Amazon Simple Queue Service

Developer Guide

Amazon Simple Queue Service: Developer Guide

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What is Amazon Simple Queue Service?

Amazon Simple Queue Service (Amazon SQS) offers a secure, durable, and available hosted queue that lets you integrate and decouple distributed software systems and components. Amazon SQS offers common constructs such as dead-letter queues (p. 43) and cost allocation tags (p. 40). It provides a generic web services API that you can access using any programming language that the AWS SDK supports.

Amazon SQS supports both standard (p. 25) and FIFO queues (p. 26). For more information, see Queue types (p. 2).

Topics

Benefits of using Amazon SQS

- **Security** – You control (p. 113) who can send messages to and receive messages from an Amazon SQS queue.

  Server-side encryption (SSE) (p. 106) lets you transmit sensitive data by protecting the contents of messages in queues using keys managed in AWS Key Management Service (AWS KMS).
- **Durability** – For the safety of your messages, Amazon SQS stores them on multiple servers. Standard queues support at-least-once message delivery (p. 26), and FIFO queues support exactly-once message processing (p. 29).
- **Availability** – Amazon SQS uses redundant infrastructure (p. 23) to provide highly-concurrent access to messages and high availability for producing and consuming messages.
- **Scalability** – Amazon SQS can process each buffered request (p. 165) independently, scaling transparently to handle any load increases or spikes without any provisioning instructions.
- **Reliability** – Amazon SQS locks your messages during processing, so that multiple producers can send and multiple consumers can receive messages at the same time.
- **Customization** – Your queues don't have to be exactly alike—for example, you can set a default delay on a queue (p. 48). You can store the contents of messages larger than 256 KB using Amazon Simple Storage Service (Amazon S3) (p. 66) or Amazon DynamoDB, with Amazon SQS holding a pointer to the Amazon S3 object, or you can split a large message into smaller messages.

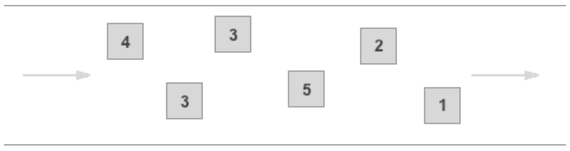
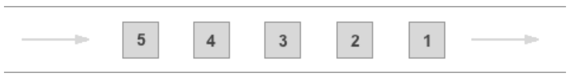
Differences between Amazon SQS, Amazon MQ, and Amazon SNS

Amazon SQS and Amazon SNS are queue and topic services that are highly scalable, simple to use, and don't require you to set up message brokers. We recommend these services for new applications that can benefit from nearly unlimited scalability and simple APIs.

Amazon MQ is a managed message broker service that provides compatibility with many popular message brokers. We recommend Amazon MQ for migrating applications from existing message brokers that rely on compatibility with APIs such as JMS or protocols such as AMQP, MQTT, OpenWire, and STOMP.

Queue types

The following table describes the capabilities of standard queues and FIFO queues.

Standard queue	FIFO queue
Unlimited Throughput – Standard queues support a nearly unlimited number of API calls per second, per API action (`SendMessage`, `ReceiveMessage`, or `DeleteMessage`). **At-Least-Once Delivery** – A message is delivered at least once, but occasionally more than one copy of a message is delivered. **Best-Effort Ordering** – Occasionally, messages are delivered in an order different from which they were sent.	**High Throughput** – If you use batching (p. 164), FIFO queues support up to 3,000 messages per second, per API method (`SendMessageBatch`, `ReceiveMessage`, or `DeleteMessageBatch`). The 3000 messages per second represent 300 API calls, each with a batch of 10 messages. To request a quota increase, submit a support request. Without batching, FIFO queues support up to 300 API calls per second, per API method (`SendMessage`, `ReceiveMessage`, or `DeleteMessage`). **Exactly-Once Processing** – A message is delivered once and remains available until a consumer processes and deletes it. Duplicates aren't introduced into the queue. **First-In-First-Out Delivery** – The order in which messages are sent and received is strictly preserved.
	
Send data between applications when the throughput is important, for example: • Decouple live user requests from intensive background work: let users upload media while resizing or encoding it. • Allocate tasks to multiple worker nodes: process a high number of credit card validation requests. • Batch messages for future processing: schedule multiple entries to be added to a database.	Send data between applications when the order of events is important, for example: • Make sure that user-entered commands are run in the right order. • Display the correct product price by sending price modifications in the right order. • Prevent a student from enrolling in a course before registering for an account.

Common tasks for getting started with Amazon SQS

- To create your first queue with Amazon SQS and send, receive, and delete a message, see Getting started with Amazon SQS (p. 7).
- To trigger a Lambda function, see Configuring a queue to trigger an AWS Lambda function (console) (p. 16).
- To discover the functionality and architecture of Amazon SQS, see How Amazon SQS works (p. 23).
- To find out the guidelines and caveats that will help you make the most of Amazon SQS, see Best practices for Amazon SQS (p. 54).
- Explore the Amazon SQS examples for one of the AWS SDKs, such as the AWS SDK for Java 2.x Developer Guide.
- To learn about Amazon SQS actions, see the *Amazon Simple Queue Service API Reference*.
- To learn about Amazon SQS AWS CLI commands, see the *AWS CLI Command Reference*.

Pricing for Amazon SQS

Amazon SQS has no upfront costs. The first million monthly requests are free. After that, you pay based on the number and content of requests, and the interactions with Amazon S3 and the AWS Key Management Service.

For information, see Amazon SQS pricing.

Setting up Amazon SQS

Topics

Before you can use Amazon SQS for the first time, you must complete the following steps.

Step 1: Create an AWS account

To access any AWS service, you first need to create an AWS account, an Amazon.com account that can use AWS products. You can use your AWS account to view your activity and usage reports and to manage authentication and access.

To avoid using your AWS account root user for Amazon SQS actions, it is a best practice to create an IAM user for each person who needs administrative access to Amazon SQS.

To set up a new account

1. Open https://portal.aws.amazon.com/billing/signup.
2. Follow the online instructions.

   Part of the sign-up procedure involves receiving a phone call and entering a verification code on the phone keypad.

Step 2: Create an IAM user

To create an administrator user for yourself and add the user to an administrators group (console)

1. Sign in to the IAM console as the account owner by choosing **Root user** and entering your AWS account email address. On the next page, enter your password.

   Note
   We strongly recommend that you adhere to the best practice of using the `Administrator` IAM user that follows and securely lock away the root user credentials. Sign in as the root user only to perform a few account and service management tasks.
2. In the navigation pane, choose **Users** and then choose **Add user**.
3. For **User name**, enter `Administrator`.
4. Select the check box next to **AWS Management Console access**. Then select **Custom password**, and then enter your new password in the text box.
5. (Optional) By default, AWS requires the new user to create a new password when first signing in. You can clear the check box next to **User must create a new password at next sign-in** to allow the new user to reset their password after they sign in.

6. Choose **Next: Permissions**.
7. Under **Set permissions**, choose **Add user to group**.
8. Choose **Create group**.
9. In the **Create group** dialog box, for **Group name** enter **`Administrators`**.
10. Choose **Filter policies**, and then select **AWS managed - job function** to filter the table contents.
11. In the policy list, select the check box for **AdministratorAccess**. Then choose **Create group**.

    Note
    You must activate IAM user and role access to Billing before you can use the `AdministratorAccess` permissions to access the AWS Billing and Cost Management console. To do this, follow the instructions in step 1 of the tutorial about delegating access to the billing console.
12. Back in the list of groups, select the check box for your new group. Choose **Refresh** if necessary to see the group in the list.
13. Choose **Next: Tags**.
14. (Optional) Add metadata to the user by attaching tags as key-value pairs. For more information about using tags in IAM, see Tagging IAM entities in the *IAM User Guide*.
15. Choose **Next: Review** to see the list of group memberships to be added to the new user. When you are ready to proceed, choose **Create user**.

You can use this same process to create more groups and users and to give your users access to your AWS account resources. To learn about using policies that restrict user permissions to specific AWS resources, see Access management and Example policies.

Step 3: Get your access key ID and secret access key

To use Amazon SQS actions (for example, using Java or through the AWS Command Line Interface), you need an access key ID and a secret access key.

Note
The access key ID and secret access key are specific to AWS Identity and Access Management. Don't confuse them with credentials for other AWS services, such as Amazon EC2 key pairs.

Access keys consist of an access key ID and secret access key, which are used to sign programmatic requests that you make to AWS. If you don't have access keys, you can create them from the AWS Management Console. As a best practice, do not use the AWS account root user access keys for any task where it's not required. Instead, create a new administrator IAM user with access keys for yourself.

The only time that you can view or download the secret access key is when you create the keys. You cannot recover them later. However, you can create new access keys at any time. You must also have permissions to perform the required IAM actions. For more information, see Permissions required to access IAM resources in the *IAM User Guide*.

To create access keys for an IAM user

1. Sign in to the AWS Management Console and open the IAM console at https://console.aws.amazon.com/iam/.
2. In the navigation pane, choose **Users**.
3. Choose the name of the user whose access keys you want to create, and then choose the **Security credentials** tab.
4. In the **Access keys** section, choose **Create access key**.

5. To view the new access key pair, choose **Show**. You will not have access to the secret access key again after this dialog box closes. Your credentials will look something like this:

   - Access key ID: AKIAIOSFODNN7EXAMPLE
   - Secret access key: wJalrXUtnFEMI/K7MDENG/bPxRfiCYEXAMPLEKEY
6. To download the key pair, choose **Download .csv file**. Store the keys in a secure location. You will not have access to the secret access key again after this dialog box closes.

   Keep the keys confidential in order to protect your AWS account and never email them. Do not share them outside your organization, even if an inquiry appears to come from AWS or Amazon.com. No one who legitimately represents Amazon will ever ask you for your secret key.
7. After you download the `.csv` file, choose **Close**. When you create an access key, the key pair is active by default, and you can use the pair right away.

Related topics

- What is IAM? in the *IAM User Guide*
- AWS security credentials in *AWS General Reference*

Step 4: Get ready to use the example code

This guide includes examples that use the AWS SDK for Java. To run the example code, follow the set-up instructions in Getting Started with AWS SDK for Java 2.0.

You can develop AWS applications in other programming languages, such as Go, JavaScript, Python and Ruby. For more information, see Tools for developing and managing applications on AWS.

> **Note**
> You can explore Amazon SQS without writing code with tools such as the AWS Command Line Interface (AWS CLI) or Windows PowerShell. You can find AWS CLI examples in the Amazon SQS section of the *AWS CLI Command Reference*. You can find Windows PowerShell examples in the Amazon Simple Queue Service section of the *AWS Tools for PowerShell Cmdlet Reference*.

Next steps

You are now ready for Getting started (p. 7) with managing Amazon SQS queues and messages using the AWS Management Console.

Getting started with Amazon SQS

This section helps you become more familiar with Amazon SQS by showing you how to manage queues and messages using the Amazon SQS console.

Topics

Prerequisites

Before you begin, complete the steps in Setting up Amazon SQS (p. 4).

Step 1: Create a queue

The first and most common Amazon SQS task is creating queues. This procedure shows how to create and configure a FIFO queue.

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. Choose **Create queue**.
3. On the **Create queue** page, specify the correct region.
4. The **Standard** queue type is selected by default. Choose **FIFO**.

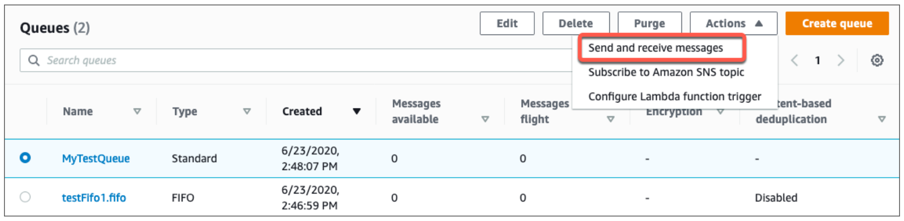
   You can't change the queue type after you create a queue.
5. Enter a **Name** for your queue. The name of a FIFO queue must end with the `.fifo` suffix.
6. To create your queue with the default parameters, scroll to the bottom and choose **Create Queue**. Amazon SQS creates the queue and displays the queue's **Details** page.

   Amazon SQS propagates information about the new queue across the system. Because Amazon SQS is a distributed system, you may experience a slight delay before the queue is displayed on the **Queues** page.

Step 2: Send a message

After you create your queue, you can send a message to it.

1. From the left navigation pane, choose **Queues**. From the queue list, select the queue that you created.
2. From **Actions**, choose **Send and receive messages**.

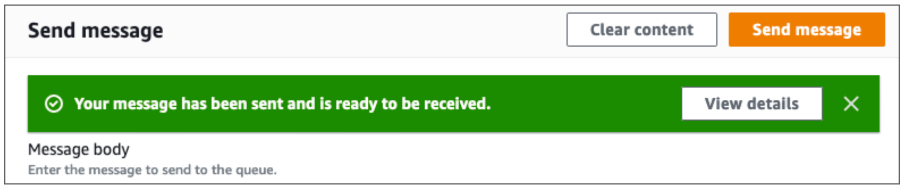

Queues (2)
Edit
Delete
Purge
Actions
Create queue
Search queues
Send and receive messages
Subscribe to Amazon SNS topic
Configure Lambda function trigger
1

	Name	Type	Created	Messages available	Messages flight	Encryption	tent-based deduplication
●	MyTestQueue	Standard	6/23/2020, 2:48:07 PM	0	0	-	-
○	testFifo1.fifo	FIFO	6/23/2020, 2:46:59 PM	0	0	-	Disabled

The console displays the **Send and receive messages** page.

3. Enter text in the **Message body**
4. Enter a **Message group id** for the queue. For more information, see FIFO delivery logic (p. 28).
5. (Optional) Enter a **Message deduplication id**. If you enable content-based deduplication, the message deduplication ID is not required. For more information, see FIFO delivery logic (p. 28).
6. Choose **Send message**.

   Your message is sent and the console displays a success message. Choose **View details** to display information about the sent message.



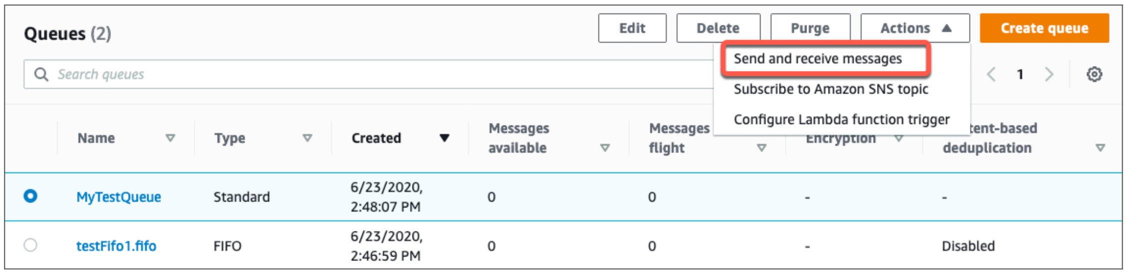
Your message has been sent and is ready to be received.

Message body
Enter the message to send to the queue.

Step 3: Receive and delete your message

After you send a message to a queue, you can retrieve the message from the queue. When you request messages from a queue, you can't specify which message to retrieve. Instead, you specify the maximum number of messages (up to 10) that you want to retrieve.

1. From the **Queues** page, select a queue.
2. From **Queue Actions**, select **Send and receive messages**.


Queues (2)
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○	testFifo1.fifo	FIFO	6/23/2020, 2:46:59 PM	0	0	-	Disabled

The console displays the **Send and receive messages** page.

3. Choose **Poll for messages.**

   Amazon SQS begins to poll servers to find messages in the queue. The progress bar on the right side of the **Receive messages** section displays the polling duration.

   The **Messages** section displays a list of the received messages. For each message, the list displays the message ID, sent date, size, and receive count.
4. To delete messages, select the messages that you want to delete and then choose **Delete**.
5. In the **Delete Messages** dialog box, choose **Delete**.

Step 4: Delete your queue

1. From the queue list, select the queue that you have created.
2. From the **Queues** page, select the queue to delete.
3. Choose **Delete queue**.

   The console displays the **Delete queue** dialog box.
4. In the **Delete queue** dialog box, confirm the deletion by entering **`delete`**.
5. Choose **Delete**.

Next steps

Now that you've created a queue and learned how to send, receive, and delete messages and how to delete a queue, you might want to try the following:

- Configure queues, including SSE and other features (p. 10).
- Send a message with attributes. (p. 19)
- Send a message from a VPC. (p. 94)
- Learn more about Amazon SQS workflows and processes: Read How Queues Work (p. 23), Best Practices (p. 54), and Quotas (p. 99). You can also explore the Amazon SQS Articles & Tutorials. If you ever have any questions, browse the Amazon SQS FAQs or participate in the Amazon SQS Developer Forums.
- Learn how to interact with Amazon SQS programmatically: Read Working with APIs (p. 158) and explore the Sample Code and Libraries and the developer centers:
  - Java
  - JavaScript
  - PHP
  - Python
  - Ruby
  - Windows & .NET
- Learn about keeping an eye on costs and resources in the Automating and troubleshooting Amazon SQS queues (p. 104) section.
- Learn about protecting your data and access to it in the Security (p. 105) section.

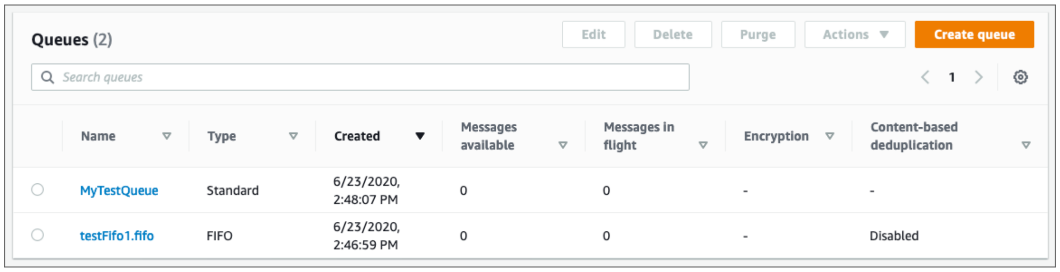
Configuring Amazon SQS queues (console)

Use the Amazon SQS console to configure and manage Amazon Simple Queue Service (Amazon SQS) queues and features. You can also use the console to configure features such as server-side encryption, associate a dead-letter queue with your queue, or set a trigger to invoke an AWS Lambda function.

Topics

Understanding the Amazon SQS console

When you open the console, choose **Queues** from the navigation pane to display the **Queues** page. The **Queues** page provides information about all of your queues in the active region.

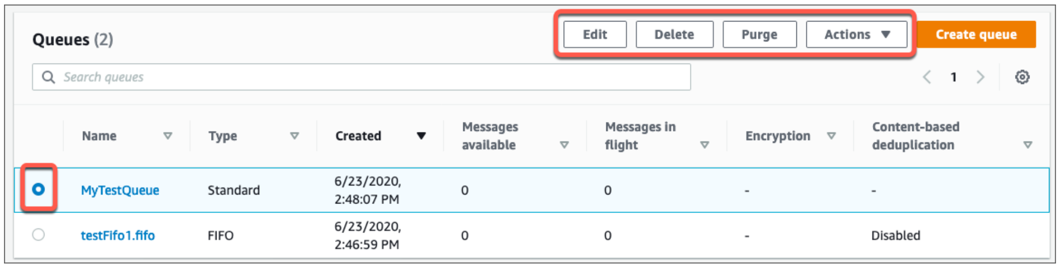


Queues (2)

	Name	Type	Created	Messages available	Messages in flight	Encryption	Content-based deduplication
○	MyTestQueue	Standard	6/23/2020, 2:48:07 PM	0	0	-	-
○	testFifo1.fifo	FIFO	6/23/2020, 2:46:59 PM	0	0	-	Disabled

The entry for each queue shows the queue type and other information about the queue. The **Type** column helps you distinguish standard queues from First-In-First Out (FIFO) queues at a glance.

From the **Queues** page, there are two ways to perform actions on a queue. You can choose the option next to the queue name and then choose the action you want to perform on the queue.



Queues (2)

	Name	Type	Created	Messages available	Messages in flight	Encryption	Content-based deduplication
●	MyTestQueue	Standard	6/23/2020, 2:48:07 PM	0	0	-	-
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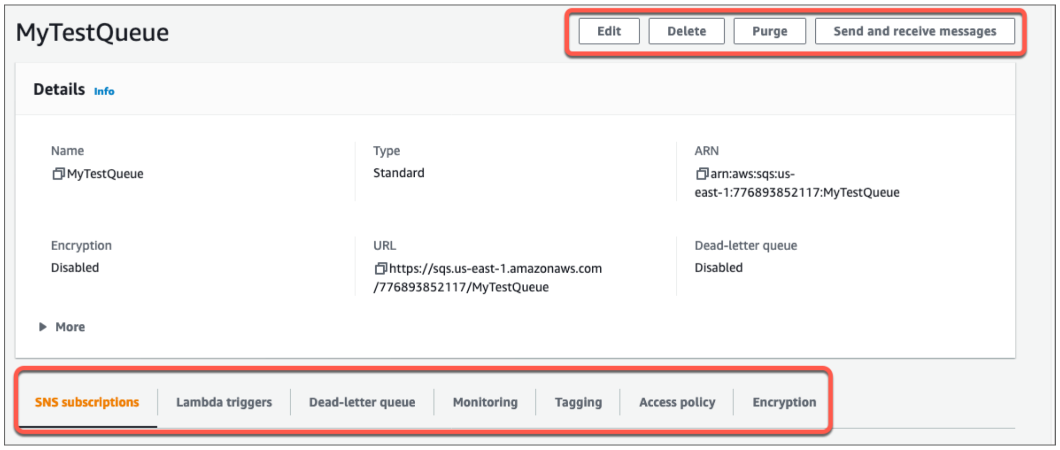
You can also choose the queue name, which open the **Details** page for the queue. The **Details** page includes the same actions as the **Queues** page. In addition, you can choose one of the tabs below the **Details** section to view additional configuration details and actions.



Name
MyTestQueue

Type
Standard

ARN
arn:aws:sqs:us-east-1:776893852117:MyTestQueue

Encryption
Disabled

URL
https://sqs.us-east-1.amazonaws.com/776893852117/MyTestQueue

Dead-letter queue
Disabled

Creating an Amazon SQS queue (console)

You can use the Amazon SQS console to create standard queues (p. 25) and FIFO queues (p. 26). The console provides default values for all settings except for the queue name.

To create an Amazon SQS queue (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. Choose **Create queue**.
3. For **Type**, the **Standard** queue type is set by default. To create a FIFO queue, choose **FIFO**.

   Note
   You can't change the queue type after you create the queue.
4. Enter a **Name** for your queue. The name of a FIFO queue must end with the `.fifo` suffix.
5. (Optional) The console sets default values for the queue configuration parameters (p. 12). Under **Configuration**, you can set new values for the following parameters:

   a. For **Visibility timeout** , enter the duration and units. The range is from 0 seconds to 12 hours. The default value is 30 seconds.

   b. For **Message retention period**, enter the duration and units. The range is from 1 minute to 14 days. The default value is 4 days.

   c. For **Delivery delay**, enter the duration and units. The range is from 0 seconds to 15 minutes. The default value is 0 seconds.

   d. For **Maximum message size**, enter a value. The range is from 1 KB to 256 KB. The default value is 256 KB.

   e. For **Receive message wait time**, enter a value. The range is from 0 to 20 seconds. The default value is 0 seconds, which sets short polling (p. 41). Any non-zero value sets long polling.

   f. For a FIFO queue, choose **Enable content-based deduplication** to enable content-based deduplication. The default setting is disabled.

   g. (Optional) For a FIFO queue, to enable higher throughput for sending and receiving messages in the queue, choose **Enable high throughput FIFO**.

      Choosing this option changes the related options (**Deduplication scope** and **FIFO throughput limit**) to the required settings for enabling high throughput for FIFO queues. If you change any of the settings required for using high throughput FIFO, normal throughput is in effect for the queue, and deduplication occurs as specified. For more information, see High throughput for FIFO queues (p. 30) and Quotas related to messages (p. 100).

