceptions to the forbidden options. For client connection using a specific *cipher suite* for a TLS version, you can configure allowed **ssl** properties.

Example Kafka Bridge consumer configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaBridge
metadata:
  name: my-bridge
spec:
  # ...
  consumer:
    config:
      auto.offset.reset: earliest
      enable.auto.commit: true
      ssl.cipher.suites: TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
      ssl.enabled.protocols: TLSv1.2
      ssl.protocol: TLSv1.2
      ssl.endpoint.identification.algorithm: HTTPS
    # ...
```

6.2.119.1. KafkaBridgeConsumerSpec schema properties

Property	Description
config	The Kafka consumer configuration used for consumer instances created by the bridge. Properties with the following prefixes cannot be set: ssl., bootstrap.servers, group.id, sasl., security. (with the exception of: ssl.endpoint.identification.algorithm, ssl.cipher.suites, ssl.protocol, ssl.enabled.protocols).
map	

6.2.120. KafkaBridgeProducerSpec schema reference

Used in: **KafkaBridgeSpec**

Full list of **KafkaBridgeProducerSpec** schema properties

Configures producer options for the Kafka Bridge as keys.

The values can be one of the following JSON types:

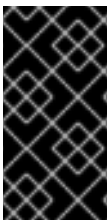
- String
- Number

- Boolean

You can specify and configure the options listed in the Apache Kafka configuration documentation for producers with the exception of those options which are managed directly by AMQ Streams. Specifically, all configuration options with keys equal to or starting with one of the following strings are forbidden:

- **ssl.**
- **sasl.**
- **security.**
- **bootstrap.servers**

When one of the forbidden options is present in the **config** property, it is ignored and a warning message will be printed to the Cluster Operator log file. All other options will be passed to Kafka



IMPORTANT

The Cluster Operator does not validate keys or values in the **config** object. If an invalid configuration is provided, the Kafka Bridge cluster might not start or might become unstable. Fix the configuration so that the Cluster Operator can roll out the new configuration to all Kafka Bridge nodes.

There are exceptions to the forbidden options. For client connection using a specific *cipher suite* for a TLS version, you can configure allowed **ssl** properties.

Example Kafka Bridge producer configuration

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaBridge
metadata:
  name: my-bridge
spec:
  # ...
  producer:
    config:
      acks: 1
      delivery.timeout.ms: 300000
      ssl.cipher.suites: TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
      ssl.enabled.protocols: TLSv1.2
      ssl.protocol: TLSv1.2
      ssl.endpoint.identification.algorithm: HTTPS
    # ...
```

6.2.120.1. **KafkaBridgeProducerSpec** schema properties

Property	Description

Property	Description
config map	The Kafka producer configuration used for producer instances created by the bridge. Properties with the following prefixes cannot be set: ssl., bootstrap.servers, sasl., security. (with the exception of: ssl.endpoint.identification.algorithm, ssl.cipher.suites, ssl.protocol, ssl.enabled.protocols).

6.2.121. KafkaBridgeTemplate schema reference

Used in: **KafkaBridgeSpec**

Property	Description
deployment **DeploymentTemplate**	Template for Kafka Bridge **Deployment**.
pod **PodTemplate**	Template for Kafka Bridge **Pods**.
apiService **InternalServiceTemplate**	Template for Kafka Bridge API **Service**.
podDisruptionBudget **PodDisruptionBudgetTemplate**	Template for Kafka Bridge **PodDisruptionBudget**.
bridgeContainer **ContainerTemplate**	Template for the Kafka Bridge container.
clusterRoleBinding **ResourceTemplate**	Template for the Kafka Bridge ClusterRoleBinding.
serviceAccount **ResourceTemplate**	Template for the Kafka Bridge service account.
initContainer	Template for the Kafka Bridge init container.

Property	Description
ContainerTemplate	

6.2.122. KafkaBridgeStatus schema reference

Used in: **KafkaBridge**

Property	Description
conditions	List of status conditions.
Condition array	
observedGeneration	The generation of the CRD that was last reconciled by the operator.
integer	
url	The URL at which external client applications can access the Kafka Bridge.
string	
labelSelector	Label selector for pods providing this resource.
string	
replicas	The current number of pods being used to provide this resource.
integer	

6.2.123. KafkaConnector schema reference

Property	Description
spec	The specification of the Kafka Connector.
KafkaConnectorSpec	
status	The status of the Kafka Connector.
KafkaConnectorStatus	

6.2.124. KafkaConnectorSpec schema reference

Used in: **KafkaConnector**

Property	Description
class	The Class for the Kafka Connector.
string	
tasksMax	The maximum number of tasks for the Kafka Connector.
integer	
autoRestart	Automatic restart of connector and tasks configuration.
AutoRestart	
config	The Kafka Connector configuration. The following properties cannot be set: connector.class, tasks.max.
map	
pause	Whether the connector should be paused. Defaults to false.
boolean	

6.2.125. AutoRestart schema reference

Used in: **KafkaConnectorSpec**, **KafkaMirrorMaker2ConnectorSpec**

Full list of **AutoRestart** schema properties

Configures automatic restarts for connectors and tasks that are in a **FAILED** state.