6. (Optional) Define an **Access policy**. The access policy (p. 135) defines the accounts, users, and roles that can access the queue. The access policy also defines the actions (such as `SendMessage`, `ReceiveMessage`, or `DeleteMessage`) that the users can access. The default policy allows only the queue owner to send and receive messages.

   To define the access policy, do one of the following:

   - Choose **Basic** to configure who can send messages to the queue and who can receive messages from the queue. The console creates the policy based on your choices and displays the resulting access policy in the read-only JSON panel.
   - Choose **Advanced** to modify the JSON access policy directly. This allows you to specify a custom set of actions that each principal (account, user, or role) can perform.
7. (Optional) To configure encryption (p. 14) for the queue, expand **Encryption**.
8. (Optional) To configure a dead-letter queue (p. 15) to receive undeliverable messages, expand **Dead-letter queue**.
9. (Optional) To add tags (p. 15) to the queue, expand **Tags**.
10. Choose **Create queue**. Amazon SQS creates the queue and displays the queue's **Details** page.

Amazon SQS propagates information about the new queue across the system. Because Amazon SQS is a distributed system, you might experience a slight delay before the console displays the queue on the **Queues** page.

After creating a queue, you can send messages (p. 18) to it, and receive and delete messages (p. 20). You can also edit (p. 12) any of the queue configuration settings except the queue type.

Editing an Amazon SQS queue (console)

You can use the Amazon SQS console to edit any queue configuration parameters (except the queue type) and add or remove queue features.

To edit an Amazon SQS queue (console)

1. Open the Queues page of the Amazon SQS console.
2. Select a queue, and then choose **Edit**.
3. (Optional) Under **Configuration**, update the queue's configuration parameters (p. 12).
4. (Optional) To update the access policy (p. 14), under **Access policy**, modify the JSON policy.
5. (Optional) To add, update, or remove encryption (p. 14), expand **Encryption**.
6. (Optional) To add, update, or remove a dead-letter queue (p. 15) (which allows you to receive undeliverable messages), expand **Dead-letter queue**.
7. (Optional) To add, update, or remove the tags (p. 15) for the queue, expand **Tags**.
8. Choose **Save**.

   The console displays the **Details** page for the queue.

Configuring queue parameters (console)

When you create (p. 11) or edit (p. 12) a queue, you can configure the following parameters:

- **Visibility timeout** – The length of time that a message received from a queue (by one consumer) won't be visible to the other message consumers. For more information, see Visibility timeout (p. 46).

  Note
  Using the console to configure the visibility timeout configures the timeout value for all of the messages in the queue. To configure the timeout for single or multiple messages, you must use one of the AWS SDKs.
- **Message retention period** – The amount of time that Amazon SQS retains messages that remain in the queue. By default, the queue retains messages for four days. You can configure a queue to retain messages for up to 14 days. For more information, see Message retention period.
- **Delivery delay** – The amount of time that Amazon SQS will delay before delivering a message that is added to the queue. For more information, see Delivery delay (p. 48).
- **Maximum message size** – The maximum message size for this queue. For more information, see Maximum message size (p. 66).
- **Receive message wait time** – The maximum amount of time that Amazon SQS waits for messages to become available after the queue gets a receive request. For more information, see Amazon SQS short and long polling (p. 41).
- **Enable content-based deduplication** – Amazon SQS can automatically create deduplication IDs based on the body of the message. For more information, see Amazon SQS FIFO (First-In-First-Out) queues (p. 26).
- **Enable high throughput FIFO** – Use to enable high throughput for messages in the queue. Choosing this option changes the related options (**Deduplication scope** and **FIFO throughput limit**) to the required settings for enabling high throughput for FIFO queues. For more information, see High throughput for FIFO queues (p. 30) and Quotas related to messages (p. 100).

To configure queue parameters for an existing queue (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**. Choose a queue and choose **Edit**.
3. Scroll to the **Configuration** section.
4. For **Visibility timeout** , enter the duration and units. The range is 0 seconds to 12 hours. The default value is 30 seconds.
5. For **Message retention period**, enter the duration and units. The range is 1 minute to 14 days. The default value is 4 days.
6. For **Delivery delay**, enter the duration and units. The range is 0 seconds to 15 minutes. The default value is 0 seconds.
7. For **Maximum message size**, enter a value. The range is 1 KB to 256 KB. The default value is 256 KB.
8. For a standard queue, enter a value for **Receive message wait time**. The range is 0 to 20 seconds. The default value is 0 seconds, which sets short polling (p. 41). Any non-zero value sets long polling.
9. For a FIFO queue, choose **Enable content-based deduplication** to enable content-based deduplication. The default setting is disabled.
10. (Optional) For a FIFO queue, to enable higher throughput for sending and receiving messages in the queue, choose **Enable high throughput FIFO**.

    Choosing this option changes the related options (**Deduplication scope** and **FIFO throughput limit**) to the required settings for enabling high throughput for FIFO queues. If you change any of the settings required for using high throughput FIFO, normal throughput is in effect for the queue, and deduplication occurs as specified. For more information, see High throughput for FIFO queues (p. 30) and Quotas related to messages (p. 100).
11. When you finish configuring the queue parameters, choose **Save**.

Configuring access policy (console)

When you edit (p. 12) a queue, you can configure its access policy.

The access policy defines the accounts, users, and roles that can access the queue. The access policy also defines the actions (such as `SendMessage`, `ReceiveMessage`, or `DeleteMessage`) that the users can access. The default policy allows only the queue owner to send and receive messages.

To configure the access policy for an existing queue (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**.
3. Choose a queue and choose **Edit**.
4. Scroll to the **Access policy** section.
5. Edit the access policy statements in the input box.
6. When you finish configuring the access policy, choose **Save**.

Configuring server-side encryption (SSE) for a queue (console)

To protect the data in a queue's messages, you can enable server-side encryption (SSE) for a queue. Amazon SQS integrates with the AWS Key Management Service (AWS KMS) to manage customer master keys (CMKs) for server-side encryption (SSE). For information about using SSE, see Encryption at rest (p. 106).

The CMK that you assign to your queue must have a key policy that includes permissions for all principals that are authorized to use the queue. For information, see Key Management (p. 108).

If you aren't the owner of the CMK, or if you log in with an account that doesn't have `kms:ListAliases` and `kms:DescribeKey` permissions, you won't be able to view information about the CMK on the Amazon SQS console. Ask the owner of the CMK to grant you these permissions. For more information, see Key Management (p. 108).

When you create (p. 11) or edit (p. 12) a queue, you can configure SSE.

To configure SSE for an existing queue (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**.
3. Choose a queue and choose **Edit**.
4. Scroll to the **Encryption** section.
5. In the **Encryption** section, choose **Enabled** to enable SSE.

   The console displays the **Description**, the **Account**, and the **CMK ARN** of the CMK.
6. Specify the CMK ID for the queue. For more information, see Key terms (p. 107).

   a. Choose the **Choose a CMK alias** option.
   b. The default key is the AWS managed CMK for Amazon SQS. To use this key, choose it from the **Customer master key** list.
   c. To use a custom CMK from your AWS account, choose it from the **Customer master key** list. For instructions on creating custom CMKs, see Creating Keys in the *AWS Key Management Service Developer Guide*.

   d. To use a custom CMK that is not in the list, or a custom CMK from another AWS account, choose **Enter the CMK alias** and enter the CMK Amazon Resource Name (ARN).
7. (Optional) For **Data key reuse period**, specify a value between 1 minute and 24 hours. The default is 5 minutes. For more information, see Understanding the data key reuse period (p. 110).
8. When you finish configuring SSE, choose **Save**.

Configuring a dead-letter queue (console)

A *dead-letter queue* is a queue that one or more source queues can use for messages that are not consumed successfully. For more information, see Amazon SQS dead-letter queues (p. 43).

Amazon SQS does *not* create the dead-letter queue automatically. You must first create the queue before using it as a dead-letter queue..

The dead-letter queue of a FIFO queue must also be a FIFO queue. Similarly, the dead-letter queue of a standard queue must also be a standard queue.

When you create (p. 11) or edit (p. 12) a queue, you can configure a dead-letter queue.

To configure a dead-letter queue for an existing queue (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**.
3. Choose a queue and choose **Edit**.
4. Scroll to the **Dead-letter queue** section and choose **Enabled**.
5. Choose the Amazon Resource Name (ARN) of an existing **Dead Letter Queue** that you want to associate with this source queue.
6. To configure the number of times that a message can be received before being sent to a dead-letter queue, set **Maximum receives** to a value between 1 and 1,000.
7. When you finish configuring the dead-letter queue, choose **Save**.

   After you save the queue, the console displays the **Details** page for your queue. On the **Details** page, the **Dead-letter queue** tab displays the **Maximum Receives** and **Dead Letter Queue** ARN in the **Dead-letter queue**.

Configuring cost allocation tags for an Amazon SQS queue (console)

To help organize and identify your Amazon SQS queues, you can add cost allocation tags to them. For more information, see Amazon SQS cost allocation tags (p. 40).

On the **Details** page for a queue, the **Tagging** tab displays the tags for the queue.

When you create (p. 11) or edit (p. 12) a queue, you can configure tags for it.

To configure tags for an existing queue (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**.
3. Choose a queue and choose **Edit**.
4. Scroll to the **Tags** section.

5. Add, modify, or remove the queue tags:
   a. To add a tag, choose **Add new tag**, enter a **Key** and **Value**, and then choose **Add new tag**.
   b. To update a tag, change its **Key** and **Value**.
   c. To remove a tag, choose **Remove** next to its key-value pair.
6. When you finish configuring the tags, choose **Save**.

Subscribing an Amazon SQS queue to an Amazon SNS topic (console)

You can subscribe one or more Amazon SQS queues to an Amazon Simple Notification Service (Amazon SNS) topic. When you publish a message to a topic, Amazon SNS sends the message to each of the subscribed queues. Amazon SQS manages the subscription and any necessary permissions. For more information about Amazon SNS, see What is Amazon Simple Notification Service? in the *Amazon Simple Notification Service Developer Guide*.

When you subscribe an Amazon SQS queue to an SNS topic, Amazon SNS uses HTTPS to forward messages to Amazon SQS. For information about using Amazon SNS with encrypted Amazon SQS queues, see Configure KMS permissions for AWS services (p. 109).

To subscribe a queue to an SNS topic (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**.
3. From the list of queues, choose the queue to subscribe to the SNS topic.
4. From **Actions**, choose **Subscribe to Amazon SNS topic**.
5. From the **Specify an Amazon SNS topic available for this queue** menu, choose the SNS topic for your queue.

   If the SNS topic isn't listed in the menu, choose **Enter Amazon SNS topic ARN** and then enter the topic's Amazon Resource Name (ARN).
6. Choose **Save**.
7. To verify the result of the subscription, publish to the topic and then view the message that the topic sends to the queue. For more information, see Publishing a message to an Amazon SNS topic in the *Amazon Simple Notification Service Developer Guide*.

If your Amazon SQS queue and SNS topic are in different AWS accounts, the topic owner must first confirm the subscription. For more information, see Confirm the subscription in the *Amazon Simple Notification Service Developer Guide*.

For information on subscribing to a cross-region SNS topic, see Sending Amazon SNS messages to an Amazon SQS queue or AWS Lambda function in a different Region in the *Amazon Simple Notification Service Developer Guide*

Configuring a queue to trigger an AWS Lambda function (console)

You can use an AWS Lambda function to process messages in an Amazon SQS queue. Lambda polls the queue and invokes your Lambda function synchronously with an event that contains queue messages.

You can specify another queue to act as a *dead-letter queue* for messages that your Lambda function can't process.

A Lambda function can process items from multiple queues (using one Lambda event source for each queue). You can use the same queue with multiple Lambda functions.

If you associate an encrypted queue with a Lambda function but Lambda doesn't poll for messages, add the `kms:Decrypt` permission to your Lambda execution role.

Note the following restrictions:

- Your queue and the Lambda function must be in the same AWS Region.
- An encrypted queue (p. 106) that uses the default key (AWS managed CMK for Amazon SQS) cannot invoke a Lambda function in a different AWS account.

For information about implementing the Lambda function, see Using AWS Lambda with Amazon SQS in the *AWS Lambda Developer Guide*.

Prerequisites

To configure Lambda function triggers, you must meet the following requirements:

- If you use an IAM user, your Amazon SQS role must include the following permissions:
  - `lambda:CreateEventSourceMapping`
  - `lambda:ListEventSourceMappings`
  - `lambda:ListFunctions`
- The Lambda execution role must include the following permissions:
  - `sqs:DeleteMessage`
  - `sqs:GetQueueAttributes`
  - `sqs:ReceiveMessage`
- If you associate an encrypted queue with a Lambda function, add the `kms:Decrypt` permission to the Lambda execution role.

For more information, see Overview of managing access in Amazon SQS (p. 115).

To configure a queue to trigger a Lambda function (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**.
3. On the **Queues** page, choose the queue to configure.
4. On the queue's page, choose the **Lambda triggers** tab.
5. On the **Lambda triggers** page, choose a Lambda trigger.

   If the list doesn't include the Lambda trigger that you need, choose **Configure Lambda function trigger**. Enter the Amazon Resource Name (ARN) of the Lambda function or choose an existing resource. Then choose **Save**.
6. Choose **Save**. The console saves the configuration and displays the **Details** page for the queue.

   On the **Details** page, the **Lambda triggers** tab displays the Lambda function and its status. It takes approximately 1 minute for the Lambda function to become associated with your queue.
7. To verify the results of the configuration, send a message to your queue (p. 18) and then view the triggered Lambda function in the Lambda console.

Managing Amazon SQS queues (console)

After you create and configure your queue, you can use the Amazon SQS console to send messages to the queue and retrieve then from the queue.

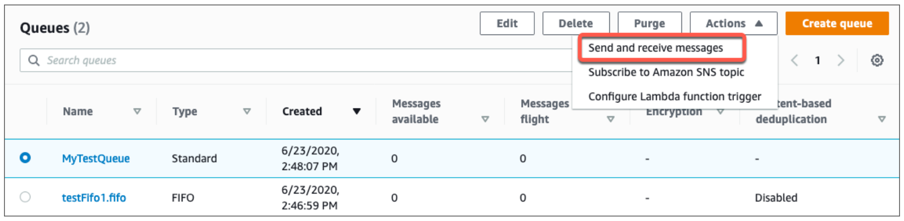
Topics

Sending messages to a queue (console)

After you create your queue, you can send messages to it.

To send a message (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**.
3. On the **Queues** page, choose a queue.
4. From **Actions**, choose **Send and receive messages**.

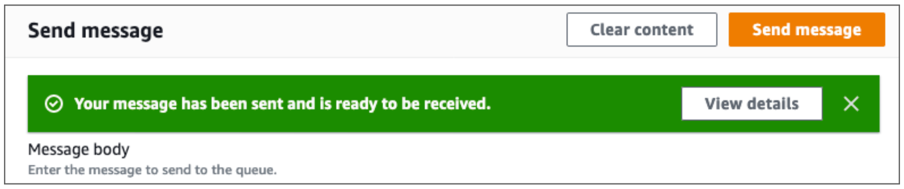

Queues (2)
Edit
Delete
Purge
Actions
Create queue
Send and receive messages
Subscribe to Amazon SNS topic
Configure Lambda function trigger
Search queues
1

	Name	Type	Created	Messages available	Messages flight	Encryption	tent-based deduplication
●	MyTestQueue	Standard	6/23/2020, 2:48:07 PM	0	0	-	-
○	testFifo1.fifo	FIFO	6/23/2020, 2:46:59 PM	0	0	-	Disabled

   The console displays the **Send and receive messages** page.
5. In the **Message body**, enter the message text.
6. For a First-In-First-Out (FIFO) queue, enter a **Message group ID**. For more information, see FIFO delivery logic (p. 28).
7. (Optional) For a FIFO queue, you can enter a **Message deduplication ID**. If you enabled content-based deduplication for the queue, the message deduplication ID isn't required. For more information, see FIFO delivery logic (p. 28).
8. (Optional) For a standard queue, you can enter a value for **Delivery delay** and choose the units. For example, enter `60` and choose **seconds**. FIFO queues don't support timers on individual messages. For more information, see Amazon SQS message timers (p. 53).

9. Choose **Send message**.

   When your message is sent, the console displays a success message. Choose **View details** to display information about the sent message.


Send message
Clear content
Send message
Your message has been sent and is ready to be received.
View details
Message body
Enter the message to send to the queue.

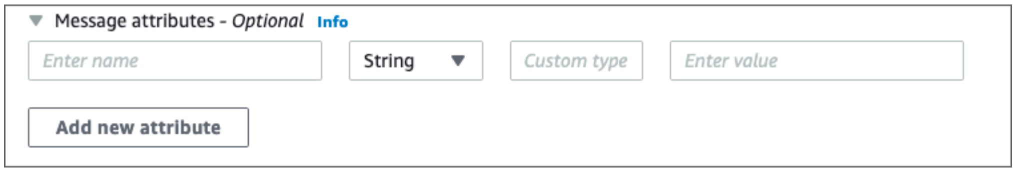
Sending a message with attributes (console)

For standard and FIFO queues, you can include structured metadata (such as timestamps, geospatial data, signatures, and identifiers) with messages. For more information, see Amazon SQS message attributes (p. 37).

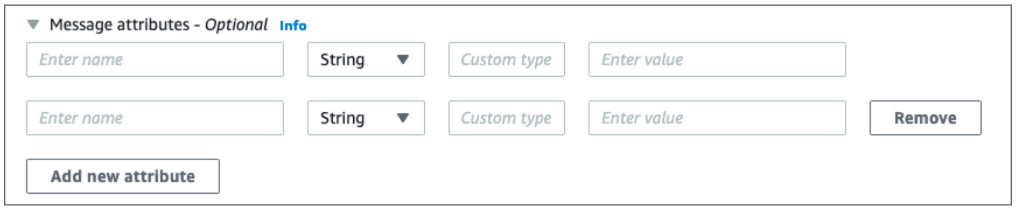
To send a message with attributes to a queue (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**.
3. On the **Queues** page, choose a queue.
4. From **Actions**, choose **Send and receive messages**.
5. Enter the message attribute parameters.

   a. In the name text box, enter a unique name of up to 256 characters.
   b. For the attribute type, choose **String**, **Number**, or **Binary**.
   c. (Optional) Enter a custom data type. For example, you could add **`byte`**, **`int`**, or **`float`** as custom data types for **Number**.
   d. In the value text box, enter the message attribute value.



6. To add another message attribute., choose **Add new attribute**.



7. You can modify the attribute values any time before sending the message.
8. To delete an attribute, choose **Remove**. To delete the first attribute, close **Message attributes**.
9. When you finish adding attributes to the message, choose **Send message**. Your message is sent and the console displays a success message. To view information about the message attributes of the sent message, choose **View details**. Choose **Done** to close the **Message details** dialog box.

Receiving and deleting messages (console)

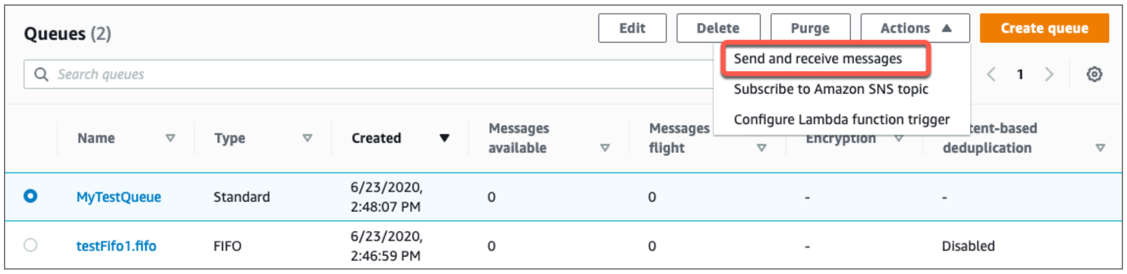
After you send messages to a queue, you can receive and delete them. When you request messages from a queue, you can't specify which messages to retrieve. Instead, you specify the maximum number of messages (up to 10) that you want to retrieve.

Note
Because Amazon SQS is a distributed system, a queue with very few messages might display an empty response to a receive request. In this case, rerun the request to get your message. Depending on your application's needs, you might have to use short or long polling (p. 41) to receive messages.

Amazon SQS doesn't automatically delete a message after retrieving it for you, in case you don't successfully receive the message (for example, if the consumers fail or you lose connectivity). To delete a message, you must send a separate request which acknowledges that you've successfully received and processed the message. Note that you must receive a message before you can delete it.

To receive and delete a message (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**.
3. On the **Queues** page, choose a queue.
4. From **Actions**, choose **Send and receive messages**.


Queues (2)
Edit
Delete
Purge
Actions
Create queue
Send and receive messages
Subscribe to Amazon SNS topic
Configure Lambda function trigger
Search queues
1

	Name	Type	Created	Messages available	Messages flight	Encryption	tent-based deduplication
●	MyTestQueue	Standard	6/23/2020, 2:48:07 PM	0	0	-	-
○	testFifo1.fifo	FIFO	6/23/2020, 2:46:59 PM	0	0	-	Disabled

The console displays the **Send and receive messages** page.

5. Choose **Poll for messages**.

   Amazon SQS begins to poll for messages in the queue. The progress bar on the right side of the **Receive messages** section displays the duration of polling.

   The **Messages** section displays a list of the received messages. For each message, the list displays the message ID, Sent date, Size, and Receive count.
6. To delete messages, choose the messages that you want to delete and choose **Delete**.
7. In the **Delete Messages** dialog box, choose **Delete**.

Purging messages from an Amazon SQS queue (console)

If you don't want to delete an Amazon SQS queue but need to delete all of the messages from it, purge the queue. The message deletion process takes up to 60 seconds. We recommend waiting for 60 seconds regardless of your queue's size.

Important
When you purge a queue, you can't retrieve any of the deleted messages.

To purge a queue (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**.
3. On the **Queues** page, choose the queue to purge.
4. Choose **Purge**.
5. In the **Purge queue** dialog box, confirm the purge by entering **`purge`** and choosing **Purge**.

   All messages are purged from the queue. The console displays a confirmation banner.

Deleting an Amazon SQS queue

If you no longer use an Amazon SQS queue and don't foresee using it in the near future, we recommend deleting it.

> **Tip**
> If you want to verify that a queue is empty before you delete it, see Confirming that a queue is empty (p. 21).

You can delete a queue even when it isn't empty. To delete the messages in a queue but not the queue itself, purge the queue (p. 20).

To delete a queue (console)

1. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
2. In the navigation pane, choose **Queues**.
3. On the **Queues** page, choose the queue to delete.
4. Choose **Delete**.
5. In the **Delete queue** dialog box, confirm the deletion by entering **`delete`**.
6. Choose **Delete**.

To delete a queue (AWS CLI AWS API)

You can use one of the following commands to delete a queue:

- AWS CLI: `aws sqs delete-queue`
- AWS API: `DeleteQueue`

Confirming that a queue is empty

In most cases, you can use long polling (p. 42) to determine if a queue is empty. In rare cases, you might receive empty responses even when a queue still contains messages, especially if you specified a low value for **Receive message wait time** when you created the queue. This section describes how to confirm that a queue is empty.

To confirm that a queue is empty (console)

1. Stop all producers from sending messages.
2. Open the Amazon SQS console at https://console.aws.amazon.com/sqs/.
3. In the navigation pane, choose **Queues**.
4. On the **Queues** page, choose a queue.

5. Choose the **Monitoring** tab.
6. At the top right of the Monitoring dashboards, choose the down arrow next to the Refresh symbol. From the dropdown menu, choose **Auto refresh**. Leave the **Refresh interval** at **1 Minute**.
7. Observe the following dashboards:

   - Approximate Number Of Messages Delayed
   - Approximate Number Of Messages Not Visible
   - Approximate Number Of Messages Visible

   When all of them show `0` values for several minutes, the queue is empty.