When enabled, a back-off algorithm applies the automatic restart to each failed connector and its tasks.

The operator attempts an automatic restart on reconciliation. If the first attempt fails, the operator makes up to six more attempts. The duration between each restart attempt increases from 2 to 30 minutes. After each restart, failed connectors and tasks transit from **FAILED** to **RESTARTING**. If the restart fails after the final attempt, there is likely to be a problem with the connector configuration. The connector and tasks remain in a **FAILED** state and you have to restart them manually. You can do this by annotating the **KafKaConnector** custom resource with **strimzi.io/restart: "true"**.

For Kafka Connect connectors, use the **autoRestart** property of the **KafkaConnector** resource to enable automatic restarts of failed connectors and tasks.

Enabling automatic restarts of failed connectors for Kafka Connect

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaConnector
metadata:
  name: my-source-connector
spec:
  autoRestart:
    enabled: true
```

For MirrorMaker 2, use the **autoRestart** property of connectors in the **KafkaMirrorMaker2** resource to enable automatic restarts of failed connectors and tasks.

Enabling automatic restarts of failed connectors for MirrorMaker 2

```
apiVersion: kafka.strimzi.io/v1beta2
kind: KafkaMirrorMaker2
metadata:
  name: my-mm2-cluster
spec:
  mirrors:
  - sourceConnector:
      autoRestart:
        enabled: true
      # ...
    heartbeatConnector:
      autoRestart:
        enabled: true
      # ...
    checkpointConnector:
      autoRestart:
        enabled: true
      # ...
```

6.2.125.1. AutoRestart schema properties

Property	Description
enabled	Whether automatic restart for failed connectors and tasks should be enabled or disabled.
boolean	

6.2.126. KafkaConnectorStatus schema reference

Used in: **KafkaConnector**

Property	Description
conditions	List of status conditions.
Condition array	
observedGeneration	The generation of the CRD that was last reconciled by the operator.
integer	
autoRestart	The auto restart status.

Property	Description
AutoRestartStatus	
connectorStatus	The connector status, as reported by the Kafka Connect REST API.
map	
tasksMax	The maximum number of tasks for the Kafka Connector.
integer	
topics	The list of topics used by the Kafka Connector.
string array	

6.2.127. AutoRestartStatus schema reference

Used in: **KafkaConnectorStatus**, **KafkaMirrorMaker2Status**

Property	Description
count	The number of times the connector or task is restarted.
integer	
connectorName	The name of the connector being restarted.
string	
lastRestartTimestamp	The last time the automatic restart was attempted. The required format is 'yyyy-MM-ddTHH:mm:ssZ' in the UTC time zone.
string	

6.2.128. KafkaMirrorMaker2 schema reference

Property	Description
spec	The specification of the Kafka MirrorMaker 2 cluster.
KafkaMirrorMaker2Spec	
status	The status of the Kafka MirrorMaker 2 cluster.
KafkaMirrorMaker2Status	

6.2.129. KafkaMirrorMaker2Spec schema reference

Used in: **KafkaMirrorMaker2**

Property	Description
version string	The Kafka Connect version. Defaults to 3.4.0. Consult the user documentation to understand the process required to upgrade or downgrade the version.
replicas integer	The number of pods in the Kafka Connect group.
image string	The docker image for the pods.
connectCluster string	The cluster alias used for Kafka Connect. The alias must match a cluster in the list at **spec.clusters**.
clusters **KafkaMirrorMaker2ClusterSpec** array	Kafka clusters for mirroring.
mirrors **KafkaMirrorMaker2MirrorSpec** array	Configuration of the MirrorMaker 2 connectors.
resources ResourceRequirements	The maximum limits for CPU and memory resources and the requested initial resources. For more information, see the external documentation for core/v1 resourcerequirements.
livenessProbe **Probe**	Pod liveness checking.
readinessProbe **Probe**	Pod readiness checking.
jvmOptions **JvmOptions**	JVM Options for pods.

Property	Description
jmxOptions **KafkaJmxOptions**	JMX Options.
logging **InlineLogging**, **ExternalLogging**	Logging configuration for Kafka Connect. The type depends on the value of the **logging.type** property within the given object, which must be one of [inline, external].
clientRackInitImage string	The image of the init container used for initializing the **client.rack**.
rack **Rack**	Configuration of the node label which will be used as the **client.rack** consumer configuration.
tracing **JaegerTracing**, **OpenTelemetryTracing**	The configuration of tracing in Kafka Connect. The type depends on the value of the **tracing.type** property within the given object, which must be one of [jaeger, opentelemetry].