To confirm that a queue is empty (AWS CLI, AWS API)

1. Stop all producers from sending messages.
2. Repeatedly run one of the following commands:

   - AWS CLI: `get-queue-attributes`
   - AWS API: `GetQueueAttributes`
3. Observe the metrics for the following attributes:

   - `ApproximateNumberOfMessagesDelayed`
   - `ApproximateNumberOfMessagesNotVisible`
   - `ApproximateNumberOfMessagesVisible`

   When all of them are `0` for several minutes, the queue is empty.

If you rely on Amazon CloudWatch metrics, make sure that you see multiple consecutive zero data points before considering that queue empty. For more information on CloudWatch metrics, see Available CloudWatch metrics for Amazon SQS (p. 149).

How Amazon SQS works

This section describes the types of Amazon SQS queues and their basic properties. It also describes the identifiers of queues and messages, and various queue and message management workflows.

Topics

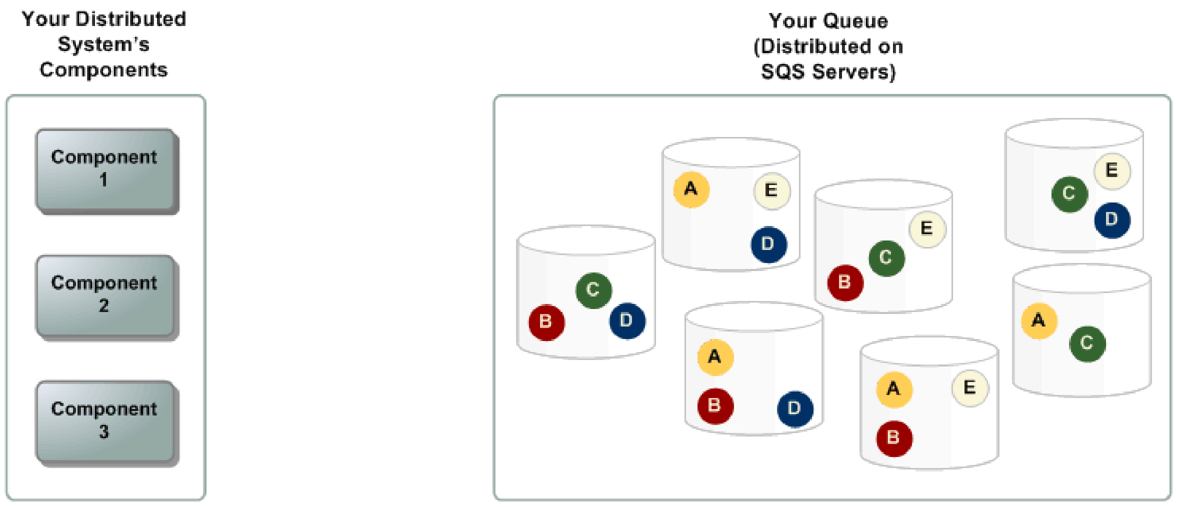
Basic Amazon SQS architecture

This section outlines the parts of a distributed messaging system and explains the lifecycle of an Amazon SQS message.

Distributed queues

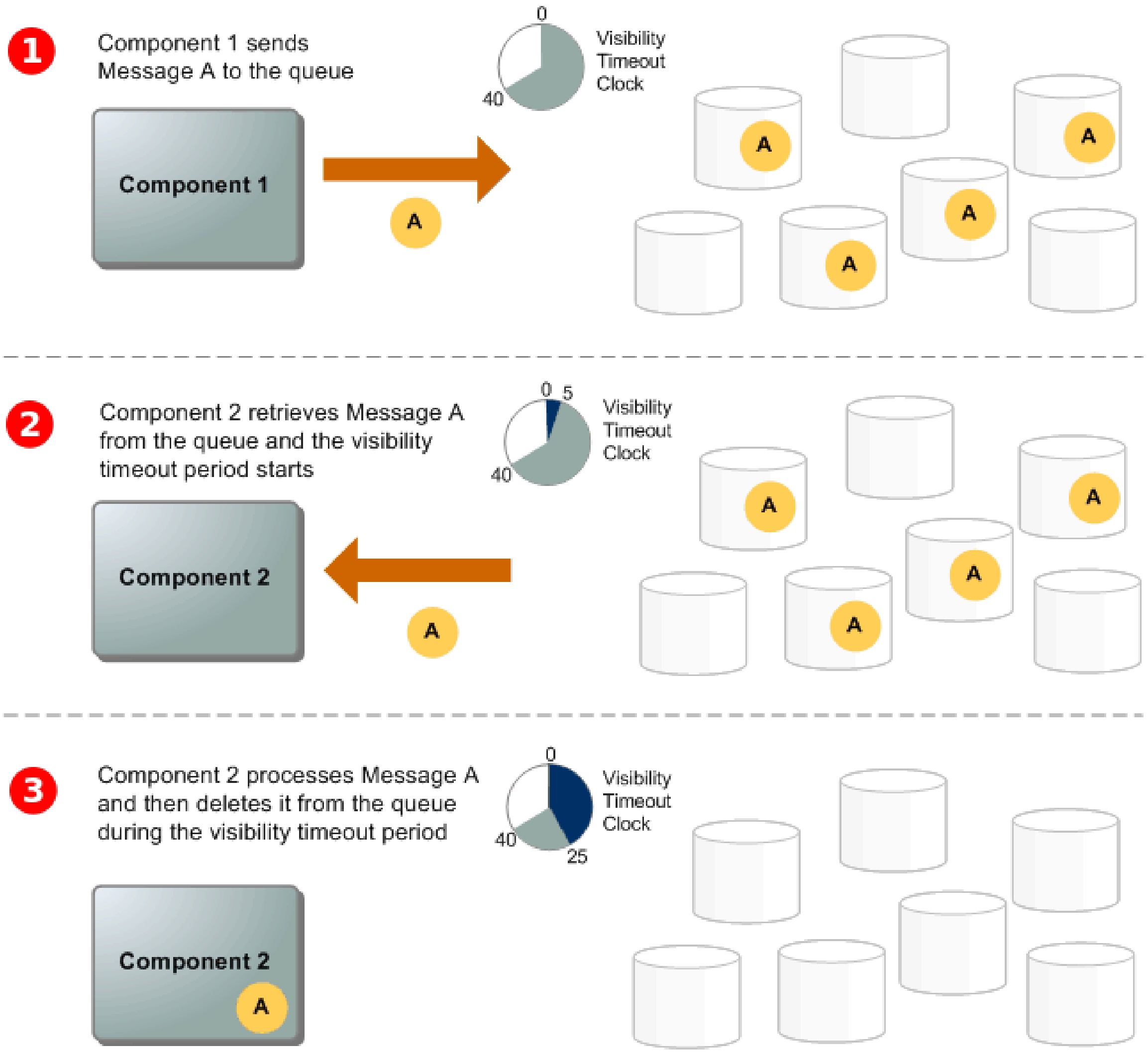
There are three main parts in a distributed messaging system: the components of your distributed system, your queue (distributed on Amazon SQS servers), and the messages in the queue.

In the following scenario, your system has several *producers* (components that send messages to the queue) and *consumers* (components that receive messages from the queue). The queue (which holds messages A through E) redundantly stores the messages across multiple Amazon SQS servers.


Your Distributed System's Components
Component 1
Component 2
Component 3
Your Queue (Distributed on SQS Servers)
A
B
C
D
E

Message lifecycle

The following scenario describes the lifecycle of an Amazon SQS message in a queue, from creation to deletion.


1
Component 1 sends Message A to the queue
Component 1
A
0
40
Visibility Timeout Clock
2
Component 2 retrieves Message A from the queue and the visibility timeout period starts
Component 2
0 5
40
Visibility Timeout Clock
3
Component 2 processes Message A and then deletes it from the queue during the visibility timeout period
Component 2
0
40
25
Visibility Timeout Clock

❶ A producer (component 1) sends message A to a queue, and the message is distributed across the Amazon SQS servers redundantly.

❷ When a consumer (component 2) is ready to process messages, it consumes messages from the queue, and message A is returned. While message A is being processed, it remains in the queue and isn't returned to subsequent receive requests for the duration of the visibility timeout (p. 46).

❸ The consumer (component 2) deletes message A from the queue to prevent the message from being received and processed again when the visibility timeout expires.

Note
Amazon SQS automatically deletes messages that have been in a queue for more than the maximum message retention period. The default message retention period is 4 days. However, you can set the message retention period to a value from 60 seconds to 1,209,600 seconds (14 days) using the `SetQueueAttributes` action.

Amazon SQS Standard queues

Amazon SQS offers *standard* as the default queue type. Standard queues support a nearly unlimited number of API calls per second, per API action (`SendMessage`, `ReceiveMessage`, or `DeleteMessage`).

Standard queues support at-least-once message delivery. However, occasionally (because of the highly distributed architecture that allows nearly unlimited throughput), more than one copy of a message might be delivered out of order. Standard queues provide best-effort ordering which ensures that messages are generally delivered in the same order as they're sent.

For information about how to create and configure queues using the Amazon SQS console, see Creating an Amazon SQS queue (console) (p. 11). For Java examples, see Amazon SQS Java SDK examples (p. 61).

You can use standard message queues in many scenarios, as long as your application can process messages that arrive more than once and out of order, for example:

- **Decouple live user requests from intensive background work** – Let users upload media while resizing or encoding it.
- **Allocate tasks to multiple worker nodes** – Process a high number of credit card validation requests.
- **Batch messages for future processing** – Schedule multiple entries to be added to a database.

For quotas related to standard queues, see Quotas related to queues (p. 99).

For best practices of working with standard queues, see Recommendations for Amazon SQS standard and FIFO queues (p. 54).

Message ordering

A standard queue makes a best effort to preserve the order of messages, but more than one copy of a message might be delivered out of order. If your system requires that order be preserved, we recommend using a *FIFO (First-In-First-Out) queue* (p. 26) or adding sequencing information in each message so you can reorder the messages when they're received.

At-least-once delivery

Amazon SQS stores copies of your messages on multiple servers for redundancy and high availability. On rare occasions, one of the servers that stores a copy of a message might be unavailable when you receive or delete a message.

If this occurs, the copy of the message isn't deleted on that unavailable server, and you might get that message copy again when you receive messages. Design your applications to be *idempotent* (they should not be affected adversely when processing the same message more than once).

Amazon SQS FIFO (First-In-First-Out) queues

FIFO queues have all the capabilities of the standard queue (p. 25).

FIFO (First-In-First-Out) queues are designed to enhance messaging between applications when the order of operations and events is critical, or where duplicates can't be tolerated. Examples of situations where you might use FIFO queues include the following:

- To make sure that user-entered commands are run in the right order.
- To display the correct product price by sending price modifications in the right order.
- To prevent a student from enrolling in a course before registering for an account.

FIFO queues also provide exactly-once processing but have a limited number of transactions per second (TPS). For information on throughput quotas, see Quotas related to messages (p. 100).

Note
The name of a FIFO queue must end with the `.fifo` suffix. The suffix counts towards the 80-character queue name quota. To determine whether a queue is FIFO (p. 26), you can check whether the queue name ends with the suffix.

Amazon SQS FIFO queues are available in all Regions where Amazon SQS is available.

For information about how to create and configure queues using the Amazon SQS console, see Creating an Amazon SQS queue (console) (p. 11). For Java examples, see Amazon SQS Java SDK examples (p. 61).

For best practices of working with FIFO queues, see Additional recommendations for Amazon SQS FIFO queues (p. 57) and Recommendations for Amazon SQS standard and FIFO queues (p. 54).

For information about compatibility of clients and services with FIFO queues, see Compatibility (p. 35).

Topics

Message ordering

The FIFO queue improves upon and complements the standard queue (p. 25). The most important features of this queue type are *FIFO (First-In-First-Out) delivery* (p. 28) and *exactly-once processing (p. 29)*:

- The order in which messages are sent and received is strictly preserved and a message is delivered once and remains available until a consumer processes and deletes it.
- Duplicates aren't introduced into the queue.

In addition, FIFO queues support *message groups* that allow multiple ordered message groups within a single queue. There is no quota to the number of message groups within a FIFO queue.

Key terms

The following key terms can help you better understand the functionality of FIFO queues. For more information, see the *Amazon Simple Queue Service API Reference*.

Message deduplication ID

The token used for deduplication of sent messages. If a message with a particular message deduplication ID is sent successfully, any messages sent with the same message deduplication ID are accepted successfully but aren't delivered during the 5-minute deduplication interval.

Note
Message deduplication applies to an entire queue, not to individual message groups.
Amazon SQS continues to keep track of the message deduplication ID even after the message is received and deleted.

Message group ID

The tag that specifies that a message belongs to a specific message group. Messages that belong to the same message group are always processed one by one, in a strict order relative to the message group (however, messages that belong to different message groups might be processed out of order).

Receive request attempt ID

The token used for deduplication of `ReceiveMessage` calls.

Sequence number

The large, non-consecutive number that Amazon SQS assigns to each message.

FIFO delivery logic

The following concepts can help you better understand the sending of messages to and receiving messages from FIFO.

Sending messages

If multiple messages are sent in succession to a FIFO queue, each with a distinct message deduplication ID, Amazon SQS stores the messages and acknowledges the transmission. Then, each message can be received and processed in the exact order in which the messages were transmitted.

In FIFO queues, messages are ordered based on message group ID. If multiple hosts (or different threads on the same host) send messages with the same message group ID to a FIFO queue, Amazon SQS stores the messages in the order in which they arrive for processing. To make sure that Amazon SQS preserves the order in which messages are sent and received, each producer should use a unique message group ID to send all its messages.

FIFO queue logic applies only per message group ID. Each message group ID represents a distinct ordered message group within an Amazon SQS queue. For each message group ID, all messages are sent and received in strict order. However, messages with different message group ID values might be sent and received out of order. You must associate a message group ID with a message. If you don't provide a message group ID, the action fails. If you require a single group of ordered messages, provide the same message group ID for messages sent to the FIFO queue.

Receiving messages

You can't request to receive messages with a specific message group ID.

When receiving messages from a FIFO queue with multiple message group IDs, Amazon SQS first attempts to return as many messages with the same message group ID as possible. This allows other consumers to process messages with a different message group ID.

> **Note**
> It is possible to receive up to 10 messages in a single call using the `MaxNumberOfMessages` request parameter of the `ReceiveMessage` action. These messages retain their FIFO order and can have the same message group ID. Thus, if there are fewer than 10 messages available with the same message group ID, you might receive messages from another message group ID, in the same batch of 10 messages, but still in FIFO order.

Retrying multiple times

FIFO queues allow the producer or consumer to attempt multiple retries:

- If the producer detects a failed `SendMessage` action, it can retry sending as many times as necessary, using the same message deduplication ID. Assuming that the producer receives at least one acknowledgement before the deduplication interval expires, multiple retries neither affect the ordering of messages nor introduce duplicates.

- If the consumer detects a failed `ReceiveMessage` action, it can retry as many times as necessary, using the same receive request attempt ID. Assuming that the consumer receives at least one acknowledgement before the visibility timeout expires, multiple retries don't affect the ordering of messages.
- When you receive a message with a message group ID, no more messages for the same message group ID are returned unless you delete the message or it becomes visible.

Exactly-once processing

Unlike standard queues, FIFO queues don't introduce duplicate messages. FIFO queues help you avoid sending duplicates to a queue. If you retry the `SendMessage` action within the 5-minute deduplication interval, Amazon SQS doesn't introduce any duplicates into the queue.

To configure deduplication, you must do one of the following:

- Enable content-based deduplication. This instructs Amazon SQS to use a SHA-256 hash to generate the message deduplication ID using the body of the message—but not the attributes of the message. For more information, see the documentation on the `CreateQueue`, `GetQueueAttributes`, and `SetQueueAttributes` actions in the *Amazon Simple Queue Service API Reference*.
- Explicitly provide the message deduplication ID (or view the sequence number) for the message. For more information, see the documentation on the `SendMessage`, `SendMessageBatch`, and `ReceiveMessage` actions in the *Amazon Simple Queue Service API Reference*.

Moving from a standard queue to a FIFO queue

If you have an existing application that uses standard queues and you want to take advantage of the ordering or exactly-once processing features of FIFO queues, you need to configure the queue and your application correctly.

Note
You can't convert an existing standard queue into a FIFO queue. To make the move, you must either create a new FIFO queue for your application or delete your existing standard queue and recreate it as a FIFO queue.

To make sure that your application correctly works with a FIFO queue, use the following checklist:

- If you use batching (p. 164), FIFO queues support up to 3,000 messages per second, per API method (`SendMessageBatch`, `ReceiveMessage`, or `DeleteMessageBatch`). The 3000 messages per second represent 300 API calls, each with a batch of 10 messages. To request a quota increase, submit a support request. Without batching, FIFO queues support up to 300 API calls per second, per API method (`SendMessage`, `ReceiveMessage`, or `DeleteMessage`).
- FIFO queues don't support per-message delays, only per-queue delays. If your application sets the same value of the `DelaySeconds` parameter on each message, you must modify your application to remove the per-message delay and set `DelaySeconds` on the entire queue instead.
- Every message sent to a FIFO queue requires a message group ID. If you don't need multiple ordered message groups, specify the same message group ID for all your messages.
- Before sending messages to a FIFO queue, confirm the following:
  - If your application can send messages with identical message bodies, you can modify your application to provide a unique message deduplication ID for each sent message.
  - If your application sends messages with unique message bodies, you can enable content-based deduplication.
- You don't have to make any code changes to your consumer. However, if it takes a long time to process messages and your visibility timeout is set to a high value, consider adding a receive request attempt

ID to each `ReceiveMessage` action. This allows you to retry receive attempts in case of networking failures and prevents queues from pausing due to failed receive attempts.

For more information, see the *Amazon Simple Queue Service API Reference*.

High throughput for FIFO queues

High throughput for FIFO queues (p. 26) supports a higher number of requests per API, per second. To increase the number of requests in high throughput for FIFO queues, you can increase the number of message groups you use. Each message group supports 300 requests per second. For information on per-queue quotas with high throughput for FIFO quotas, see Quotas related to messages (p. 100) and Partitions and data distribution for high throughput for SQS FIFO queues (p. 30).

You can enable high throughput for any new or existing FIFO queue. The feature includes three new options when you create and edit FIFO queues:

- **Enable high throughput FIFO** – Makes higher throughput available for messages in the current FIFO queue.
- **Deduplication scope** – Specifies whether deduplication occurs at the queue or message group level.
- **FIFO throughput limit** – Specifies whether the throughput quota on messages in the FIFO queue is set at the queue or message group level.

To enable high throughput for a FIFO queue (console)

1. Start creating (p. 11) or editing (p. 12) a FIFO queue.
2. When specifying options for the queue, choose **Enable high throughput FIFO**.

   Enabling high throughput for FIFO queues sets the related options as follows:

   - **Deduplication scope** is set to **Message group**, the required setting for using high throughput for FIFO queues.
   - **FIFO throughput limit** is set to **Per message group ID**, the required setting for using high throughput for FIFO queues.

   If you change any of the settings required for using high throughput for FIFO queues, normal throughput is in effect for the queue, and deduplication occurs as specified.
3. Continue specifying all options for the queue. When you finish, choose **Create queue** or **Save**.

After creating or editing the FIFO queue, you can send messages (p. 18) to it and receive and delete messages (p. 20), all at a higher TPS.

Partitions and data distribution for high throughput for SQS FIFO queues

Amazon SQS stores FIFO queue data in partitions. A *partition* is an allocation of storage for a queue that is automatically replicated across multiple Availability Zones within an AWS Region. You don't manage partitions. Instead, Amazon SQS handles partition management.

For FIFO queues, Amazon SQS modifies the number of partitions in a queue in the following situations:

- If the current request rate approaches or exceeds what the existing partitions can support, additional partitions are allocated until the queue reaches the regional quota. For information on quotas, see Quotas related to messages (p. 100).

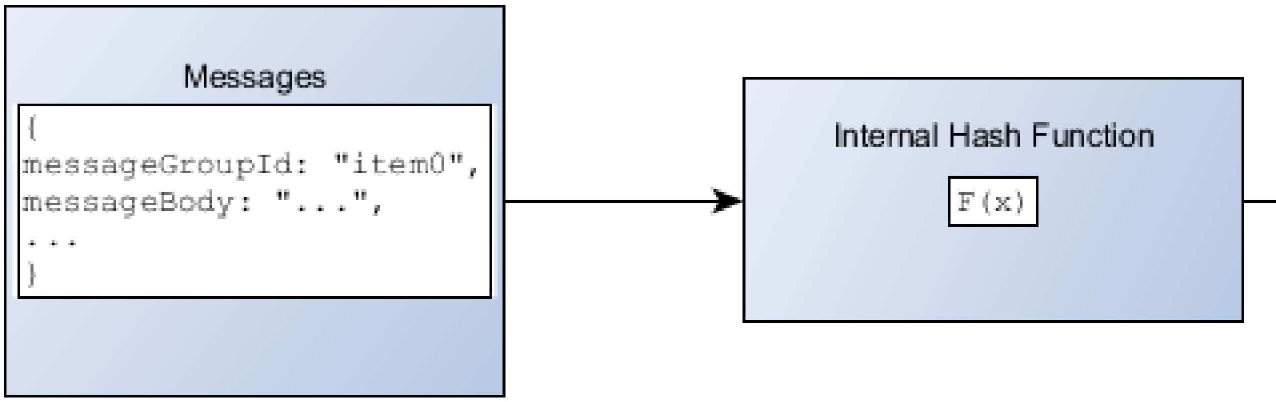
- If the current partitions have low utilization, the number of partitions may be reduced.

Partition management occurs automatically in the background and is transparent to your applications. Your queue and messages are available at all times.

Distributing data by message group IDs

To add a message to a FIFO queue, Amazon SQS uses the value of each message’s message group ID as input to an internal hash function. The output value from the hash function determines which partition stores the message.

The following diagram shows a queue that spans multiple partitions. The queue’s message group ID is based on item number. Amazon SQS uses its hash function to determine where to store a new item; in this case, it's based on the hash value of the string `item0`. Note that the items are stored in the same order in which they are added to the queue. Each item's location is determined by the hash value of its message group ID.



```
{
messageGroupId: "item0",
messageBody: "...",
...
}
```

Note
Amazon SQS is optimized for uniform distribution of items across a FIFO queue's partitions, regardless of the number of partitions. AWS recommends that you use message group IDs that can have a large number of distinct values.

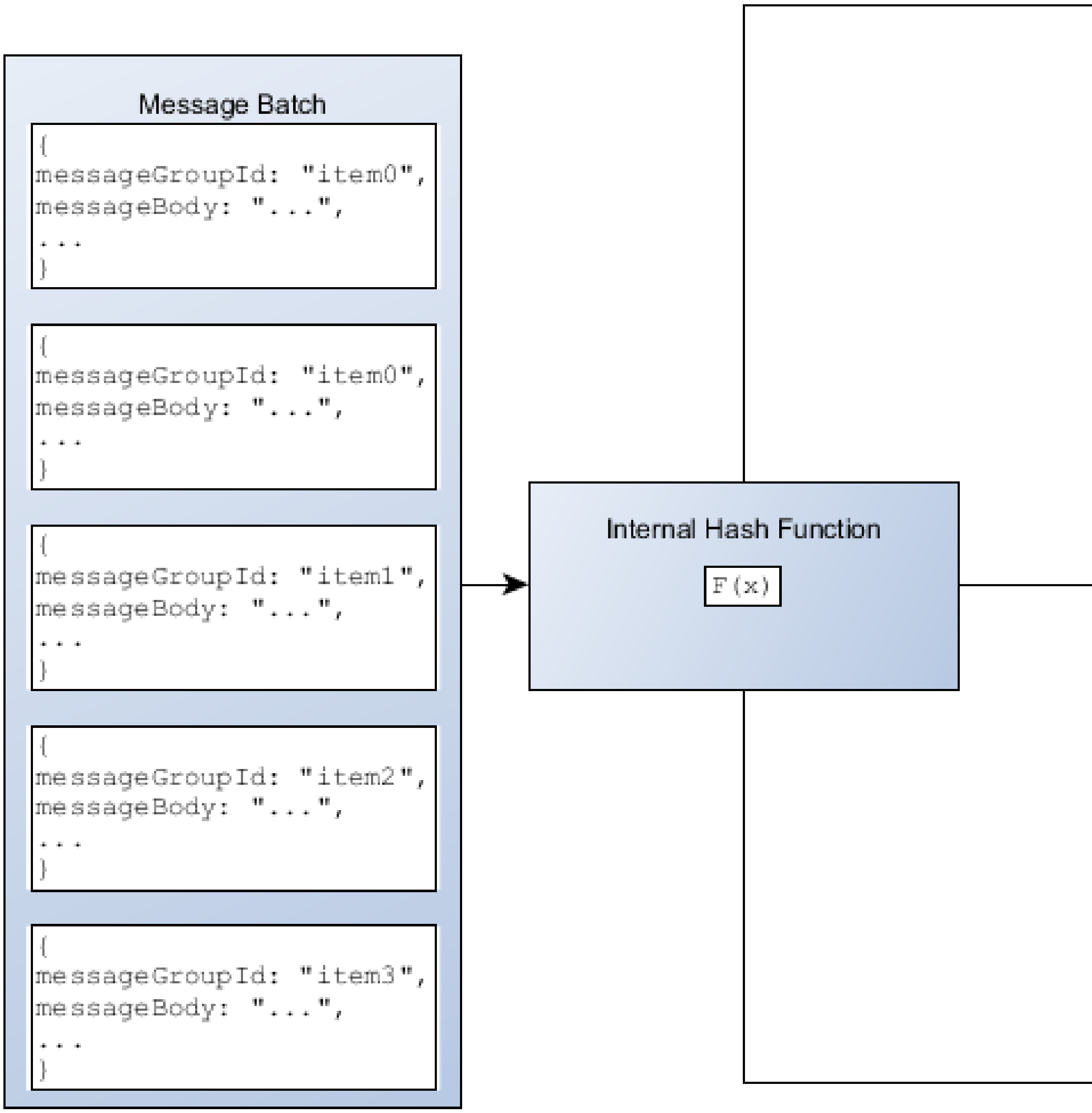
Optimizing partition utilization

Each partition supports up to 3,000 messages per second with batching, or up to 300 messages per second for send, receive, and delete operations.

When using batch APIs, each message is routed based on the process described in Distributing data by message group IDs (p. 31). Messages that are routed to the same partition are grouped and processed in a single transaction.

To optimize partition utilization, AWS recommends batching messages with the same message group IDs when possible.

In the following example, a batch of messages with various message group IDs is sent. The batch is split into three groups, each of which counts against the quota for the partition.


Message Batch
{
messageGroupId: "item0",
messageBody: "...",
...
}
{
messageGroupId: "item0",
messageBody: "...",
...
}
{
messageGroupId: "item1",
messageBody: "...",
...
}
{
messageGroupId: "item2",
messageBody: "...",
...
}
{
messageGroupId: "item3",
messageBody: "...",
...
}
Internal Hash Function
F(x)

Note
Amazon SQS only guarantees that messages with the same message group ID are grouped within a batch request. Depending on the output of the internal hash function and the number of partitions, messages with different message group IDs might be grouped. Since the hash function or number of partitions can change at any time, messages that are grouped at one point may not be grouped later.

Compatibility

Clients

The Amazon SQS Buffered Asynchronous Client doesn't currently support FIFO queues.

Services

If your application uses multiple AWS services, or a mix of AWS and external services, it is important to understand which service functionality doesn't support FIFO queues.

Some AWS or external services that send notifications to Amazon SQS might not be compatible with FIFO queues, despite allowing you to set a FIFO queue as a target.

The following features of AWS services aren't currently compatible with FIFO queues:

- Amazon S3 Event Notifications
- Auto Scaling Lifecycle Hooks
- AWS IoT Rule Actions
- AWS Lambda Dead-Letter Queues

For information about compatibility of other services with FIFO queues, see your service documentation.

Amazon SQS queue and message identifiers

This section describes the identifiers of standard and FIFO queues. These identifiers can help you find and manipulate specific queues and messages.

Topics

Identifiers for Amazon SQS Standard and FIFO queues

For more information about the following identifiers, see the *Amazon Simple Queue Service API Reference*.

Queue name and URL

When you create a new queue, you must specify a queue name unique for your AWS account and region. Amazon SQS assigns each queue you create an identifier called a *queue URL* that includes the queue name and other Amazon SQS components. Whenever you want to perform an action on a queue, you provide its queue URL.

The name of a FIFO queue must end with the `.fifo` suffix. The suffix counts towards the 80-character queue name quota. To determine whether a queue is FIFO (p. 26), you can check whether the queue name ends with the suffix.

The following is the queue URL for a queue named `MyQueue` owned by a user with the AWS account number `123456789012`.

```
https://sqs.us-east-2.amazonaws.com/123456789012/MyQueue
```

You can retrieve the URL of a queue programmatically by listing your queues and parsing the string that follows the account number. For more information, see `ListQueues`.

Message ID

Each message receives a system-assigned *message ID* that Amazon SQS returns to you in the `SendMessage` response. This identifier is useful for identifying messages. (However, to delete a message you need the message's *receipt handle*.) The maximum length of a message ID is 100 characters.

Receipt handle

Every time you receive a message from a queue, you receive a *receipt handle* for that message. This handle is associated with the action of receiving the message, not with the message itself. To delete the message or to change the message visibility, you must provide the receipt handle (not the message ID). Thus, you must always receive a message before you can delete it (you can't put a message into the queue and then recall it). The maximum length of a receipt handle is 1,024 characters.

Important
If you receive a message more than once, each time you receive it, you get a different receipt handle. You must provide the most recently received receipt handle when you request to delete the message (otherwise, the message might not be deleted).

The following is an example of a receipt handle (broken across three lines).

```
MbZj6wDWli+JvwwJaBV+3dcjk2YW2vA3+STFFljTM8tJJg6HRG6PYSasuWXPJB+Cw
Lj1FjgXUv1uSj1gUPAWV66FU/WeR4mq2OKpEGYWbnLmpRCJVAyeMjeU5ZBdtcQ+QE
auMZc8ZRv37sIW2iJKq3M9MFx1YvV11A2x/KSbkJ0=
```

Additional identifiers for Amazon SQS FIFO queues

For more information about the following identifiers, see Exactly-once processing (p. 29) and the *Amazon Simple Queue Service API Reference*.

Message deduplication ID

The token used for deduplication of sent messages. If a message with a particular message deduplication ID is sent successfully, any messages sent with the same message deduplication ID are accepted successfully but aren't delivered during the 5-minute deduplication interval.

Message group ID

The tag that specifies that a message belongs to a specific message group. Messages that belong to the same message group are always processed one by one, in a strict order relative to the message group (however, messages that belong to different message groups might be processed out of order).

Sequence number

The large, non-consecutive number that Amazon SQS assigns to each message.

Message metadata

You can use message attributes to attach custom metadata to Amazon SQS messages for your applications. You can use message system attributes to store metadata for other AWS services, such as AWS X-Ray.

Topics

Amazon SQS message attributes

Amazon SQS lets you include structured metadata (such as timestamps, geospatial data, signatures, and identifiers) with messages using *message attributes*. Each message can have up to 10 attributes. Message attributes are optional and separate from the message body (however, they are sent alongside it). Your consumer can use message attributes to handle a message in a particular way without having to process the message body first. For information about sending messages with attributes using the Amazon SQS console, see Sending a message with attributes (console) (p. 19).

Note
Don't confuse message attributes with *message system attributes*: Whereas you can use message attributes to attach custom metadata to Amazon SQS messages for your applications, you can use message system attributes (p. 39) to store metadata for other AWS services, such as AWS X-Ray.

Topics

Message attribute components

Important
All components of a message attribute are included in the 256 KB message size restriction.
The `Name`, `Type`, `Value`, and the message body must not be empty or null.

Each message attribute consists of the following components:

- **Name** – The message attribute name can contain the following characters: `A-Z`, `a-z`, `0-9`, underscore (_), hyphen (-), and period (`.`). The following restrictions apply:
  - Can be up to 256 characters long
  - Can't start with `AWS.` or `Amazon.` (or any casing variations)
  - Is case-sensitive
  - Must be unique among all attribute names for the message
  - Must not start or end with a period
  - Must not have periods in a sequence

- **Type** – The message attribute data type. Supported types include `String`, `Number`, and `Binary`. You can also add custom information for any data type. The data type has the same restrictions as the message body (for more information, see `SendMessage` in the *Amazon Simple Queue Service API Reference*). In addition, the following restrictions apply:
  - Can be up to 256 characters long
  - Is case-sensitive
- **Value** – The message attribute value. For `String` data types, the attribute values has the same restrictions as the message body.

Message attribute data types

Message attribute data types instruct Amazon SQS how to handle the corresponding message attribute values. For example, if the type is `Number`, Amazon SQS validates numerical values.

Amazon SQS supports the logical data types `String`, `Number`, and `Binary` with optional custom data type labels with the format *`.custom-data-type`*

- **String** – `String` attributes can store Unicode text using any valid XML characters.
- **Number** – `Number` attributes can store positive or negative numerical values. A number can have up to 38 digits of precision, and it can be between 10^-128 and 10^+126.

  Note
  Amazon SQS removes leading and trailing zeroes.
- **Binary** – Binary attributes can store any binary data such as compressed data, encrypted data, or images.
- **Custom** – To create a custom data type, append a custom-type label to any data type. For example:
  - `Number.byte`, `Number.short`, `Number.int`, and `Number.float` can help distinguish between number types.
  - `Binary.gif` and `Binary.png` can help distinguish between file types.

  Note
  Amazon SQS doesn't interpret, validate, or use the appended data.
  The custom-type label has the same restrictions as the message body.

Calculating the MD5 message digest for message attributes

If you use the AWS SDK for Java, you can skip this section. The `MessageMD5ChecksumHandler` class of the SDK for Java supports MD5 message digests for Amazon SQS message attributes.

If you use either the Query API or one of the AWS SDKs that doesn't support MD5 message digests for Amazon SQS message attributes, you must use the following guidelines to perform the MD5 message digest calculation.

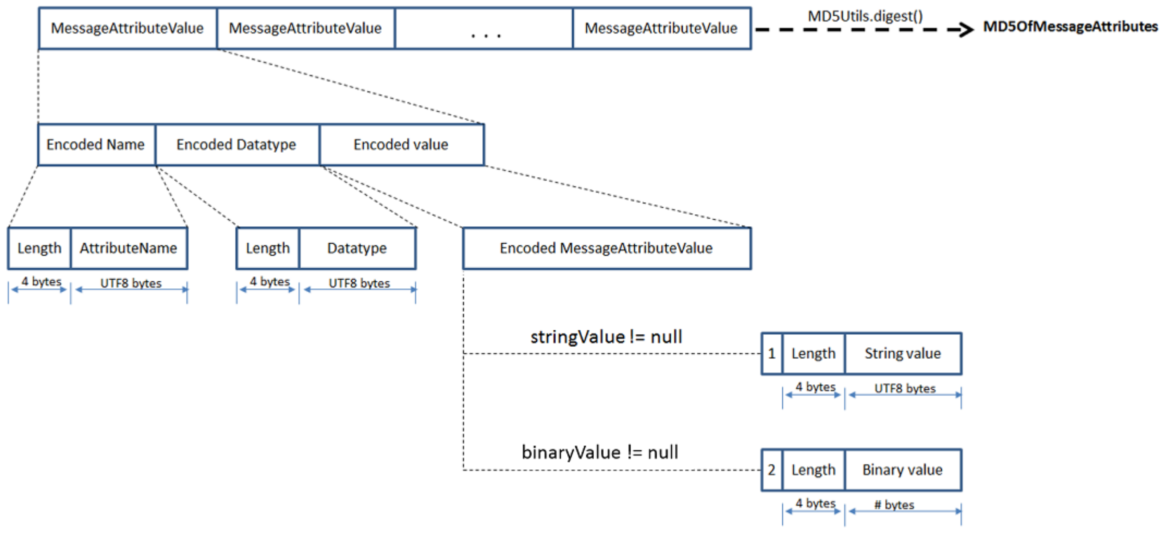
Note
Always include custom data type suffixes in the MD5 message-digest calculation.

Overview

The following is an overview of the MD5 message digest calculation algorithm:

1. Sort all message attributes by name in ascending order.
2. Encode the individual parts of each attribute (`Name`, `Type`, and `Value`) into a buffer.
3. Compute the message digest of the entire buffer.

The following diagram shows the encoding of the MD5 message digest for a single message attribute:



To encode a single Amazon SQS message attribute

1. Encode the name: the length (4 bytes) and the UTF-8 bytes of the name.
2. Encode the data type: the length (4 bytes) and the UTF-8 bytes of the data type.
3. Encode the transport type (`String` or `Binary`) of the value (1 byte).

   Note
   The logical data types `String` and `Number` use the `String` transport type.
   The logical data type `Binary` uses the `Binary` transport type.

   a. For the `String` transport type, encode 1.
   b. For the `Binary` transport type, encode 2.
4. Encode the attribute value.

   a. For the `String` transport type, encode the attribute value: the length (4 bytes) and the UTF-8 bytes of the value.
   b. For the `Binary` transport type, encode the attribute value: the length (4 bytes) and the raw bytes of the value.

Amazon SQS message system attributes

Whereas you can use message attributes (p. 37) to attach custom metadata to Amazon SQS messages for your applications, you can use *message system attributes* to store metadata for other AWS services, such as AWS X-Ray. For more information, see the `MessageSystemAttribute` request parameter of the `SendMessage` and `SendMessageBatch` API actions, the `AWSTraceHeader` attribute of the `ReceiveMessage` API action, and the `MessageSystemAttributeValue` data type in the *Amazon Simple Queue Service API Reference*.

Message system attributes are structured exactly like message attributes, with the following exceptions:

- Currently, the only supported message system attribute is `AWSTraceHeader`. Its type must be `String` and its value must be a correctly formatted AWS X-Ray trace header string.
- The size of a message system attribute doesn't count towards the total size of a message.

Resources required to process Amazon SQS messages

To help you estimate the resources you need to process queued messages, Amazon SQS can determine the approximate number of delayed, visible, and not visible messages in a queue. For more information about visibility, see Amazon SQS visibility timeout (p. 46).

Note
For standard queues, the result is approximate because of the distributed architecture of Amazon SQS. In most cases, the count should be close to the actual number of messages in the queue.
For FIFO queues, the result is exact.

The following table lists the attribute name to use with the `GetQueueAttributes` action:

Task	Attribute name
Get the approximate number of messages available for retrieval from the queue.	`ApproximateNumberOfMessages`
Get the approximate number of messages in the queue that are delayed and not available for reading immediately. This can happen when the queue is configured as a delay queue or when a message has been sent with a delay parameter.	`ApproximateNumberOfMessagesDelayed`
Get the approximate number of messages that are in flight. Messages are considered to be *in flight* if they have been sent to a client but have not yet been deleted or have not yet reached the end of their visibility window.	`ApproximateNumberOfMessagesNotVisible`

List queue pagination

The `listQueues` and `listDeadLetterQueues` API methods support optional pagination controls. By default, these API methods return up to 1000 queues in the response message. You can set the `MaxResults` parameter to return fewer results in each response.

Set parameter `MaxResults` in the `listQueues` or `listDeadLetterQueues` request to specify the maximum number of results to be returned in the response. If you do not set `MaxResults`, the response includes a maximum of 1,000 results and the `NextToken` value in the response is null.

If you set `MaxResults`, the response includes a value for `NextToken` if there are additional results to display. Use `NextToken` as a parameter in your next request to `listQueues` to receive the next page of results. If there are no additional results to display, the `NextToken` value in the response is null.

Amazon SQS cost allocation tags

To organize and identify your Amazon SQS queues for cost allocation, you can add metadata *tags* that identify a queue's purpose, owner, or environment. —this is especially useful when you have many queues. To configure tags using the Amazon SQS console, see the section called “Configuring tags for a queue” (p. 15)

You can use cost allocation tags to organize your AWS bill to reflect your own cost structure. To do this, sign up to get your AWS account bill to include tag keys and values. For more information, see Setting Up a Monthly Cost Allocation Report in the *AWS Billing and Cost Management User Guide*.

Each tag consists of a key-value pair that you define. For example, you can easily identify your *production* and *testing* queues if you tag your queues as follows:

Queue	Key	Value
`MyQueueA`	`QueueType`	`Production`
`MyQueueB`	`QueueType`	`Testing`

Note
When you use queue tags, keep the following guidelines in mind:

- We don't recommend adding more than 50 tags to a queue.
- Tags don't have any semantic meaning. Amazon SQS interprets tags as character strings.
- Tags are case-sensitive.
- A new tag with a key identical to that of an existing tag overwrites the existing tag.
- Tagging actions are limited to 5 TPS per AWS account. If your application requires a higher throughput, submit a request.

For a full list of tag restrictions, see Quotas related to queues (p. 99).

Amazon SQS short and long polling

Amazon SQS provides short polling and long polling to receive messages from a queue. By default, queues use short polling.

With *short polling*, the `ReceiveMessage` request queries only a subset of the servers (based on a weighted random distribution) to find messages that are available to include in the response. Amazon SQS sends the response right away, even if the query found no messages.

With *long polling*, the `ReceiveMessage` request queries all of the servers for messages. Amazon SQS sends a response after it collects at least one available message, up to the maximum number of messages specified in the request. Amazon SQS sends an empty response only if the polling wait time expires.

The following sections explain the details of short polling and long polling.

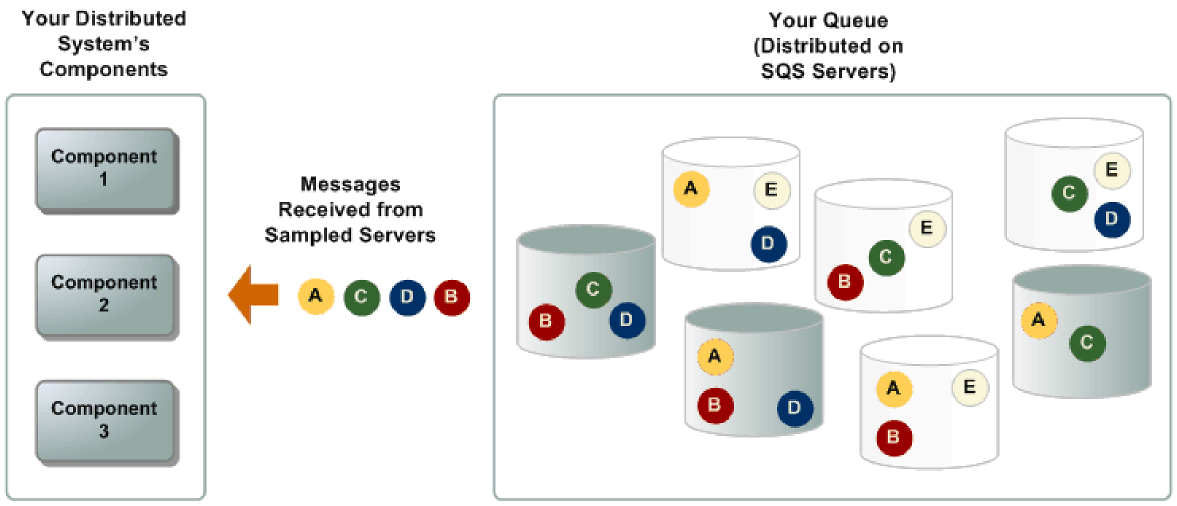
Topics

Consuming messages using short polling

When you consume messages from a queue using short polling, Amazon SQS samples a subset of its servers (based on a weighted random distribution) and returns messages from only those servers.

Thus, a particular `ReceiveMessage` request might not return all of your messages. However, if you have fewer than 1,000 messages in your queue, a subsequent request will return your messages. If you keep consuming from your queues, Amazon SQS samples all of its servers, and you receive all of your messages.

The following diagram shows the short-polling behavior of messages returned from a standard queue after one of your system components makes a receive request. Amazon SQS samples several of its servers (in gray) and returns messages A, C, D, and B from these servers. Message E isn't returned for this request, but is returned for a subsequent request.


Your Distributed System's Components
Component 1
Component 2
Component 3
Messages Received from Sampled Servers
A C D B
Your Queue (Distributed on SQS Servers)
A E D
B C D
A E D
C E D
A B D
A E B
B C E
A C

Consuming messages using long polling

When the wait time for the `ReceiveMessage` API action is greater than 0, *long polling* is in effect. The maximum long polling wait time is 20 seconds. Long polling helps reduce the cost of using Amazon SQS by eliminating the number of empty responses (when there are no messages available for a `ReceiveMessage` request) and false empty responses (when messages are available but aren't included in a response). For information about enabling long polling for a new or existing queue using the Amazon SQS console, see the Configuring queue parameters (console) (p. 12). For best practices, see Setting up long polling (p. 55).

Long polling offers the following benefits:

- Reduce empty responses by allowing Amazon SQS to wait until a message is available in a queue before sending a response. Unless the connection times out, the response to the `ReceiveMessage` request contains at least one of the available messages, up to the maximum number of messages specified in the `ReceiveMessage` action. In rare cases, you might receive empty responses even when a queue still contains messages, especially if you specify a low value for the `ReceiveMessageWaitTimeSeconds` parameter.
- Reduce false empty responses by querying all—rather than a subset of—Amazon SQS servers.
- Return messages as soon as they become available.

For information about how to confirm that a queue is empty, see Confirming that a queue is empty (p. 21).

Differences between long and short polling

Short polling occurs when the `WaitTimeSeconds` parameter of a `ReceiveMessage` request is set to `0` in one of two ways:

- The `ReceiveMessage` call sets `WaitTimeSeconds` to `0`.
- The `ReceiveMessage` call doesn't set `WaitTimeSeconds`, but the queue attribute `ReceiveMessageWaitTimeSeconds` is set to `0`.

Amazon SQS dead-letter queues

Amazon SQS supports *dead-letter queues*, which other queues (*source queues*) can target for messages that can't be processed (consumed) successfully. Dead-letter queues are useful for debugging your application or messaging system because they let you isolate problematic messages to determine why their processing doesn't succeed. For information about creating a queue and configuring a dead-letter queue for it using the Amazon SQS console, see Configuring a dead-letter queue (console) (p. 15).

Important
Amazon SQS does *not* create the dead-letter queue automatically. You must first create the queue before using it as a dead-letter queue.

Topics

How do dead-letter queues work?

Sometimes, messages can't be processed because of a variety of possible issues, such as erroneous conditions within the producer or consumer application or an unexpected state change that causes an issue with your application code. For example, if a user places a web order with a particular product ID, but the product ID is deleted, the web store's code fails and displays an error, and the message with the order request is sent to a dead-letter queue.

Occasionally, producers and consumers might fail to interpret aspects of the protocol that they use to communicate, causing message corruption or loss. Also, the consumer's hardware errors might corrupt message payload.

The *redrive policy* specifies the *source queue*, the *dead-letter queue*, and the conditions under which Amazon SQS moves messages from the former to the latter if the consumer of the source queue fails to process a message a specified number of times. When the `ReceiveCount` for a message exceeds the `maxReceiveCount` for a queue, Amazon SQS moves the message to a dead-letter queue (with its original message ID). For example, if the source queue has a redrive policy with `maxReceiveCount` set to 5, and the consumer of the source queue receives a message 6 times without ever deleting it, Amazon SQS moves the message to the dead-letter queue.

To specify a dead-letter queue, you can use the console or the AWS SDK for Java. You must do this for each queue that sends messages to a dead-letter queue. Multiple queues of the same type can target a single dead-letter queue. For more information, see Configuring a dead-letter queue (console) (p. 15) and the `RedrivePolicy` attribute of the `CreateQueue` or `SetQueueAttributes` action.