template **KafkaConnectTemplate**	Template for Kafka Connect and Kafka Mirror Maker 2 resources. The template allows users to specify how the **Deployment**, **Pods** and **Service** are generated.
externalConfiguration **ExternalConfiguration**	Pass data from Secrets or ConfigMaps to the Kafka Connect pods and use them to configure connectors.
metricsConfig **JmxPrometheusExporterMetrics**	Metrics configuration. The type depends on the value of the **metricsConfig.type** property within the given object, which must be one of [jmxPrometheusExporter].

6.2.130. KafkaMirrorMaker2ClusterSpec schema reference

Used in: **KafkaMirrorMaker2Spec**

Full list of **KafkaMirrorMaker2ClusterSpec** schema properties

Configures Kafka clusters for mirroring.

6.2.130.1. config

Use the **config** properties to configure Kafka options.

Standard Apache Kafka configuration may be provided, restricted to those properties not managed directly by AMQ Streams.

For client connection using a specific *cipher suite* for a TLS version, you can configure allowed **ssl** properties. You can also configure the **ssl.endpoint.identification.algorithm** property to enable or disable hostname verification.

6.2.130.2. KafkaMirrorMaker2ClusterSpec schema properties

Property	Description
alias string	Alias used to reference the Kafka cluster.
bootstrapServers string	A comma-separated list of **host:port** pairs for establishing the connection to the Kafka cluster.
tls **ClientTls**	TLS configuration for connecting MirrorMaker 2 connectors to a cluster.
authentication **KafkaClientAuthenticationTls**, **KafkaClientAuthenticationScramSha256**, **KafkaClientAuthenticationScramSha512**, **KafkaClientAuthenticationPlain**, **KafkaClientAuthenticationOAuth**	Authentication configuration for connecting to the cluster. The type depends on the value of the **authentication.type** property within the given object, which must be one of [tls, scram-sha-256, scram-sha-512, plain, oauth].
config map	The MirrorMaker 2 cluster config. Properties with the following prefixes cannot be set: ssl., sasl., security., listeners, plugin.path, rest., bootstrap.servers, consumer.interceptor.classes, producer.interceptor.classes (with the exception of: ssl.endpoint.identification.algorithm, ssl.cipher.suites, ssl.protocol, ssl.enabled.protocols).

6.2.131. KafkaMirrorMaker2MirrorSpec schema reference

Used in: **KafkaMirrorMaker2Spec**

Property	Description
sourceCluster string	The alias of the source cluster used by the Kafka MirrorMaker 2 connectors. The alias must match a cluster in the list at **spec.clusters**.

Property	Description
targetCluster string	The alias of the target cluster used by the Kafka MirrorMaker 2 connectors. The alias must match a cluster in the list at **spec.clusters**.
sourceConnector **KafkaMirrorMaker2ConnectorSpec**	The specification of the Kafka MirrorMaker 2 source connector.
heartbeatConnector **KafkaMirrorMaker2ConnectorSpec**	The specification of the Kafka MirrorMaker 2 heartbeat connector.
checkpointConnector **KafkaMirrorMaker2ConnectorSpec**	The specification of the Kafka MirrorMaker 2 checkpoint connector.
topicsPattern string	A regular expression matching the topics to be mirrored, for example, "topic1|topic2|topic3". Comma-separated lists are also supported.
topicsBlacklistPattern string	**The topicsBlacklistPattern property has been deprecated, and should now be configured using .spec.mirrors.topicsExcludePattern.** A regular expression matching the topics to exclude from mirroring. Comma-separated lists are also supported.
topicsExcludePattern string	A regular expression matching the topics to exclude from mirroring. Comma-separated lists are also supported.
groupsPattern string	A regular expression matching the consumer groups to be mirrored. Comma-separated lists are also supported.
groupsBlacklistPattern string	**The groupsBlacklistPattern property has been deprecated, and should now be configured using .spec.mirrors.groupsExcludePattern.** A regular expression matching the consumer groups to exclude from mirroring. Comma-separated lists are also supported.
groupsExcludePattern string	A regular expression matching the consumer groups to exclude from mirroring. Comma-separated lists are also supported.

6.2.132. KafkaMirrorMaker2ConnectorSpec schema reference

Used in: **KafkaMirrorMaker2MirrorSpec**

Property	Description
tasksMax integer	The maximum number of tasks for the Kafka Connector.
config map	The Kafka Connector configuration. The following properties cannot be set: connector.class, tasks.max.
autoRestart **AutoRestart**	Automatic restart of connector and tasks configuration.
pause boolean	Whether the connector should be paused. Defaults to false.

6.2.133. KafkaMirrorMaker2Status schema reference

Used in: **KafkaMirrorMaker2**

Property	Description
conditions **Condition** array	List of status conditions.