Important
The dead-letter queue of a FIFO queue must also be a FIFO queue. Similarly, the dead-letter queue of a standard queue must also be a standard queue.
You must use the same AWS account to create the dead-letter queue and the other queues that send messages to the dead-letter queue. Also, dead-letter queues must reside in the same region as the other queues that use the dead-letter queue. For example, if you create a queue in

the US East (Ohio) region and you want to use a dead-letter queue with that queue, the second queue must also be in the US East (Ohio) region.
The expiration of a message is always based on its original enqueue timestamp. When a message is moved to a dead-letter queue, the enqueue timestamp is unchanged. The `ApproximateAgeOfOldestMessage` metric indicates when the message moved to the dead-letter queue, *not* when the message was originally sent. For example, assume that a message spends 1 day in the original queue before it's moved to a dead-letter queue. If the dead-letter queue's retention period is 4 days, the message is deleted from the dead-letter queue after 3 days and the `ApproximateAgeOfOldestMessage` is 3 days. Thus, it is a best practice to always set the retention period of a dead-letter queue to be longer than the retention period of the original queue.

What are the benefits of dead-letter queues?

The main task of a dead-letter queue is handling message failure. A dead-letter queue lets you set aside and isolate messages that can't be processed correctly to determine why their processing didn't succeed. Setting up a dead-letter queue allows you to do the following:

- Configure an alarm for any messages delivered to a dead-letter queue.
- Examine logs for exceptions that might have caused messages to be delivered to a dead-letter queue.
- Analyze the contents of messages delivered to a dead-letter queue to diagnose software or the producer's or consumer's hardware issues.
- Determine whether you have given your consumer sufficient time to process messages.

How do different queue types handle message failure?

Standard queues

Standard queues (p. 25) keep processing messages until the expiration of the retention period. This continuous processing of messages minimizes the chances of having your queue blocked by messages that can't be processed. Continuous message processing also provides faster recovery for your queue.

In a system that processes thousands of messages, having a large number of messages that the consumer repeatedly fails to acknowledge and delete might increase costs and place extra load on the hardware. Instead of trying to process failing messages until they expire, it is better to move them to a dead-letter queue after a few processing attempts.

Note
Standard queues allow a high number of inflight messages. If the majority of your messages can't be consumed and aren't sent to a dead-letter queue, your rate of processing valid messages can slow down. Thus, to maintain the efficiency of your queue, make sure that your application correctly handles message processing.

FIFO queues

FIFO queues (p. 26) provide exactly-once processing by consuming messages in sequence from a message group. Thus, although the consumer can continue to retrieve ordered messages from another message group, the first message group remains unavailable until the message blocking the queue is processed successfully.

Note
FIFO queues allow a lower number of inflight messages. Thus, to keep your FIFO queue from getting blocked by a message, make sure that your application correctly handles message processing.

When should I use a dead-letter queue?

✓ Do use dead-letter queues with standard queues. You should always take advantage of dead-letter queues when your applications don’t depend on ordering. Dead-letter queues can help you troubleshoot incorrect message transmission operations.

> **Note**
> Even when you use dead-letter queues, you should continue to monitor your queues and retry sending messages that fail for transient reasons.

✓ Do use dead-letter queues to decrease the number of messages and to reduce the possibility of exposing your system to *poison-pill messages* (messages that can be received but can’t be processed).

✗ Don’t use a dead-letter queue with standard queues when you want to be able to keep retrying the transmission of a message indefinitely. For example, don’t use a dead-letter queue if your program must wait for a dependent process to become active or available.

✗ Don’t use a dead-letter queue with a FIFO queue if you don’t want to break the exact order of messages or operations. For example, don’t use a dead-letter queue with instructions in an Edit Decision List (EDL) for a video editing suite, where changing the order of edits changes the context of subsequent edits.

Troubleshooting dead-letter queues

In some cases, Amazon SQS dead-letter queues might not always behave as expected. This section gives an overview of common issues and shows how to resolve them.

Viewing messages using the console might cause messages to be moved to a dead-letter queue

Amazon SQS counts viewing a message in the console against the corresponding queue's redrive policy. Thus, if you view a message in the console the number of times specified in the corresponding queue's redrive policy, the message is moved to the corresponding queue's dead-letter queue.

To adjust this behavior, you can do one of the following:

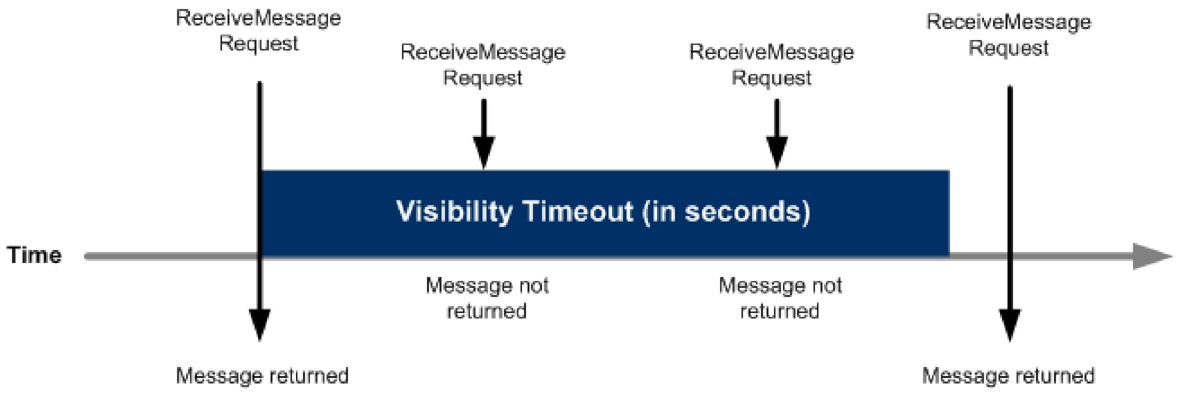
- Increase the **Maximum Receives** setting for the corresponding queue's redrive policy.
- Avoid viewing the corresponding queue's messages in the console.

The `NumberOfMessagesSent` and `NumberOfMessagesReceived` for a dead-letter queue don't match

If you send a message to a dead-letter queue manually, it is captured by the `NumberOfMessagesSent` metric. However, if a message is sent to a dead-letter queue as a result of a failed processing attempt, it isn't captured by this metric. Thus, it is possible for the values of `NumberOfMessagesSent` and `NumberOfMessagesReceived` to be different.

Amazon SQS visibility timeout

When a consumer receives and processes a message from a queue, the message remains in the queue. Amazon SQS doesn't automatically delete the message. Because Amazon SQS is a distributed system, there's no guarantee that the consumer actually receives the message (for example, due to a connectivity issue, or due to an issue in the consumer application). Thus, the consumer must delete the message from the queue after receiving and processing it.



Immediately after a message is received, it remains in the queue. To prevent other consumers from processing the message again, Amazon SQS sets a *visibility timeout*, a period of time during which Amazon SQS prevents other consumers from receiving and processing the message. The default visibility timeout for a message is 30 seconds. The minimum is 0 seconds. The maximum is 12 hours. For information about configuring visibility timeout for a queue using the console, see Configuring queue parameters (console) (p. 12).

Note
For standard queues, the visibility timeout isn't a guarantee against receiving a message twice. For more information, see At-least-once delivery (p. 26).
FIFO queues allow the producer or consumer to attempt multiple retries:

- If the producer detects a failed `SendMessage` action, it can retry sending as many times as necessary, using the same message deduplication ID. Assuming that the producer receives at least one acknowledgement before the deduplication interval expires, multiple retries neither affect the ordering of messages nor introduce duplicates.
- If the consumer detects a failed `ReceiveMessage` action, it can retry as many times as necessary, using the same receive request attempt ID. Assuming that the consumer receives at least one acknowledgement before the visibility timeout expires, multiple retries don't affect the ordering of messages.
- When you receive a message with a message group ID, no more messages for the same message group ID are returned unless you delete the message or it becomes visible.

Topics

Inflight messages

An Amazon SQS message has three basic states:

1. Sent to a queue by a producer.
2. Received from the queue by a consumer.
3. Deleted from the queue.

A message is considered to be *stored* after it is sent to a queue by a producer, but not yet received from the queue by a consumer (that is, between states 1 and 2). There is no quota to the number of stored messages. A message is considered to be *in flight* after it is received from a queue by a consumer, but not yet deleted from the queue (that is, between states 2 and 3). There is a quota to the number of inflight messages.

Important
Quotas that apply to inflight messages are unrelated to the *unlimited* number of stored messages.

For most standard queues (depending on queue traffic and message backlog), there can be a maximum of approximately 120,000 inflight messages (received from a queue by a consumer, but not yet deleted from the queue). If you reach this quota while using short polling (p. 41), Amazon SQS returns the `OverLimit` error message. If you use long polling (p. 42), Amazon SQS returns no error messages. To avoid reaching the quota, you should delete messages from the queue after they're processed. You can also increase the number of queues you use to process your messages. To request a quota increase, submit a support request.

For FIFO queues, there can be a maximum of 20,000 inflight messages (received from a queue by a consumer, but not yet deleted from the queue). If you reach this quota, Amazon SQS returns no error messages.

Setting the visibility timeout

The visibility timeout begins when Amazon SQS returns a message. During this time, the consumer processes and deletes the message. However, if the consumer fails before deleting the message and your system doesn't call the `DeleteMessage` action for that message before the visibility timeout expires, the message becomes visible to other consumers and the message is received again. If a message must be received only once, your consumer should delete it within the duration of the visibility timeout.

Every Amazon SQS queue has the default visibility timeout setting of 30 seconds. You can change this setting for the entire queue. Typically, you should set the visibility timeout to the maximum time that it takes your application to process and delete a message from the queue. When receiving messages, you can also set a special visibility timeout for the returned messages without changing the overall queue timeout. For more information, see the best practices in the Processing messages in a timely manner (p. 54) section.

If you don't know how long it takes to process a message, create a *heartbeat* for your consumer process: Specify the initial visibility timeout (for example, 2 minutes) and then—as long as your consumer still works on the message—keep extending the visibility timeout by 2 minutes every minute.

Important
The maximum visibility timeout is 12 hours from the time that Amazon SQS receives the `ReceiveMessage` request. Extending the visibility timeout does not reset the 12-hour maximum. If your consumer needs longer than 12 hours, consider using Step Functions.

Changing the visibility timeout for a message

When you receive a message from a queue and begin to process it, the visibility timeout for the queue may be insufficient (for example, you might need to process and delete a message). You can shorten or extend a message's visibility by specifying a new timeout value using the `ChangeMessageVisibility` action.

For example, if the default timeout for a queue is 60 seconds, 15 seconds have elapsed since you received the message, and you send a `ChangeMessageVisibility` call with `VisibilityTimeout` set to 10 seconds, the 10 seconds begin to count from the time that you make the `ChangeMessageVisibility` call. Thus, any attempt to change the visibility timeout or to delete that message 10 seconds after you initially change the visibility timeout (a total of 25 seconds) might result in an error.

> **Note**
> The new timeout period takes effect from the time you call the `ChangeMessageVisibility` action. In addition, the new timeout period applies only to the particular receipt of the message. `ChangeMessageVisibility` doesn't affect the timeout of later receipts of the message or later queues.

Terminating the visibility timeout for a message

When you receive a message from a queue, you might find that you actually don't want to process and delete that message. Amazon SQS allows you to terminate the visibility timeout for a specific message. This makes the message immediately visible to other components in the system and available for processing.

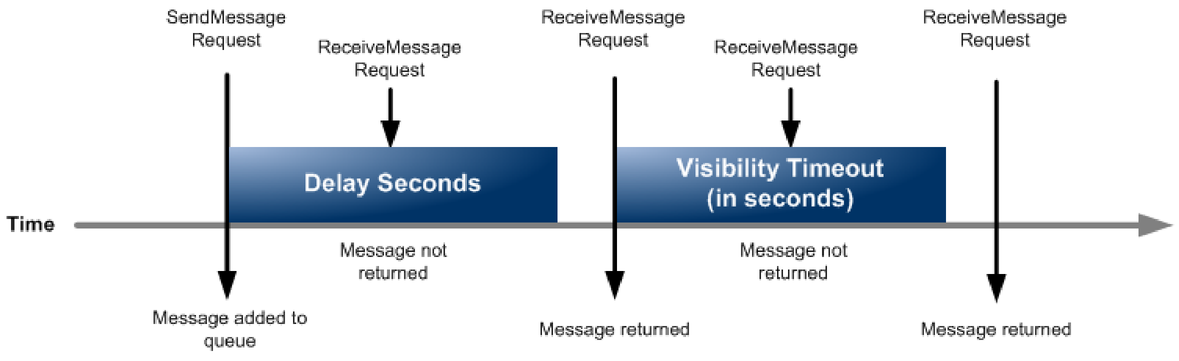
To terminate a message's visibility timeout after calling `ReceiveMessage`, call `ChangeMessageVisibility` with `VisibilityTimeout` set to 0 seconds.

Amazon SQS delay queues

Delay queues let you postpone the delivery of new messages to a queue for a number of seconds, for example, when your consumer application needs additional time to process messages. If you create a delay queue, any messages that you send to the queue remain invisible to consumers for the duration of the delay period. The default (minimum) delay for a queue is 0 seconds. The maximum is 15 minutes. For information about configuring delay queues using the console see Configuring queue parameters (console) (p. 12).

> **Note**
> For standard queues, the per-queue delay setting is *not retroactive*—changing the setting doesn't affect the delay of messages already in the queue.
> For FIFO queues, the per-queue delay setting is *retroactive*—changing the setting affects the delay of messages already in the queue.

Delay queues are similar to visibility timeouts (p. 46) because both features make messages unavailable to consumers for a specific period of time. The difference between the two is that, for delay queues, a message is hidden *when it is first added to queue*, whereas for visibility timeouts a message is hidden *only after it is consumed from the queue*. The following diagram illustrates the relationship between delay queues and visibility timeouts.



To set delay seconds on *individual messages*, rather than on an entire queue, use message timers (p. 53) to allow Amazon SQS to use the message timer's `DelaySeconds` value instead of the delay queue's `DelaySeconds` value.

Amazon SQS temporary queues

Temporary queues help you save development time and deployment costs when using common message patterns such as *request-response*. You can use the Temporary Queue Client to create high-throughput, cost-effective, application-managed temporary queues.

The client maps multiple *temporary queues*—application-managed queues created on demand for a particular process—onto a single Amazon SQS queue automatically. This allows your application to make fewer API calls and have a higher throughput when the traffic to each temporary queue is low. When a temporary queue is no longer in use, the client cleans up the temporary queue automatically, even if some processes that use the client aren't shut down cleanly.

The following are the benefits of temporary queues:

- They serve as lightweight communication channels for specific threads or processes.
- They can be created and deleted without incurring additional cost.
- They are API-compatible with static (normal) Amazon SQS queues. This means that existing code that sends and receives messages can send messages to and receive messages from virtual queues.

Topics

Virtual queues

Virtual queues are local data structures that the Temporary Queue Client creates. Virtual queues let you combine multiple low-traffic destinations into a single Amazon SQS queue. For best practices, see Avoid reusing the same message group ID with virtual queues (p. 59).

Note

- Creating a virtual queue creates only temporary data structures for consumers to receive messages in. Because a virtual queue makes no API calls to Amazon SQS, virtual queues incur no cost.
- TPS quotas apply to all virtual queues across a single host queue. For more information, see Quotas related to messages (p. 100).

The `AmazonSQSVirtualQueuesClient` wrapper class adds support for attributes related to virtual queues. To create a virtual queue, you must call the `CreateQueue` API action using the `HostQueueURL` attribute. This attribute specifies the existing queue that hosts the virtual queues.

The URL of a virtual queue is in the following format.

```
https://sqs.us-east-2.amazonaws.com/123456789012/MyQueue#MyVirtualQueueName
```

When a producer calls the `SendMessage` or `SendMessageBatch` API action on a virtual queue URL, the Temporary Queue Client does the following:

1. Extracts the virtual queue name.
2. Attaches the virtual queue name as an additional message attribute.
3. Sends the message to the host queue.

While the producer sends messages, a background thread polls the host queue and sends received messages to virtual queues according to the corresponding message attributes.

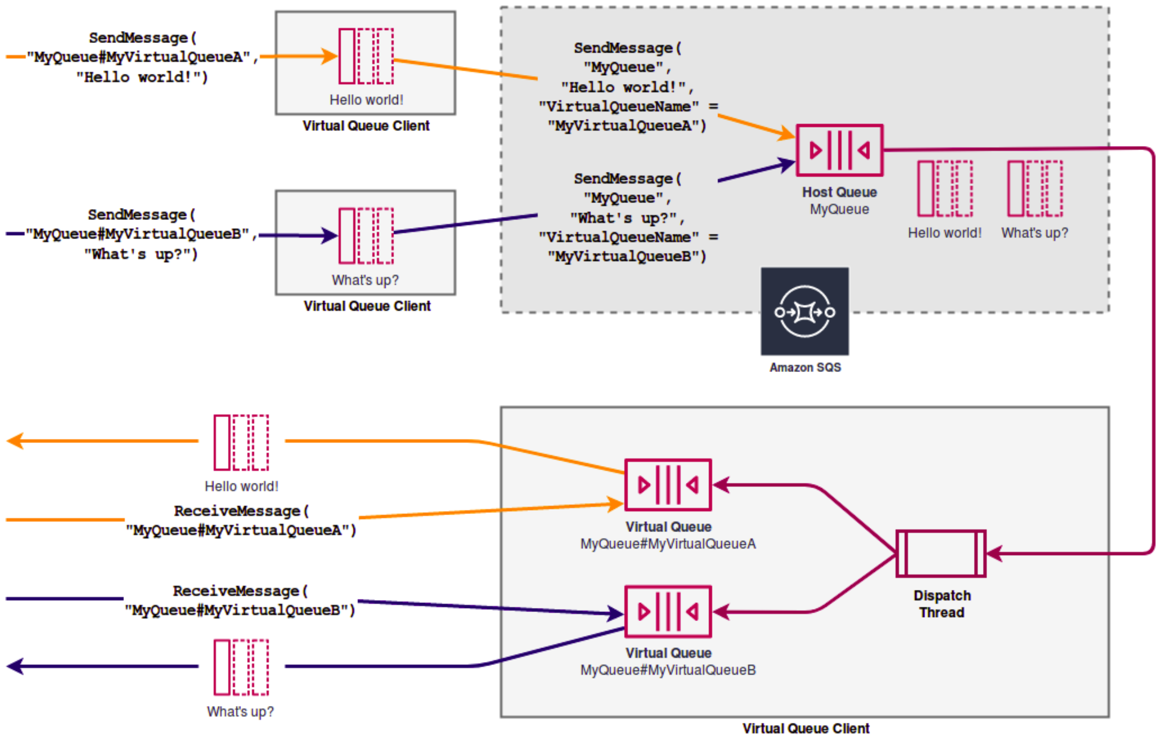
While the consumer calls the `ReceiveMessage` API action on a virtual queue URL, the Temporary Queue Client blocks the call locally until the background thread sends a message into the virtual queue. (This process is similar to message prefetching in the Buffered Asynchronous Client (p. 165): a single API action can provide messages to up to 10 virtual queues.) Deleting a virtual queue removes any client-side resources without calling Amazon SQS itself.

The `AmazonSQSTemporaryQueuesClient` class turns all queues it creates into temporary queues automatically. It also creates host queues with the same queue attributes automatically, on demand. These queues' names share a common, configurable prefix (by default, `__RequesterClientQueues__`) that identifies them as temporary queues. This allows the client to act as a drop-in replacement that optimizes existing code which creates and deletes queues. The client also includes the `AmazonSQSRequester` and `AmazonSQSResponder` interfaces that allow two-way communication between queues.

Request-response messaging pattern (virtual queues)

The most common use case for temporary queues is the *request-response* messaging pattern, where a requester creates a *temporary queue* for receiving each response message. To avoid creating an Amazon SQS queue for each response message, the Temporary Queue Client lets you create and delete multiple temporary queues without making any Amazon SQS API calls. For more information, see Implementing request-response systems (p. 56).

The following diagram shows a common configuration using this pattern.


SendMessage("MyQueue#MyVirtualQueueA", "Hello world!")
Hello world!
Virtual Queue Client
SendMessage("MyQueue#MyVirtualQueueB", "What's up?")
What's up?
Virtual Queue Client
SendMessage("MyQueue", "Hello world!", "VirtualQueueName" = "MyVirtualQueueA")
SendMessage("MyQueue", "What's up?", "VirtualQueueName" = "MyVirtualQueueB")
Host Queue
MyQueue
Hello world!
What's up?
Amazon SQS
Hello world!
ReceiveMessage("MyQueue#MyVirtualQueueA")
ReceiveMessage("MyQueue#MyVirtualQueueB")
What's up?
Virtual Queue
MyQueue#MyVirtualQueueA
Virtual Queue
MyQueue#MyVirtualQueueB
Dispatch Thread
Virtual Queue Client

Example scenario: Processing a login request

The following example scenario shows how you can use the `AmazonSQSRequester` and `AmazonSQSResponder` interfaces to process a user's login request.

On the client side

```
public class LoginClient {

    // Specify the Amazon SQS queue to which to send requests.
    private final String requestQueueUrl;

    // Use the AmazonSQSRequester interface to create
    // a temporary queue for each response.
    private final AmazonSQSRequester sqsRequester =
            AmazonSQSRequesterClientBuilder.defaultClient();

    private final LoginClient(String requestQueueUrl) {
        this.requestQueueUrl = requestQueueUrl;
    }

    // Send a login request.
    public String login(String body) throws TimeoutException {
        SendMessageRequest request = new SendMessageRequest()
                .withMessageBody(body)
                .withQueueUrl(requestQueueUrl);

        // If no response is received, in 20 seconds,
        // trigger the TimeoutException.
        Message reply = sqsRequester.sendMessageAndGetResponse(request,
                20, TimeUnit.SECONDS);

        return reply.getBody();
    }
}
```

Sending a login request does the following:

1. Creates a temporary queue.
2. Attaches the temporary queue's URL to the message as an attribute.
3. Sends the message.
4. Receives a response from the temporary queue.
5. Deletes the temporary queue.
6. Returns the response.

On the server side

The following example assumes that, upon construction, a thread is created to poll the queue and call the `handleLoginRequest()` method for every message. In addition, `doLogin()` is an assumed method.

```
public class LoginServer {

    // Specify the Amazon SQS queue to poll for login requests.
    private final String requestQueueUrl;

    // Use the AmazonSQSResponder interface to take care
    // of sending responses to the correct response destination.
    private final AmazonSQSResponder sqsResponder =
            AmazonSQSResponderClientBuilder.defaultClient();

    private final AmazonSQS(String requestQueueUrl) {
        this.requestQueueUrl = requestQueueUrl;
    }

    // Process login requests from the client.
    public void handleLoginRequest(Message message) {

        // Process the login and return a serialized result.
        String response = doLogin(message.getBody());

        // Extract the URL of the temporary queue from the message attribute
        // and send the response to the temporary queue.
        sqsResponder.sendResponseMessage(MessageContent.fromMessage(message),
                new MessageContent(response));
    }
}
```

Cleaning up queues

To make sure that Amazon SQS reclaims any in-memory resources used by virtual queues, when your application no longer needs the Temporary Queue Client, it should call the `shutdown()` method. You can also use the `shutdown()` method of the `AmazonSQSRequester` interface.

The Temporary Queue Client also provides a way to eliminate orphaned host queues. For each queue that receives an API call over a period of time (by default, five minutes), the client uses the `TagQueue` API action to tag a queue that remains in use.

Note
Any API action taken on a queue marks it as non-idle, including a `ReceiveMessage` action that returns no messages.

The background thread uses the `ListQueues` and `ListTags` API actions to check all queues with the configured prefix, deleting any queues that haven't been tagged for at least five minutes. In this way, if one client doesn't shut down cleanly, the other active clients clean up after it. In order to reduce the duplication of work, all clients with the same prefix communicate through a shared, internal work queue named after the prefix.

Amazon SQS message timers

Message timers let you specify an initial invisibility period for a message added to a queue. For example, if you send a message with a 45-second timer, the message isn't visible to consumers for its first 45 seconds in the queue. The default (minimum) delay for a message is 0 seconds. The maximum is 15 minutes. For information about sending messages with timers using the console, see Sending messages to a queue (console) (p. 18).

Note
FIFO queues don't support timers on individual messages.

To set a delay period on *an entire queue*, rather than on individual messages, use delay queues (p. 48). A message timer setting for an individual message overrides any `DelaySeconds` value on an Amazon SQS delay queue.

Best practices for Amazon SQS

These best practices can help you make the most of Amazon SQS.

Topics

Recommendations for Amazon SQS standard and FIFO queues

The following best practices can help you reduce costs and process messages efficiently using Amazon SQS.

Topics

Working with Amazon SQS messages

The following guidelines can help you process messages efficiently using Amazon SQS.

Topics

Processing messages in a timely manner

Setting the visibility timeout depends on how long it takes your application to process and delete a message. For example, if your application requires 10 seconds to process a message and you set the visibility timeout to 15 minutes, you must wait for a relatively long time to attempt to process the message again if the previous processing attempt fails. Alternatively, if your application requires 10 seconds to process a message but you set the visibility timeout to only 2 seconds, a duplicate message is received by another consumer while the original consumer is still working on the message.

To make sure that there is sufficient time to process messages, use one of the following strategies:

- If you know (or can reasonably estimate) how long it takes to process a message, extend the message's *visibility timeout* to the maximum time it takes to process and delete the message. For more information, see Configuring the Visibility Timeout (p. 47).
- If you don't know how long it takes to process a message, create a *heartbeat* for your consumer process: Specify the initial visibility timeout (for example, 2 minutes) and then—as long as your

consumer still works on the message—keep extending the visibility timeout by 2 minutes every minute.

> **Important**
> The maximum visibility timeout is 12 hours from the time that Amazon SQS receives the `ReceiveMessage` request. Extending the visibility timeout does not reset the 12-hour maximum. If your consumer needs longer than 12 hours, consider using Step Functions.

Handling request errors

To handle request errors, use one of the following strategies:

- If you use an AWS SDK, you already have automatic *retry and backoff* logic at your disposal. For more information, see Error Retries and Exponential Backoff in AWS in the *Amazon Web Services General Reference*.
- If you don't use the AWS SDK features for retry and backoff, allow a pause (for example, 200 ms) before retrying the ReceiveMessage action after receiving no messages, a timeout, or an error message from Amazon SQS. For subsequent use of `ReceiveMessage` that gives the same results, allow a longer pause (for example, 400 ms).

Setting up long polling

When the wait time for the `ReceiveMessage` API action is greater than 0, *long polling* is in effect. The maximum long polling wait time is 20 seconds. Long polling helps reduce the cost of using Amazon SQS by eliminating the number of empty responses (when there are no messages available for a `ReceiveMessage` request) and false empty responses (when messages are available but aren't included in a response). For more information, see Amazon SQS short and long polling (p. 41).

For optimal message processing, use the following strategies:

- In most cases, you can set the `ReceiveMessage` wait time to 20 seconds. If 20 seconds is too long for your application, set a shorter `ReceiveMessage` wait time (1 second minimum). If you don't use an AWS SDK to access Amazon SQS, or if you configure an AWS SDK to have a shorter wait time, you might have to modify your Amazon SQS client to either allow longer requests or use a shorter wait time for long polling.
- If you implement long polling for multiple queues, use one thread for each queue instead of a single thread for all queues. Using a single thread for each queue allows your application to process the messages in each of the queues as they become available, while using a single thread for polling multiple queues might cause your application to become unable to process messages available in other queues while the application waits (up to 20 seconds) for the queue which doesn't have any available messages.

> **Important**
> To avoid HTTP errors, make sure that the HTTP response timeout for `ReceiveMessage` requests is longer than the `WaitTimeSeconds` parameter. For more information, see ReceiveMessage.

Capturing problematic messages

To capture all messages that can't be processed, and to collect accurate CloudWatch metrics, configure a dead-letter queue (p. 43).

- The redrive policy redirects messages to a dead-letter queue after the source queue fails to process a message a specified number of times.

- Using a dead-letter queue decreases the number of messages and reduces the possibility of exposing you to *poison pill* messages (messages that are received but can't be processed).
- Including a poison pill message in a queue can distort the `ApproximateAgeOfOldestMessage` (p. 149) CloudWatch metric by giving an incorrect age of the poison pill message. Configuring a dead-letter queue helps avoid false alarms when using this metric.

Setting up dead-letter queue retention

The expiration of a message is always based on its original enqueue timestamp. When a message is moved to a dead-letter queue, the enqueue timestamp is unchanged. The `ApproximateAgeOfOldestMessage` metric indicates when the message moved to the dead-letter queue, *not* when the message was originally sent. For example, assume that a message spends 1 day in the original queue before it's moved to a dead-letter queue. If the dead-letter queue's retention period is 4 days, the message is deleted from the dead-letter queue after 3 days and the `ApproximateAgeOfOldestMessage` is 3 days. Thus, it is a best practice to always set the retention period of a dead-letter queue to be longer than the retention period of the original queue.

Avoiding inconsistent message processing

Because Amazon SQS is a distributed system, it is possible for a consumer to not receive a message even when Amazon SQS marks the message as delivered while returning successfully from a `ReceiveMessage` API method call. In this case, Amazon SQS records the message as delivered at least once, although the consumer has never received it. Because no additional attempts to deliver messages are made under these conditions, we don't recommend setting the number of maximum receives to 1 for a dead-letter queue (p. 43).

Implementing request-response systems

When implementing a request-response or remote procedure call (RPC) system, keep the following best practices in mind:

- Don't create reply queues *per message*. Instead, create reply queues on startup, *per producer*, and use a correlation ID message attribute to map replies to requests.
- Don't let your producers share reply queues. This can cause a producer to receive response messages intended for another producer.

For more information about implementing the request-response pattern using the Temporary Queue Client, see Request-response messaging pattern (virtual queues) (p. 50).

Reducing Amazon SQS costs

The following best practices can help you reduce costs and take advantage of additional potential cost reduction and near-instantaneous response.

Batching message actions

To reduce costs, batch your message actions:

- To send, receive, and delete messages, and to change the message visibility timeout for multiple messages with a single action, use the Amazon SQS batch API actions (p. 164).
- To combine client-side buffering with request batching, use long polling together with the buffered asynchronous client (p. 165) included with the AWS SDK for Java.

Note
The Amazon SQS Buffered Asynchronous Client doesn't currently support FIFO queues.

Using the appropriate polling mode

- Long polling lets you consume messages from your Amazon SQS queue as soon as they become available.
  - To reduce the cost of using Amazon SQS and to decrease the number of empty receives to an empty queue (responses to the `ReceiveMessage` action which return no messages), enable long polling. For more information, see Amazon SQS Long Polling (p. 41).
  - To increase efficiency when polling for multiple threads with multiple receives, decrease the number of threads.
  - Long polling is preferable over short polling in most cases.
- Short polling returns responses immediately, even if the polled Amazon SQS queue is empty.
  - To satisfy the requirements of an application that expects immediate responses to the `ReceiveMessage` request, use short polling.
  - Short polling is billed the same as long polling.

Moving from an Amazon SQS Standard queue to a FIFO queue

If you're not setting the `DelaySeconds` parameter on each message, you can move to a FIFO queue by providing a message group ID for every sent message.

For more information, see Moving from a standard queue to a FIFO queue (p. 29).

Additional recommendations for Amazon SQS FIFO queues

The following best practices can help you use the message deduplication ID and message group ID optimally. For more information, see the `SendMessage` and `SendMessageBatch` actions in the *Amazon Simple Queue Service API Reference*.

Topics

Using the Amazon SQS message deduplication ID

The message deduplication ID is the token used for deduplication of sent messages. If a message with a particular message deduplication ID is sent successfully, any messages sent with the same message deduplication ID are accepted successfully but aren't delivered during the 5-minute deduplication interval.

Note
Message deduplication applies to an entire queue, not to individual message groups.

Amazon SQS continues to keep track of the message deduplication ID even after the message is received and deleted.

Providing the message deduplication ID

The producer should provide message deduplication ID values for each message in the following scenarios:

- Messages sent with identical message bodies that Amazon SQS must treat as unique.
- Messages sent with identical content but different message attributes that Amazon SQS must treat as unique.
- Messages sent with different content (for example, retry counts included in the message body) that Amazon SQS must treat as duplicates.

Enabling deduplication for a single-producer/consumer system

If you have a single producer and a single consumer and the messages are unique because an application-specific message ID is included in the body of the message, follow these best practices:

- Enable content-based deduplication for the queue (each of your messages has a unique body). The producer can omit the message deduplication ID.
- Although the consumer isn't required to provide a receive request attempt ID for each request, it's a best practice because it allows fail-retry sequences to execute faster.
- You can retry send or receive requests because they don't interfere with the ordering of messages in FIFO queues.

Designing for outage recovery scenarios

The deduplication process in FIFO queues is time-sensitive. When designing your application, make sure that both the producer and the consumer can recover in case of a client or network outage.

- The producer must be aware of the deduplication interval of the queue. Amazon SQS has a *minimum* deduplication interval of 5 minutes. Retrying `SendMessage` requests after the deduplication interval expires can introduce duplicate messages into the queue. For example, a mobile device in a car sends messages whose order is important. If the car loses cellular connectivity for a period of time before receiving an acknowledgement, retrying the request after regaining cellular connectivity can create a duplicate.
- The consumer must have a visibility timeout that minimizes the risk of being unable to process messages before the visibility timeout expires. You can extend the visibility timeout while the messages are being processed by calling the `ChangeMessageVisibility` action. However, if the visibility timeout expires, another consumer can immediately begin to process the messages, causing a message to be processed multiple times. To avoid this scenario, configure a dead-letter queue (p. 43).

Working with visibility timeouts

For optimal performance, set the visibility timeout (p. 46) to be larger than the AWS SDK read timeout. This applies to using the `ReceiveMessage` API action with either short polling (p. 41) or long polling (p. 41).

Using the Amazon SQS message group ID

The message group ID is the tag that specifies that a message belongs to a specific message group. Messages that belong to the same message group are always processed one by one, in a strict order relative to the message group (however, messages that belong to different message groups might be processed out of order).

Interleaving multiple ordered message groups

To interleave multiple ordered message groups within a single FIFO queue, use message group ID values (for example, session data for multiple users). In this scenario, multiple consumers can process the queue, but the session data of each user is processed in a FIFO manner.

Note
When messages that belong to a particular message group ID are invisible, no other consumer can process messages with the same message group ID.

Avoiding processing duplicates in a multiple-producer/consumer system

To avoid processing duplicate messages in a system with multiple producers and consumers where throughput and latency are more important than ordering, the producer should generate a unique message group ID for each message.

Note
In this scenario, duplicates are eliminated. However, the ordering of message can't be guaranteed.
Any scenario with multiple producers and consumers increases the risk of inadvertently delivering a duplicate message if a worker doesn't process the message within the visibility timeout and the message becomes available to another worker.

Avoid having a large backlog of messages with the same message group ID

For FIFO queues, there can be a maximum of 20,000 inflight messages (received from a queue by a consumer, but not yet deleted from the queue). If you reach this quota, Amazon SQS returns no error messages. A FIFO queue looks through the first 20k messages to determine available message groups. This means that if you have a backlog of messages in a single message group, you can't consume messages from other message groups that were sent to the queue at a later time until you successfully consume the messages from the backlog.

Note
A backlog of messages that have the same message group ID might build up because of a consumer that can't successfully process a message. Message processing issues can occur because of an issue with the content of a message or because of a technical issue with the consumer.
To move away messages that can't be processed repeatedly, and to unblock the processing of other messages that have the same message group ID, consider setting up a dead-letter queue (p. 43) policy.

Avoid reusing the same message group ID with virtual queues

To prevent messages with the same message group ID sent to different virtual queues (p. 49) with the same host queue from blocking each other, avoid reusing the same message group ID with virtual queues.

Using the Amazon SQS receive request attempt ID

The receive request attempt ID is the token used for deduplication of `ReceiveMessage` calls.

During a long-lasting network outage that causes connectivity issues between your SDK and Amazon SQS, it's a best practice to provide the receive request attempt ID and to retry with the same receive request attempt ID if the SDK operation fails.

Amazon SQS Java SDK examples

You can use the AWS SDK for Java to build Java applications that interact with Amazon Simple Queue Service (Amazon SQS) and other AWS services. To install and set up the SDK, see Getting started in the *AWS SDK for Java 2.x Developer Guide*.

For examples of basic Amazon SQS queue operations, such as how to create a queue or send a message, see Working with Amazon SQS Message Queues in the *AWS SDK for Java 2.x Developer Guide*.

The examples in this topic demonstrate additional Amazon SQS features, such as server-side encryption (SSE), cost-allocation tags, and message attributes.

Topics

Using server-side encryption (SSE)

You can use the AWS SDK for Java to add server-side encryption (SSE) to an Amazon SQS queue. Each queue uses an AWS Key Management Service (AWS KMS) customer master key (CMK) to generate the data encryption keys. This example uses the AWS managed CMK for Amazon SQS. For more information about using SSE and the role of the CMK, see Encryption at rest (p. 106).

Adding SSE to an existing queue

To enable server-side encryption for an existing queue, use the `SetQueueAttributes` method to set the `KmsMasterKeyId` attribute.

The following code example sets the master key as the AWS managed CMK for Amazon SQS. The example also sets the master key reuse period (p. 107) to 140 seconds.

Before you run the example code, make sure that you have set your AWS credentials. For more information, see Set up AWS Credentials and Region for Development in the *AWS SDK for Java 2.x Developer Guide*.

```
// Create an SqsClient for the specified Region.
SqsClient sqsClient = SqsClient.builder().region(Region.US_WEST_1).build();

// Get the URL of your queue.
String myQueueName = "my queue";
GetQueueUrlResponse getQueueUrlResponse =

 sqsClient.getQueueUrl(GetQueueUrlRequest.builder().queueName(myQueueName).build());
String queueUrl = getQueueUrlResponse.queueUrl();

// Create a hashmap for the attributes. Add the key alias and reuse period to the hashmap.
HashMap<QueueAttributeName, String> attributes = new HashMap<QueueAttributeName, String>();
final String kmsMasterKeyAlias = "alias/aws/sqs";  // the alias of the AWS managed CMK for
 Amazon SQS.
```

```
attributes.put(QueueAttributeName.KMS_MASTER_KEY_ID, kmsMasterKeyAlias);
attributes.put(QueueAttributeName.KMS_DATA_KEY_REUSE_PERIOD_SECONDS, "140");

// Create the SetQueueAttributesRequest.
SetQueueAttributesRequest set_attrs_request = SetQueueAttributesRequest.builder()
          .queueUrl(queueUrl)
          .attributes(attributes)
          .build();

sqsClient.setQueueAttributes(set_attrs_request);
```

Disabling SSE for a queue

To disable server-side encryption for an existing queue, set the `KmsMasterKeyId` attribute to an empty string using the `SetQueueAttributes` method.

Important
`null` isn't a valid value for `KmsMasterKeyId`.

Creating a queue with SSE

To enable SSE when you create the queue, add the `KmsMasterKeyId` attribute to the `CreateQueue` API method.

The following example creates a new queue with SSE enabled. The queue uses the AWS managed CMK for Amazon SQS. The example also sets the master key reuse period (p. 107) to 160 seconds.

Before you run the example code, make sure that you have set your AWS credentials. For more information, see Set up AWS Credentials and Region for Development in the *AWS SDK for Java 2.x Developer Guide*.

```
// Create an SqsClient for the specified Region.
SqsClient sqsClient = SqsClient.builder().region(Region.US_WEST_1).build();

// Create a hashmap for the attributes. Add the key alias and reuse period to the hashmap.
HashMap<QueueAttributeName, String> attributes = new HashMap<QueueAttributeName, String>();
final String kmsMasterKeyAlias = "alias/aws/sqs";  // the alias of the AWS managed CMK for
 Amazon SQS.
attributes.put(QueueAttributeName.KMS_MASTER_KEY_ID, kmsMasterKeyAlias);
attributes.put(QueueAttributeName.KMS_DATA_KEY_REUSE_PERIOD_SECONDS, "140");

// Add the attributes to the CreateQueueRequest.
CreateQueueRequest createQueueRequest =
                CreateQueueRequest.builder()
                        .queueName(queueName)
                        .attributes(attributes)
                        .build();
sqsClient.createQueue(createQueueRequest);
```

Retrieving SSE attributes

For information about retrieving queue attributes, see Examples in the *Amazon Simple Queue Service API Reference*.

To retrieve the CMK ID or the data key reuse period for a particular queue, run the `GetQueueAttributes` method and retrieve the `KmsMasterKeyId` and `KmsDataKeyReusePeriodSeconds` values.

Configuring tags for a queue

Use cost-allocation tags to help organize and identify your Amazon SQS queues. The following examples show how to configure tags using the AWS SDK for Java. For more information, see Amazon SQS cost allocation tags (p. 40).

Before you run the example code, make sure that you have set your AWS credentials. For more information, see Set up AWS Credentials and Region for Development in the *AWS SDK for Java 2.x Developer Guide*.

Listing tags

To list the tags for a queue, use the `ListQueueTags` method.

```
// Create an SqsClient for the specified region.
SqsClient sqsClient = SqsClient.builder().region(Region.US_WEST_1).build();

// Get the queue URL.
String queueName = "MyStandardQ1";
GetQueueUrlResponse getQueueUrlResponse =
        sqsClient.getQueueUrl(GetQueueUrlRequest.builder().queueName(queueName).build());
String queueUrl = getQueueUrlResponse.queueUrl();

// Create the ListQueueTagsRequest.
final ListQueueTagsRequest listQueueTagsRequest =

 ListQueueTagsRequest.builder().queueUrl(queueUrl).build();

// Retrieve the list of queue tags and print them.
final ListQueueTagsResponse listQueueTagsResponse =
                                  sqsClient.listQueueTags(listQueueTagsRequest);
System.out.println(String.format("ListQueueTags: \tTags for queue %s are %s.\n",
                queueName, listQueueTagsResponse.tags() ));
```

Adding or updating tags

To add or update tag values for a queue, use the `TagQueue` method.

```
 // Create an SqsClient for the specified Region.
SqsClient sqsClient = SqsClient.builder().region(Region.US_WEST_1).build();

// Get the queue URL.
String queueName = "MyStandardQ1";
GetQueueUrlResponse getQueueUrlResponse =
        sqsClient.getQueueUrl(GetQueueUrlRequest.builder().queueName(queueName).build());
String queueUrl = getQueueUrlResponse.queueUrl();

// Build a hashmap of the tags.
final HashMap<String, String> addedTags = new HashMap<>();
        addedTags.put("Team", "Development");
        addedTags.put("Priority", "Beta");
        addedTags.put("Accounting ID", "456def");

//Create the TagQueueRequest and add them to the queue.
final TagQueueRequest tagQueueRequest = TagQueueRequest.builder()
        .queueUrl(queueUrl)
        .tags(addedTags)
        .build();
```

```
sqsClient.tagQueue(tagQueueRequest);
```

Removing tags

To remove one or more tags from the queue, use the `UntagQueue` method. The following example removes the `Accounting ID` tag.

```
// Create the UntagQueueRequest.
final UntagQueueRequest untagQueueRequest = UntagQueueRequest.builder()
        .queueUrl(queueUrl)
        .tagKeys("Accounting ID")
        .build();

// Remove the tag from this queue.
sqsClient.untagQueue(untagQueueRequest);
```

Sending message attributes

You can include structured metadata (such as timestamps, geospatial data, signatures, and identifiers) with messages using *message attributes*. For more information, see Amazon SQS message attributes (p. 37).

Before you run the example code, make sure that you have set your AWS credentials. For more information, see Set up AWS Credentials and Region for Development in the *AWS SDK for Java 2.x Developer Guide*.

Defining attributes

To define an attribute for a message, add the following code, which uses the `MessageAttributeValue` data type. For more information, see Message attribute components (p. 37) and Message attribute data types (p. 38).

The AWS SDK for Java automatically calculates the message body and message attribute checksums and compares them with the data that Amazon SQS returns. For more information, see the *AWS SDK for Java 2.x Developer Guide* and Calculating the MD5 message digest for message attributes (p. 38) for other programming languages.

String

This example defines a `String` attribute named `Name` with the value `Jane`.

```
final Map<String, MessageAttributeValue> messageAttributes = new HashMap<>();
messageAttributes.put("Name", new MessageAttributeValue()
.withDataType("String")
.withStringValue("Jane"));
```

Number

This example defines a `Number` attribute named `AccurateWeight` with the value `230.000000000000000001`.

```
final Map<String, MessageAttributeValue> messageAttributes = new HashMap<>();
```

```
messageAttributes.put("AccurateWeight", new MessageAttributeValue()
.withDataType("Number")
.withStringValue("230.000000000000000001"));
```

Binary

This example defines a `Binary` attribute named `ByteArray` with the value of an uninitialized 10-byte array.

```
final Map<String, MessageAttributeValue> messageAttributes = new HashMap<>();
messageAttributes.put("ByteArray", new MessageAttributeValue()
.withDataType("Binary")
.withBinaryValue(ByteBuffer.wrap(new byte[10])));
```

String (custom)

This example defines the custom attribute `String.EmployeeId` named `EmployeeId` with the value `ABC123456`.

```
final Map<String, MessageAttributeValue> messageAttributes = new HashMap<>();
messageAttributes.put("EmployeeId", new MessageAttributeValue()
.withDataType("String.EmployeeId")
.withStringValue("ABC123456"));
```

Number (custom)

This example defines the custom attribute `Number.AccountId` named `AccountId` with the value `000123456`.

```
final Map<String, MessageAttributeValue> messageAttributes = new HashMap<>();
messageAttributes.put("AccountId", new MessageAttributeValue()
.withDataType("Number.AccountId")
.withStringValue("000123456"));
```

Note
Because the base data type is `Number`, the `ReceiveMessage` method returns `123456`.

Binary (custom)

This example defines the custom attribute `Binary.JPEG` named `ApplicationIcon` with the value of an uninitialized 10-byte array.

```
final Map<String, MessageAttributeValue> messageAttributes = new HashMap<>();
messageAttributes.put("ApplicationIcon", new MessageAttributeValue()
.withDataType("Binary.JPEG")
.withBinaryValue(ByteBuffer.wrap(new byte[10])));
```

Sending a message with attributes

This example adds the attributes to the `SendMessageRequest` before sending the message.

```
// Send a message with an attribute.
final SendMessageRequest sendMessageRequest = new SendMessageRequest();
sendMessageRequest.withMessageBody("This is my message text.");
sendMessageRequest.withQueueUrl(myQueueUrl);
sendMessageRequest.withMessageAttributes(messageAttributes);
sqs.sendMessage(sendMessageRequest);
```

Important
If you send a message to a First-In-First-Out (FIFO) queue, make sure that the `sendMessage` method executes *after* you provide the message group ID.
If you use the `SendMessageBatch` method instead of `SendMessage`, you must specify message attributes for each message in the batch.

Managing large Amazon SQS messages using Amazon S3

To manage large Amazon Simple Queue Service (Amazon SQS) messages, you can use Amazon Simple Storage Service (Amazon S3) and the Amazon SQS Extended Client Library for Java. This is especially useful for storing and consuming messages up to 2 GB. Unless your application requires repeatedly creating queues and leaving them inactive or storing large amounts of data in your queues, consider using Amazon S3 for storing your data.

You can use the Amazon SQS Extended Client Library for Java to do the following:

- Specify whether messages are always stored in Amazon S3 or only when the size of a message exceeds 256 KB
- Send a message that references a single message object stored in an S3 bucket
- Retrieve the message object from an S3 bucket
- Delete the message object from an S3 bucket

You can use the Amazon SQS Extended Client Library for Java to manage Amazon SQS messages using Amazon S3 *only* with the AWS SDK for Java. You can't do this with the AWS CLI, the Amazon SQS console, the Amazon SQS HTTP API, or any of the other AWS SDKs.

The SDK for Java and Amazon SQS Extended Client Library for Java require the J2SE Development Kit 8.0 or later.