observedGeneration integer	The generation of the CRD that was last reconciled by the operator.
url string	The URL of the REST API endpoint for managing and monitoring Kafka Connect connectors.
autoRestartStatuses **AutoRestartStatus** array	List of MirrorMaker 2 connector auto restart statuses.
connectorPlugins **ConnectorPlugin** array	The list of connector plugins available in this Kafka Connect deployment.

Property	Description
connectors	List of MirrorMaker 2 connector statuses, as reported by the Kafka Connect REST API.
map array	
labelSelector	Label selector for pods providing this resource.
string	
replicas	The current number of pods being used to provide this resource.
integer	

6.2.134. KafkaRebalance schema reference

Property	Description
spec	The specification of the Kafka rebalance.
KafkaRebalanceSpec	
status	The status of the Kafka rebalance.
KafkaRebalanceStatus	

6.2.135. KafkaRebalanceSpec schema reference

Used in: **KafkaRebalance**

Property	Description
mode	Mode to run the rebalancing. The supported modes are **full**, **add-brokers**, **remove-brokers**. If not specified, the **full** mode is used by default. • **full** mode runs the rebalancing across all the brokers in the cluster. • **add-brokers** mode can be used after scaling up the cluster to move some replicas to the newly added brokers. • **remove-brokers** mode can be used before scaling down the cluster to move replicas out of the brokers to be removed.
string (one of [remove-brokers, full, add-brokers])	

Property	Description
brokers integer array	The list of newly added brokers in case of scaling up or the ones to be removed in case of scaling down to use for rebalancing. This list can be used only with rebalancing mode **add-brokers** and **removed-brokers**. It is ignored with**full** mode.
goals string array	A list of goals, ordered by decreasing priority, to use for generating and executing the rebalance proposal. The supported goals are available at https://github.com/linkedin/cruise-control#goals. If an empty goals list is provided, the goals declared in the default.goals Cruise Control configuration parameter are used.
skipHardGoalCheck boolean	Whether to allow the hard goals specified in the Kafka CR to be skipped in optimization proposal generation. This can be useful when some of those hard goals are preventing a balance solution being found. Default is false.
rebalanceDisk boolean	Enables intra-broker disk balancing, which balances disk space utilization between disks on the same broker. Only applies to Kafka deployments that use JBOD storage with multiple disks. When enabled, inter-broker balancing is disabled. Default is false.
excludedTopics string	A regular expression where any matching topics will be excluded from the calculation of optimization proposals. This expression will be parsed by the java.util.regex.Pattern class; for more information on the supported format consult the documentation for that class.
concurrentPartitionMovementsPerBroker integer	The upper bound of ongoing partition replica movements going into/out of each broker. Default is 5.

Property	Description
concurrentIntraBrokerPartitionMovements integer	The upper bound of ongoing partition replica movements between disks within each broker. Default is 2.
concurrentLeaderMovements integer	The upper bound of ongoing partition leadership movements. Default is 1000.
replicationThrottle integer	The upper bound, in bytes per second, on the bandwidth used to move replicas. There is no limit by default.
replicaMovementStrategies string array	A list of strategy class names used to determine the execution order for the replica movements in the generated optimization proposal. By default BaseReplicaMovementStrategy is used, which will execute the replica movements in the order that they were generated.

6.2.136. KafkaRebalanceStatus schema reference

Used in: **KafkaRebalance**

Property	Description
conditions **Condition** array	List of status conditions.
observedGeneration integer	The generation of the CRD that was last reconciled by the operator.
sessionId string	The session identifier for requests to Cruise Control pertaining to this KafkaRebalance resource. This is used by the Kafka Rebalance operator to track the status of ongoing rebalancing operations.
optimizationResult map	A JSON object describing the optimization result.

APPENDIX A. 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. If you are using RPM packages, this step is not required.

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

Installing packages with DNF

To install a package and all the package dependencies, use:

```
dnf install <package_name>
```

To install a previously-downloaded package from a local directory, use:

```
dnf install <path_to_download_package>
```

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