Prerequisites

The following example uses the AWS Java SDK. To install and set up the SDK, see Set up the AWS SDK for Java in the *AWS SDK for Java Developer Guide*.

Before you run the example code, configure your AWS credentials. For more information, see Set up AWS Credentials and Region for Development in the *AWS SDK for Java Developer Guide*.

Example: Using Amazon S3 to manage large Amazon SQS messages

The following example creates an Amazon S3 bucket with a random name and adds a lifecycle rule to permanently delete objects after 14 days. It also creates a queue named `MyQueue` and sends a random message that is stored in an S3 bucket and is more than 256 KB to the queue. Finally, the code retrieves the message, returns information about it, and then deletes the message, the queue, and the bucket.

```
/*
 * Copyright 2010-2021 Amazon.com, Inc. or its affiliates. All Rights Reserved.
 *
 * Licensed under the Apache License, Version 2.0 (the "License").
 * You may not use this file except in compliance with the License.
 * A copy of the License is located at
 *
 *  https://aws.amazon.com/apache2.0
 *
 * or in the "license" file accompanying this file. This file is distributed
 * on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 * express or implied. See the License for the specific language governing
 * permissions and limitations under the License.
 *
 */

import com.amazon.sqs.javamessaging.AmazonSQSExtendedClient;
import com.amazon.sqs.javamessaging.ExtendedClientConfiguration;
import com.amazonaws.services.s3.AmazonS3;
import com.amazonaws.services.s3.AmazonS3ClientBuilder;
import com.amazonaws.services.s3.model.*;
import com.amazonaws.services.sqs.AmazonSQS;
import com.amazonaws.services.sqs.AmazonSQSClientBuilder;
import com.amazonaws.services.sqs.model.*;
import org.joda.time.DateTime;
import org.joda.time.format.DateTimeFormat;

import java.util.Arrays;
import java.util.List;
import java.util.UUID;

public class SQSExtendedClientExample {

// Create an Amazon S3 bucket with a random name.
private final static String S3_BUCKET_NAME = UUID.randomUUID() + "-"
        + DateTimeFormat.forPattern("yyMMdd-hhmmss").print(new DateTime());

public static void main(String[] args) {

    /*
     * Create a new instance of the builder with all defaults (credentials
     * and region) set automatically. For more information, see
     * Creating Service Clients in the AWS SDK for Java Developer Guide.
     */
    final AmazonS3 s3 = AmazonS3ClientBuilder.defaultClient();

    /*
     * Set the Amazon S3 bucket name, and then set a lifecycle rule on the
     * bucket to permanently delete objects 14 days after each object's
     * creation date.
     */
    final BucketLifecycleConfiguration.Rule expirationRule =
            new BucketLifecycleConfiguration.Rule();
    expirationRule.withExpirationInDays(14).withStatus("Enabled");
    final BucketLifecycleConfiguration lifecycleConfig =
            new BucketLifecycleConfiguration().withRules(expirationRule);

    // Create the bucket and allow message objects to be stored in the bucket.
    s3.createBucket(S3_BUCKET_NAME);
    s3.setBucketLifecycleConfiguration(S3_BUCKET_NAME, lifecycleConfig);
    System.out.println("Bucket created and configured.");

    /*
     * Set the Amazon SQS extended client configuration with large payload
     * support enabled.
     */
    final ExtendedClientConfiguration extendedClientConfig =
            new ExtendedClientConfiguration()
                    .withLargePayloadSupportEnabled(s3, S3_BUCKET_NAME);

    final AmazonSQS sqsExtended =
            new AmazonSQSExtendedClient(AmazonSQSClientBuilder
                    .defaultClient(), extendedClientConfig);

    /*
     * Create a long string of characters for the message object which will
     * be stored in the bucket.
     */
    int stringLength = 300000;
    char[] chars = new char[stringLength];
    Arrays.fill(chars, 'x');
    final String myLongString = new String(chars);

    // Create a message queue for this example.
    final String QueueName = "MyQueue" + UUID.randomUUID().toString();
    final CreateQueueRequest createQueueRequest =
            new CreateQueueRequest(QueueName);
    final String myQueueUrl = sqsExtended
            .createQueue(createQueueRequest).getQueueUrl();
    System.out.println("Queue created.");

    // Send the message.
    final SendMessageRequest myMessageRequest =
            new SendMessageRequest(myQueueUrl, myLongString);
    sqsExtended.sendMessage(myMessageRequest);
    System.out.println("Sent the message.");

    // Receive the message.
    final ReceiveMessageRequest receiveMessageRequest =
            new ReceiveMessageRequest(myQueueUrl);
    List<Message> messages = sqsExtended
            .receiveMessage(receiveMessageRequest).getMessages();

    // Print information about the message.
    for (Message message : messages) {
        System.out.println("\nMessage received.");
        System.out.println("  ID: " + message.getMessageId());
        System.out.println("  Receipt handle: " + message.getReceiptHandle());
        System.out.println("  Message body (first 5 characters): "
                + message.getBody().substring(0, 5));
    }

    // Delete the message, the queue, and the bucket.
    final String messageReceiptHandle = messages.get(0).getReceiptHandle();
    sqsExtended.deleteMessage(new DeleteMessageRequest(myQueueUrl,
            messageReceiptHandle));
    System.out.println("Deleted the message.");

    sqsExtended.deleteQueue(new DeleteQueueRequest(myQueueUrl));
    System.out.println("Deleted the queue.");

    deleteBucketAndAllContents(s3);
    System.out.println("Deleted the bucket.");
}

private static void deleteBucketAndAllContents(AmazonS3 client) {

    ObjectListing objectListing = client.listObjects(S3_BUCKET_NAME);

    while (true) {
        for (S3ObjectSummary objectSummary : objectListing
                .getObjectSummaries()) {
            client.deleteObject(S3_BUCKET_NAME, objectSummary.getKey());
        }

        if (objectListing.isTruncated()) {
            objectListing = client.listNextBatchOfObjects(objectListing);
        } else {
            break;
        }
    }

    final VersionListing list = client.listVersions(
            new ListVersionsRequest().withBucketName(S3_BUCKET_NAME));

    for (S3VersionSummary s : list.getVersionSummaries()) {
        client.deleteVersion(S3_BUCKET_NAME, s.getKey(), s.getVersionId());
    }

    client.deleteBucket(S3_BUCKET_NAME);
}
}
```

Working with JMS and Amazon SQS

The Amazon SQS Java Messaging Library is a Java Message Service (JMS) interface for Amazon SQS that lets you take advantage of Amazon SQS in applications that already use JMS. The interface lets you use Amazon SQS as the JMS provider with minimal code changes. Together with the AWS SDK for Java, the Amazon SQS Java Messaging Library lets you create JMS connections and sessions, as well as producers and consumers that send and receive messages to and from Amazon SQS queues.

The library supports sending and receiving messages to a queue (the JMS point-to-point model) according to the JMS 1.1 specification. The library supports sending text, byte, or object messages synchronously to Amazon SQS queues. The library also supports receiving objects synchronously or asynchronously.

For information about features of the Amazon SQS Java Messaging Library that support the JMS 1.1 specification, see Supported JMS 1.1 implementations (p. 91) and the Amazon SQS FAQs.

Topics

Prerequisites

Before you begin, you must have the following prerequisites:

- **SDK for Java**

  There are two ways to include the SDK for Java in your project:
  - Download and install the SDK for Java.
  - Use Maven to get the Amazon SQS Java Messaging Library.

    Note
    The SDK for Java is included as a dependency.
    The SDK for Java and Amazon SQS Extended Client Library for Java require the J2SE Development Kit 8.0 or later.

    For information about downloading the SDK for Java, see SDK for Java.
- **Amazon SQS Java Messaging Library**

  If you don't use Maven, you must add the `amazon-sqs-java-messaging-lib.jar` package to the Java class path. For information about downloading the library, see Amazon SQS Java Messaging Library.

  Note
  The Amazon SQS Java Messaging Library includes support for Maven and the Spring Framework.

For code samples that use Maven, the Spring Framework, and the Amazon SQS Java Messaging Library, see Working Java example for using JMS with Amazon SQS Standard queues (p. 77).

```
<dependency>
  <groupId>com.amazonaws</groupId>
  <artifactId>amazon-sqs-java-messaging-lib</artifactId>
  <version>1.0.4</version>
  <type>jar</type>
</dependency>
```

- **Amazon SQS Queue**

  Create a queue using the AWS Management Console for Amazon SQS, the `CreateQueue` API, or the wrapped Amazon SQS client included in the Amazon SQS Java Messaging Library.

  - For information about creating a queue with Amazon SQS using either the AWS Management Console or the `CreateQueue` API, see Creating a Queue (p. 11).
  - For information about using the Amazon SQS Java Messaging Library, see Getting started with the Amazon SQS Java Messaging Library (p. 71).

Getting started with the Amazon SQS Java Messaging Library

To get started using the Java Message Service (JMS) with Amazon SQS, use the code examples in this section. The following sections show how to create a JMS connection and a session, and how to send and receive a message.

The wrapped Amazon SQS client object included in the Amazon SQS Java Messaging Library checks if an Amazon SQS queue exists. If the queue doesn't exist, the client creates it.

Creating a JMS connection

1. Create a connection factory and call the `createConnection` method against the factory.

   ```
   // Create a new connection factory with all defaults (credentials and region) set
    automatically
   SQSConnectionFactory connectionFactory = new SQSConnectionFactory(
           new ProviderConfiguration(),
           AmazonSQSClientBuilder.defaultClient()
           );

   // Create the connection.
   SQSConnection connection = connectionFactory.createConnection();
   ```

   The `SQSConnection` class extends `javax.jms.Connection`. Together with the JMS standard connection methods, `SQSConnection` offers additional methods, such as `getAmazonSQSClient` and `getWrappedAmazonSQSClient`. Both methods let you perform administrative operations not included in the JMS specification, such as creating new queues. However, the `getWrappedAmazonSQSClient` method also provides a wrapped version of the Amazon SQS client used by the current connection. The wrapper transforms every exception from the client into an `JMSException`, allowing it to be more easily used by existing code that expects `JMSException` occurrences.
2. You can use the client objects returned from `getAmazonSQSClient` and `getWrappedAmazonSQSClient` to perform administrative operations not included in the JMS specification (for example, you can create an Amazon SQS queue).

If you have existing code that expects JMS exceptions, then you should use `getWrappedAmazonSQSClient`:

- If you use `getWrappedAmazonSQSClient`, the returned client object transforms all exceptions into JMS exceptions.
- If you use `getAmazonSQSClient`, the exceptions are all Amazon SQS exceptions.

Creating an Amazon SQS queue

The wrapped client object checks if an Amazon SQS queue exists.

If a queue doesn't exist, the client creates it. If the queue does exist, the function doesn't return anything. For more information, see the "Create the queue if needed" section in the TextMessageSender.java (p. 79) example.

To create a standard queue

```
// Get the wrapped client
AmazonSQSMessagingClientWrapper client = connection.getWrappedAmazonSQSClient();

// Create an SQS queue named MyQueue, if it doesn't already exist
if (!client.queueExists("MyQueue")) {
    client.createQueue("MyQueue");
}
```

To create a FIFO queue

```
// Get the wrapped client
AmazonSQSMessagingClientWrapper client = connection.getWrappedAmazonSQSClient();

// Create an Amazon SQS FIFO queue named MyQueue.fifo, if it doesn't already exist
if (!client.queueExists("MyQueue.fifo")) {
    Map<String, String> attributes = new HashMap<String, String>();
    attributes.put("FifoQueue", "true");
    attributes.put("ContentBasedDeduplication", "true");
    client.createQueue(new
 CreateQueueRequest().withQueueName("MyQueue.fifo").withAttributes(attributes));
}
```

Note
The name of a FIFO queue must end with the `.fifo` suffix.
For more information about the `ContentBasedDeduplication` attribute, see Exactly-once processing (p. 29).

Sending messages synchronously

1. When the connection and the underlying Amazon SQS queue are ready, create a nontransacted JMS session with `AUTO_ACKNOWLEDGE` mode.

```
// Create the nontransacted session with AUTO_ACKNOWLEDGE mode
Session session = connection.createSession(false, Session.AUTO_ACKNOWLEDGE);
```

2. To send a text message to the queue, create a JMS queue identity and a message producer.

```
// Create a queue identity and specify the queue name to the session
```

```
Queue queue = session.createQueue("MyQueue");

// Create a producer for the 'MyQueue'
MessageProducer producer = session.createProducer(queue);
```

3. Create a text message and send it to the queue.

   - To send a message to a standard queue, you don't need to set any additional parameters.

     ```
     // Create the text message
     TextMessage message = session.createTextMessage("Hello World!");

     // Send the message
     producer.send(message);
     System.out.println("JMS Message " + message.getJMSMessageID());
     ```

   - To send a message to a FIFO queue, you must set the message group ID. You can also set a message deduplication ID. For more information, see Key terms (p. 27).

     ```
     // Create the text message
     TextMessage message = session.createTextMessage("Hello World!");

     // Set the message group ID
     message.setStringProperty("JMSXGroupID", "Default");

     // You can also set a custom message deduplication ID
     // message.setStringProperty("JMS_SQS_DeduplicationId", "hello");
     // Here, it's not needed because content-based deduplication is enabled for the queue

     // Send the message
     producer.send(message);
     System.out.println("JMS Message " + message.getJMSMessageID());
     System.out.println("JMS Message Sequence Number " +
      message.getStringProperty("JMS_SQS_SequenceNumber"));
     ```

Receiving messages synchronously

1. To receive messages, create a consumer for the same queue and invoke the `start` method.

   You can call the `start` method on the connection at any time. However, the consumer doesn't begin to receive messages until you call it.

   ```
   // Create a consumer for the 'MyQueue'
   MessageConsumer consumer = session.createConsumer(queue);
   // Start receiving incoming messages
   connection.start();
   ```

2. Call the `receive` method on the consumer with a timeout set to 1 second, and then print the contents of the received message.

   - After receiving a message from a standard queue, you can access the contents of the message.

     ```
     // Receive a message from 'MyQueue' and wait up to 1 second
     Message receivedMessage = consumer.receive(1000);

     // Cast the received message as TextMessage and display the text
     if (receivedMessage != null) {
         System.out.println("Received: " + ((TextMessage) receivedMessage).getText());
     }
     ```

- After receiving a message from a FIFO queue, you can access the contents of the message and other, FIFO-specific message attributes, such as the message group ID, message deduplication ID, and sequence number. For more information, see Key terms (p. 27).

```
// Receive a message from 'MyQueue' and wait up to 1 second
Message receivedMessage = consumer.receive(1000);

// Cast the received message as TextMessage and display the text
if (receivedMessage != null) {
    System.out.println("Received: " + ((TextMessage) receivedMessage).getText());
    System.out.println("Group id: " +
 receivedMessage.getStringProperty("JMSXGroupID"));
    System.out.println("Message deduplication id: " +
 receivedMessage.getStringProperty("JMS_SQS_DeduplicationId"));
    System.out.println("Message sequence number: " +
 receivedMessage.getStringProperty("JMS_SQS_SequenceNumber"));
}
```

3. Close the connection and the session.

```
// Close the connection (and the session).
connection.close();
```

The output looks similar to the following:

```
JMS Message ID:8example-588b-44e5-bbcf-d816example2
Received: Hello World!
```

Note
You can use the Spring Framework to initialize these objects.
For additional information, see `SpringExampleConfiguration.xml`, `SpringExample.java`, and the other helper classes in `ExampleConfiguration.java` and `ExampleCommon.java` in the Working Java example for using JMS with Amazon SQS Standard queues (p. 77) section.

For complete examples of sending and receiving objects, see TextMessageSender.java (p. 79) and SyncMessageReceiver.java (p. 80).

Receiving messages asynchronously

In the example in Getting started with the Amazon SQS Java Messaging Library (p. 71), a message is sent to `MyQueue` and received synchronously.

The following example shows how to receive the messages asynchronously through a listener.

1. Implement the `MessageListener` interface.

```
class MyListener implements MessageListener {

    @Override
    public void onMessage(Message message) {
        try {
            // Cast the received message as TextMessage and print the text to screen.
            System.out.println("Received: " + ((TextMessage) message).getText());
        } catch (JMSException e) {
            e.printStackTrace();
        }
    }
}
```

The `onMessage` method of the `MessageListener` interface is called when you receive a message. In this listener implementation, the text stored in the message is printed.

2. Instead of explicitly calling the `receive` method on the consumer, set the message listener of the consumer to an instance of the `MyListener` implementation. The main thread waits for one second.

```
// Create a consumer for the 'MyQueue'.
MessageConsumer consumer = session.createConsumer(queue);

// Instantiate and set the message listener for the consumer.
consumer.setMessageListener(new MyListener());

// Start receiving incoming messages.
connection.start();

// Wait for 1 second. The listener onMessage() method is invoked when a message is
 received.
Thread.sleep(1000);
```

The rest of the steps are identical to the ones in the Getting started with the Amazon SQS Java Messaging Library (p. 71) example. For a complete example of an asynchronous consumer, see `AsyncMessageReceiver.java` in Working Java example for using JMS with Amazon SQS Standard queues (p. 77).

The output for this example looks similar to the following:

```
JMS Message ID:8example-588b-44e5-bbcf-d816example2
Received: Hello World!
```

Using client acknowledge mode

The example in Getting started with the Amazon SQS Java Messaging Library (p. 71) uses `AUTO_ACKNOWLEDGE` mode where every received message is acknowledged automatically (and therefore deleted from the underlying Amazon SQS queue).

1. To explicitly acknowledge the messages after they're processed, you must create the session with `CLIENT_ACKNOWLEDGE` mode.

```
// Create the non-transacted session with CLIENT_ACKNOWLEDGE mode.
Session session = connection.createSession(false, Session.CLIENT_ACKNOWLEDGE);
```

2. When the message is received, display it and then explicitly acknowledge it.

```
// Cast the received message as TextMessage and print the text to screen. Also
 acknowledge the message.
if (receivedMessage != null) {
    System.out.println("Received: " + ((TextMessage) receivedMessage).getText());
    receivedMessage.acknowledge();
    System.out.println("Acknowledged: " + message.getJMSMessageID());
}
```

Note
In this mode, when a message is acknowledged, all messages received before this message are implicitly acknowledged as well. For example, if 10 messages are received, and only

the 10th message is acknowledged (in the order the messages are received), then all of the previous nine messages are also acknowledged.

The rest of the steps are identical to the ones in the Getting started with the Amazon SQS Java Messaging Library (p. 71) example. For a complete example of a synchronous consumer with client acknowledge mode, see `SyncMessageReceiverClientAcknowledge.java` in Working Java example for using JMS with Amazon SQS Standard queues (p. 77).

The output for this example looks similar to the following:

```
JMS Message ID:4example-aa0e-403f-b6df-5e02example5
Received: Hello World!
Acknowledged: ID:4example-aa0e-403f-b6df-5e02example5
```

Using unordered acknowledge mode

When using `CLIENT_ACKNOWLEDGE` mode, all messages received before an explicitly-acknowledged message are acknowledged automatically. For more information, see Using client acknowledge mode (p. 75).

The Amazon SQS Java Messaging Library provides another acknowledgement mode. When using `UNORDERED_ACKNOWLEDGE` mode, all received messages must be individually and explicitly acknowledged by the client, regardless of their reception order. To do this, create a session with `UNORDERED_ACKNOWLEDGE` mode.

```
// Create the non-transacted session with UNORDERED_ACKNOWLEDGE mode.
Session session = connection.createSession(false, SQSSession.UNORDERED_ACKNOWLEDGE);
```

The remaining steps are identical to the ones in the Using client acknowledge mode (p. 75) example. For a complete example of a synchronous consumer with `UNORDERED_ACKNOWLEDGE` mode, see `SyncMessageReceiverUnorderedAcknowledge.java`.

In this example, the output looks similar to the following:

```
JMS Message ID:dexample-73ad-4adb-bc6c-4357example7
Received: Hello World!
Acknowledged: ID:dexample-73ad-4adb-bc6c-4357example7
```

Using the Amazon SQS Java Message Service (JMS) Client with other Amazon SQS clients

Using the Amazon SQS Java Message Service (JMS) Client with the AWS SDK limits Amazon SQS message size to 256 KB. However, you can create a JMS provider using any Amazon SQS client. For example, you can use the JMS Client with the Amazon SQS Extended Client Library for Java to send an Amazon SQS message that contains a reference to a message payload (up to 2 GB) in Amazon S3. For more information, see Managing large Amazon SQS messages using Amazon S3 (p. 66).

The following Java code example creates the JMS provider for the Extended Client Library:

```
AmazonS3 s3 = new AmazonS3Client(credentials);
Region s3Region = Region.getRegion(Regions.US_WEST_2);
s3.setRegion(s3Region);
```

```
// Set the Amazon S3 bucket name, and set a lifecycle rule on the bucket to
// permanently delete objects a certain number of days after each object's creation date.
// Next, create the bucket, and enable message objects to be stored in the bucket.
BucketLifecycleConfiguration.Rule expirationRule = new BucketLifecycleConfiguration.Rule();
expirationRule.withExpirationInDays(14).withStatus("Enabled");
BucketLifecycleConfiguration lifecycleConfig = new
 BucketLifecycleConfiguration().withRules(expirationRule);

s3.createBucket(s3BucketName);
s3.setBucketLifecycleConfiguration(s3BucketName, lifecycleConfig);
System.out.println("Bucket created and configured.");

// Set the SQS extended client configuration with large payload support enabled.
ExtendedClientConfiguration extendedClientConfig = new ExtendedClientConfiguration()
    .withLargePayloadSupportEnabled(s3, s3BucketName);

AmazonSQS sqsExtended = new AmazonSQSExtendedClient(new AmazonSQSClient(credentials),
 extendedClientConfig);
Region sqsRegion = Region.getRegion(Regions.US_WEST_2);
sqsExtended.setRegion(sqsRegion);
```

The following Java code example creates the connection factory:

```
// Create the connection factory using the environment variable credential provider.
// Pass the configured Amazon SQS Extended Client to the JMS connection factory.
SQSConnectionFactory connectionFactory = new SQSConnectionFactory(
        new ProviderConfiguration(),
        sqsExtended
        );

// Create the connection.
SQSConnection connection = connectionFactory.createConnection();
```

Working Java example for using JMS with Amazon SQS Standard queues

The following code examples show how to use the Java Message Service (JMS) with Amazon SQS standard queues. For more information about working with FIFO queues, see To create a FIFO queue (p. 72), Sending messages synchronously (p. 72), and Receiving messages synchronously (p. 73). (Receiving messages synchronously is the same for standard and FIFO queues. However, messages in FIFO queues contain more attributes.)

ExampleConfiguration.java

The following Java code example sets the default queue name, the region, and the credentials to be used with the other Java examples.

```
/*
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 *
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 * on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 * express or implied. See the License for the specific language governing
 * permissions and limitations under the License.
 *
 */

public class ExampleConfiguration {
    public static final String DEFAULT_QUEUE_NAME = "SQSJMSClientExampleQueue";

    public static final Region DEFAULT_REGION = Region.getRegion(Regions.US_EAST_2);

    private static String getParameter( String args[], int i ) {
        if( i + 1 >= args.length ) {
            throw new IllegalArgumentException( "Missing parameter for " + args[i] );
        }
        return args[i+1];
    }

    /**
     * Parse the command line and return the resulting config. If the config parsing fails
     * print the error and the usage message and then call System.exit
     *
     * @param app the app to use when printing the usage string
     * @param args the command line arguments
     * @return the parsed config
     */
    public static ExampleConfiguration parseConfig(String app, String args[]) {
        try {
            return new ExampleConfiguration(args);
        } catch (IllegalArgumentException e) {
            System.err.println( "ERROR: " + e.getMessage() );
            System.err.println();
            System.err.println( "Usage: " + app + " [--queue <queue>] [--region <region>]
 [--credentials <credentials>] ");
            System.err.println( "  or" );
            System.err.println( "       " + app + " <spring.xml>" );
            System.exit(-1);
            return null;
        }
    }

    private ExampleConfiguration(String args[]) {
        for( int i = 0; i < args.length; ++i ) {
            String arg = args[i];
            if( arg.equals( "--queue" ) ) {
                setQueueName(getParameter(args, i));
                i++;
            } else if( arg.equals( "--region" ) ) {
                String regionName = getParameter(args, i);
                try {
                    setRegion(Region.getRegion(Regions.fromName(regionName)));
                } catch( IllegalArgumentException e ) {
                    throw new IllegalArgumentException( "Unrecognized region " +
 regionName );
                }
                i++;
            } else if( arg.equals( "--credentials" ) ) {
                String credsFile = getParameter(args, i);
                try {
                    setCredentialsProvider( new
 PropertiesFileCredentialsProvider(credsFile) );
                } catch (AmazonClientException e) {
                    throw new IllegalArgumentException("Error reading credentials from " +
 credsFile, e );
                }
                i++;
            } else {
                throw new IllegalArgumentException("Unrecognized option " + arg);
            }
        }
    }

    private String queueName = DEFAULT_QUEUE_NAME;
    private Region region = DEFAULT_REGION;
    private AWSCredentialsProvider credentialsProvider = new
 DefaultAWSCredentialsProviderChain();

    public String getQueueName() {
        return queueName;
    }

    public void setQueueName(String queueName) {
        this.queueName = queueName;
    }

    public Region getRegion() {
        return region;
    }

    public void setRegion(Region region) {
        this.region = region;
    }

    public AWSCredentialsProvider getCredentialsProvider() {
        return credentialsProvider;
    }

    public void setCredentialsProvider(AWSCredentialsProvider credentialsProvider) {
        // Make sure they're usable first
        credentialsProvider.getCredentials();
        this.credentialsProvider = credentialsProvider;
    }
}
```

TextMessageSender.java

The following Java code example creates a text message producer.

```
/*
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 *
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 * on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 * express or implied. See the License for the specific language governing
 * permissions and limitations under the License.
 *
 */

public class TextMessageSender {
    public static void main(String args[]) throws JMSException {
        ExampleConfiguration config = ExampleConfiguration.parseConfig("TextMessageSender",
 args);
```

```
        ExampleCommon.setupLogging();

        // Create the connection factory based on the config
        SQSConnectionFactory connectionFactory = new SQSConnectionFactory(
                new ProviderConfiguration(),
                AmazonSQSClientBuilder.standard()
                        .withRegion(config.getRegion().getName())
                        .withCredentials(config.getCredentialsProvider())
                );

        // Create the connection
        SQSConnection connection = connectionFactory.createConnection();

        // Create the queue if needed
        ExampleCommon.ensureQueueExists(connection, config.getQueueName());

        // Create the session
        Session session = connection.createSession(false, Session.AUTO_ACKNOWLEDGE);
        MessageProducer producer =
 session.createProducer( session.createQueue( config.getQueueName() ) );

        sendMessages(session, producer);

        // Close the connection. This closes the session automatically
        connection.close();
        System.out.println( "Connection closed" );
    }

    private static void sendMessages( Session session, MessageProducer producer ) {
        BufferedReader inputReader = new BufferedReader(
            new InputStreamReader( System.in, Charset.defaultCharset() ) );

        try {
            String input;
            while( true ) {
                System.out.print( "Enter message to send (leave empty to exit): " );
                input = inputReader.readLine();
                if( input == null || input.equals("" ) ) break;

                TextMessage message = session.createTextMessage(input);
                producer.send(message);
                System.out.println( "Send message " + message.getJMSMessageID() );
            }
        } catch (EOFException e) {
            // Just return on EOF
        } catch (IOException e) {
            System.err.println( "Failed reading input: " + e.getMessage() );
        } catch (JMSException e) {
            System.err.println( "Failed sending message: " + e.getMessage() );
            e.printStackTrace();
        }
    }
}
```

SyncMessageReceiver.java

The following Java code example creates a synchronous message consumer.

```
/*
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 *
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 * on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 * express or implied. See the License for the specific language governing
 * permissions and limitations under the License.
 *
 */

public class SyncMessageReceiver {
public static void main(String args[]) throws JMSException {
    ExampleConfiguration config = ExampleConfiguration.parseConfig("SyncMessageReceiver",
 args);

    ExampleCommon.setupLogging();

    // Create the connection factory based on the config
    SQSConnectionFactory connectionFactory = new SQSConnectionFactory(
            new ProviderConfiguration(),
            AmazonSQSClientBuilder.standard()
                    .withRegion(config.getRegion().getName())
                    .withCredentials(config.getCredentialsProvider())
            );

    // Create the connection
    SQSConnection connection = connectionFactory.createConnection();

    // Create the queue if needed
    ExampleCommon.ensureQueueExists(connection, config.getQueueName());

    // Create the session
    Session session = connection.createSession(false, Session.CLIENT_ACKNOWLEDGE);
    MessageConsumer consumer =
 session.createConsumer( session.createQueue( config.getQueueName() ) );

    connection.start();

    receiveMessages(session, consumer);

    // Close the connection. This closes the session automatically
    connection.close();
    System.out.println( "Connection closed" );
}

private static void receiveMessages( Session session, MessageConsumer consumer ) {
    try {
        while( true ) {
            System.out.println( "Waiting for messages");
            // Wait 1 minute for a message
            Message message = consumer.receive(TimeUnit.MINUTES.toMillis(1));
            if( message == null ) {
                System.out.println( "Shutting down after 1 minute of silence" );
                break;
            }
            ExampleCommon.handleMessage(message);
            message.acknowledge();
            System.out.println( "Acknowledged message " + message.getJMSMessageID() );
        }
    } catch (JMSException e) {
        System.err.println( "Error receiving from SQS: " + e.getMessage() );
        e.printStackTrace();
    }
}
}
```

AsyncMessageReceiver.java

The following Java code example creates an asynchronous message consumer.

```
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 * on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 * express or implied. See the License for the specific language governing
 * permissions and limitations under the License.
 *
 */

public class AsyncMessageReceiver {
    public static void main(String args[]) throws JMSException, InterruptedException {
        ExampleConfiguration config =
 ExampleConfiguration.parseConfig("AsyncMessageReceiver", args);

        ExampleCommon.setupLogging();

        // Create the connection factory based on the config
        SQSConnectionFactory connectionFactory = new SQSConnectionFactory(
                new ProviderConfiguration(),
                AmazonSQSClientBuilder.standard()
                        .withRegion(config.getRegion().getName())
                        .withCredentials(config.getCredentialsProvider())
                );

        // Create the connection
        SQSConnection connection = connectionFactory.createConnection();

        // Create the queue if needed
        ExampleCommon.ensureQueueExists(connection, config.getQueueName());

        // Create the session
        Session session = connection.createSession(false, Session.CLIENT_ACKNOWLEDGE);
        MessageConsumer consumer =
 session.createConsumer( session.createQueue( config.getQueueName() ) );

        ReceiverCallback callback = new ReceiverCallback();
        consumer.setMessageListener( callback );

        // No messages are processed until this is called
        connection.start();

        callback.waitForOneMinuteOfSilence();
        System.out.println( "Returning after one minute of silence" );

        // Close the connection. This closes the session automatically
        connection.close();
        System.out.println( "Connection closed" );
    }


    private static class ReceiverCallback implements MessageListener {
        // Used to listen for message silence
        private volatile long timeOfLastMessage = System.nanoTime();

        public void waitForOneMinuteOfSilence() throws InterruptedException {
            for(;;) {
                long timeSinceLastMessage = System.nanoTime() - timeOfLastMessage;
                long remainingTillOneMinuteOfSilence =
                    TimeUnit.MINUTES.toNanos(1) - timeSinceLastMessage;
                if( remainingTillOneMinuteOfSilence < 0 ) {
                    break;
                }
                TimeUnit.NANOSECONDS.sleep(remainingTillOneMinuteOfSilence);
            }
        }


        @Override
        public void onMessage(Message message) {
            try {
                ExampleCommon.handleMessage(message);
                message.acknowledge();
                System.out.println( "Acknowledged message " + message.getJMSMessageID() );
                timeOfLastMessage = System.nanoTime();
            } catch (JMSException e) {
                System.err.println( "Error processing message: " + e.getMessage() );
                e.printStackTrace();
            }
        }
    }
}
```

SyncMessageReceiverClientAcknowledge.java

The following Java code example creates a synchronous consumer with client acknowledge mode.

```
/*
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 * on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 * express or implied. See the License for the specific language governing
 * permissions and limitations under the License.
 *
 */

/**
 * An example class to demonstrate the behavior of CLIENT_ACKNOWLEDGE mode for received
 messages. This example
 * complements the example given in {@link SyncMessageReceiverUnorderedAcknowledge} for
 UNORDERED_ACKNOWLEDGE mode.
 *
 * First, a session, a message producer, and a message consumer are created. Then, two
 messages are sent. Next, two messages
 * are received but only the second one is acknowledged. After waiting for the visibility
 time out period, an attempt to
 * receive another message is made. It's shown that no message is returned for this attempt
 since in CLIENT_ACKNOWLEDGE mode,
 * as expected, all the messages prior to the acknowledged messages are also acknowledged.
 *
 * This ISN'T the behavior for UNORDERED_ACKNOWLEDGE mode. Please see {@link
 SyncMessageReceiverUnorderedAcknowledge}
 * for an example.
 */
public class SyncMessageReceiverClientAcknowledge {

    // Visibility time-out for the queue. It must match to the one set for the queue for
 this example to work.
    private static final long TIME_OUT_SECONDS = 1;

    public static void main(String args[]) throws JMSException, InterruptedException {
        // Create the configuration for the example
        ExampleConfiguration config =
 ExampleConfiguration.parseConfig("SyncMessageReceiverClientAcknowledge", args);

        // Setup logging for the example
        ExampleCommon.setupLogging();

        // Create the connection factory based on the config
        SQSConnectionFactory connectionFactory = new SQSConnectionFactory(
                new ProviderConfiguration(),
                AmazonSQSClientBuilder.standard()
                        .withRegion(config.getRegion().getName())
                        .withCredentials(config.getCredentialsProvider())
                );

        // Create the connection
        SQSConnection connection = connectionFactory.createConnection();

        // Create the queue if needed
        ExampleCommon.ensureQueueExists(connection, config.getQueueName());

        // Create the session  with client acknowledge mode
        Session session = connection.createSession(false, Session.CLIENT_ACKNOWLEDGE);

        // Create the producer and consume
        MessageProducer producer =
 session.createProducer(session.createQueue(config.getQueueName()));
        MessageConsumer consumer =
 session.createConsumer(session.createQueue(config.getQueueName()));

        // Open the connection
        connection.start();

        // Send two text messages
        sendMessage(producer, session, "Message 1");
        sendMessage(producer, session, "Message 2");

        // Receive a message and don't acknowledge it
        receiveMessage(consumer, false);

        // Receive another message and acknowledge it
        receiveMessage(consumer, true);

        // Wait for the visibility time out, so that unacknowledged messages reappear in
 the queue
        System.out.println("Waiting for visibility timeout...");
        Thread.sleep(TimeUnit.SECONDS.toMillis(TIME_OUT_SECONDS));

        // Attempt to receive another message and acknowledge it. This results in receiving
 no messages since
        // we have acknowledged the second message. Although we didn't explicitly
 acknowledge the first message,
        // in the CLIENT_ACKNOWLEDGE mode, all the messages received prior to the
 explicitly acknowledged message
```

```
        // are also acknowledged. Therefore, we have implicitly acknowledged the first
 message.
        receiveMessage(consumer, true);

        // Close the connection. This closes the session automatically
        connection.close();
        System.out.println("Connection closed.");
    }

    /**
     * Sends a message through the producer.
     *
     * @param producer Message producer
     * @param session Session
     * @param messageText Text for the message to be sent
     * @throws JMSException
     */
    private static void sendMessage(MessageProducer producer, Session session, String
 messageText) throws JMSException {
        // Create a text message and send it
        producer.send(session.createTextMessage(messageText));
    }

    /**
     * Receives a message through the consumer synchronously with the default timeout
 (TIME_OUT_SECONDS).
     * If a message is received, the message is printed. If no message is received, "Queue
 is empty!" is
     * printed.
     *
     * @param consumer Message consumer
     * @param acknowledge If true and a message is received, the received message is
 acknowledged.
     * @throws JMSException
     */
    private static void receiveMessage(MessageConsumer consumer, boolean acknowledge)
 throws JMSException {
        // Receive a message
        Message message = consumer.receive(TimeUnit.SECONDS.toMillis(TIME_OUT_SECONDS));

        if (message == null) {
            System.out.println("Queue is empty!");
        } else {
            // Since this queue has only text messages, cast the message object and print
 the text
            System.out.println("Received: " + ((TextMessage) message).getText());

            // Acknowledge the message if asked
            if (acknowledge) message.acknowledge();
        }
    }
}
```

SyncMessageReceiverUnorderedAcknowledge.java

The following Java code example creates a synchronous consumer with unordered acknowledge mode.

```
/*
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 * on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 * express or implied. See the License for the specific language governing
 * permissions and limitations under the License.
 *
 */

/**
 * An example class to demonstrate the behavior of UNORDERED_ACKNOWLEDGE mode for received
 messages. This example
 * complements the example given in {@link SyncMessageReceiverClientAcknowledge} for
 CLIENT_ACKNOWLEDGE mode.
 *
 * First, a session, a message producer, and a message consumer are created. Then, two
 messages are sent. Next, two messages
 * are received but only the second one is acknowledged. After waiting for the visibility
 time out period, an attempt to
 * receive another message is made. It's shown that the first message received in the prior
 attempt is returned again
 * for the second attempt. In UNORDERED_ACKNOWLEDGE mode, all the messages must be
 explicitly acknowledged no matter what
 * the order they're received.
 *
 * This ISN'T the behavior for CLIENT_ACKNOWLEDGE mode. Please see {@link
 SyncMessageReceiverClientAcknowledge}
 * for an example.
 */
public class SyncMessageReceiverUnorderedAcknowledge {

    // Visibility time-out for the queue. It must match to the one set for the queue for
 this example to work.
    private static final long TIME_OUT_SECONDS = 1;

    public static void main(String args[]) throws JMSException, InterruptedException {
        // Create the configuration for the example
        ExampleConfiguration config =
 ExampleConfiguration.parseConfig("SyncMessageReceiverUnorderedAcknowledge", args);

        // Setup logging for the example
        ExampleCommon.setupLogging();

        // Create the connection factory based on the config
        SQSConnectionFactory connectionFactory = new SQSConnectionFactory(
                new ProviderConfiguration(),
                AmazonSQSClientBuilder.standard()
                        .withRegion(config.getRegion().getName())
                        .withCredentials(config.getCredentialsProvider())
                );

        // Create the connection
        SQSConnection connection = connectionFactory.createConnection();

        // Create the queue if needed
        ExampleCommon.ensureQueueExists(connection, config.getQueueName());

        // Create the session  with unordered acknowledge mode
        Session session = connection.createSession(false,
 SQSSession.UNORDERED_ACKNOWLEDGE);

        // Create the producer and consume
        MessageProducer producer =
 session.createProducer(session.createQueue(config.getQueueName()));
        MessageConsumer consumer =
 session.createConsumer(session.createQueue(config.getQueueName()));
```

```
        // Open the connection
        connection.start();

        // Send two text messages
        sendMessage(producer, session, "Message 1");
        sendMessage(producer, session, "Message 2");

        // Receive a message and don't acknowledge it
        receiveMessage(consumer, false);

        // Receive another message and acknowledge it
        receiveMessage(consumer, true);

        // Wait for the visibility time out, so that unacknowledged messages reappear in
the queue
        System.out.println("Waiting for visibility timeout...");
        Thread.sleep(TimeUnit.SECONDS.toMillis(TIME_OUT_SECONDS));

        // Attempt to receive another message and acknowledge it. This results in receiving
the first message since
        // we have acknowledged only the second message. In the UNORDERED_ACKNOWLEDGE mode,
all the messages must
        // be explicitly acknowledged.
        receiveMessage(consumer, true);

        // Close the connection. This closes the session automatically
        connection.close();
        System.out.println("Connection closed.");
    }

    /**
     * Sends a message through the producer.
     *
     * @param producer Message producer
     * @param session Session
     * @param messageText Text for the message to be sent
     * @throws JMSException
     */
    private static void sendMessage(MessageProducer producer, Session session, String
messageText) throws JMSException {
        // Create a text message and send it
        producer.send(session.createTextMessage(messageText));
    }

    /**
     * Receives a message through the consumer synchronously with the default timeout
(TIME_OUT_SECONDS).
     * If a message is received, the message is printed. If no message is received, "Queue
is empty!" is
     * printed.
     *
     * @param consumer Message consumer
     * @param acknowledge If true and a message is received, the received message is
acknowledged.
     * @throws JMSException
     */
    private static void receiveMessage(MessageConsumer consumer, boolean acknowledge)
throws JMSException {
        // Receive a message
        Message message = consumer.receive(TimeUnit.SECONDS.toMillis(TIME_OUT_SECONDS));

        if (message == null) {
            System.out.println("Queue is empty!");
        } else {
            // Since this queue has only text messages, cast the message object and print
 the text
            System.out.println("Received: " + ((TextMessage) message).getText());

            // Acknowledge the message if asked
            if (acknowledge) message.acknowledge();
        }
    }
}
```

SpringExampleConfiguration.xml

The following XML code example is a bean configuration file for SpringExample.java (p. 89).

```
<!--
    Copyright 2010-2021 Amazon.com, Inc. or its affiliates. All Rights Reserved.

    Licensed under the Apache License, Version 2.0 (the "License").
    You may not use this file except in compliance with the License.
    A copy of the License is located at

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    or in the "license" file accompanying this file. This file is distributed
    on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
    express or implied. See the License for the specific language governing
    permissions and limitations under the License.
-->

<?xml version="1.0" encoding="UTF-8"?>
<beans
    xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:util="http://www.springframework.org/schema/util"
    xmlns:p="http://www.springframework.org/schema/p"
    xsi:schemaLocation="
        http://www.springframework.org/schema/beans http://www.springframework.org/schema/
beans/spring-beans-3.0.xsd
        http://www.springframework.org/schema/util http://www.springframework.org/schema/
util/spring-util-3.0.xsd
    ">

    <bean id="CredentialsProviderBean"
 class="com.amazonaws.auth.DefaultAWSCredentialsProviderChain"/>

    <bean id="ClientBuilder" class="com.amazonaws.services.sqs.AmazonSQSClientBuilder"
 factory-method="standard">
        <property name="region" value="us-east-2"/>
        <property name="credentials" ref="CredentialsProviderBean"/>
    </bean>

    <bean id="ProviderConfiguration"
 class="com.amazon.sqs.javamessaging.ProviderConfiguration">
        <property name="numberOfMessagesToPrefetch" value="5"/>
    </bean>

    <bean id="ConnectionFactory" class="com.amazon.sqs.javamessaging.SQSConnectionFactory">
        <constructor-arg ref="ProviderConfiguration" />
        <constructor-arg ref="ClientBuilder" />
    </bean>

    <bean id="Connection" class="javax.jms.Connection"
        factory-bean="ConnectionFactory"
        factory-method="createConnection"
        init-method="start"
        destroy-method="close" />

    <bean id="QueueName" class="java.lang.String">
        <constructor-arg value="SQSJMSClientExampleQueue"/>
    </bean>
</beans>
```

SpringExample.java

The following Java code example uses the bean configuration file to initialize your objects.

```
/*
 * Copyright 2010-2021 Amazon.com, Inc. or its affiliates. All Rights Reserved.
 *
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 * You may not use this file except in compliance with the License.
 * A copy of the License is located at
 *
 *  https://aws.amazon.com/apache2.0
 *
 * or in the "license" file accompanying this file. This file is distributed
 * on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 * express or implied. See the License for the specific language governing
 * permissions and limitations under the License.
 *
 */

public class SpringExample {
    public static void main(String args[]) throws JMSException {
        if( args.length != 1 || !args[0].endsWith(".xml")) {
            System.err.println( "Usage: " + SpringExample.class.getName() + " <spring
 config.xml>" );
            System.exit(1);
        }

        File springFile = new File( args[0] );
        if( !springFile.exists() || !springFile.canRead() ) {
            System.err.println( "File " + args[0] + " doesn't exist or isn't readable.");
            System.exit(2);
        }

        ExampleCommon.setupLogging();

        FileSystemXmlApplicationContext context =
            new FileSystemXmlApplicationContext( "file://" +
 springFile.getAbsolutePath() );

        Connection connection;
        try {
            connection = context.getBean(Connection.class);
        } catch( NoSuchBeanDefinitionException e ) {
            System.err.println( "Can't find the JMS connection to use: " +
 e.getMessage() );
            System.exit(3);
            return;
        }

        String queueName;
        try {
            queueName = context.getBean("QueueName", String.class);
        } catch( NoSuchBeanDefinitionException e ) {
            System.err.println( "Can't find the name of the queue to use: " +
 e.getMessage() );
            System.exit(3);
            return;
        }

        if( connection instanceof SQSConnection ) {
            ExampleCommon.ensureQueueExists( (SQSConnection) connection, queueName );
        }

        // Create the session
        Session session = connection.createSession(false, Session.CLIENT_ACKNOWLEDGE);
        MessageConsumer consumer =
 session.createConsumer( session.createQueue( queueName) );

        receiveMessages(session, consumer);

        // The context can be setup to close the connection for us
        context.close();
        System.out.println( "Context closed" );
    }

    private static void receiveMessages( Session session, MessageConsumer consumer ) {
        try {
            while( true ) {
                System.out.println( "Waiting for messages");
                // Wait 1 minute for a message
                Message message = consumer.receive(TimeUnit.MINUTES.toMillis(1));
                if( message == null ) {
                    System.out.println( "Shutting down after 1 minute of silence" );
                    break;
                }
                ExampleCommon.handleMessage(message);
                message.acknowledge();
                System.out.println( "Acknowledged message" );
            }
        } catch (JMSException e) {
            System.err.println( "Error receiving from SQS: " + e.getMessage() );
            e.printStackTrace();
        }
    }
}
```

ExampleCommon.java

The following Java code example checks if an Amazon SQS queue exists and then creates one if it doesn't. It also includes example logging code.

```
/*
 * Copyright 2010-2021 Amazon.com, Inc. or its affiliates. All Rights Reserved.
 *
 * Licensed under the Apache License, Version 2.0 (the "License").
 * You may not use this file except in compliance with the License.
 * A copy of the License is located at
 *
 *  https://aws.amazon.com/apache2.0
 *
 * or in the "license" file accompanying this file. This file is distributed
 * on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 * express or implied. See the License for the specific language governing
 * permissions and limitations under the License.
 *
 */
```

```
public class ExampleCommon {
    /**
     * A utility function to check the queue exists and create it if needed. For most
     * use cases this is usually done by an administrator before the application is run.
     */
    public static void ensureQueueExists(SQSConnection connection, String queueName) throws
 JMSException {
        AmazonSQSMessagingClientWrapper client = connection.getWrappedAmazonSQSClient();

        /**
         * In most cases, you can do this with just a createQueue call, but GetQueueUrl
         * (called by queueExists) is a faster operation for the common case where the
 queue
         * already exists. Also many users and roles have permission to call GetQueueUrl
         * but don't have permission to call CreateQueue.
         */
        if( !client.queueExists(queueName) ) {
            client.createQueue( queueName );
        }
    }

    public static void setupLogging() {
        // Setup logging
        BasicConfigurator.configure();
        Logger.getRootLogger().setLevel(Level.WARN);
    }

    public static void handleMessage(Message message) throws JMSException {
        System.out.println( "Got message " + message.getJMSMessageID() );
        System.out.println( "Content: ");
        if( message instanceof TextMessage ) {
            TextMessage txtMessage = ( TextMessage ) message;
            System.out.println( "\t" + txtMessage.getText() );
        } else if( message instanceof BytesMessage ){
            BytesMessage byteMessage = ( BytesMessage ) message;
            // Assume the length fits in an int - SQS only supports sizes up to 256k so
 that
            // should be true
            byte[] bytes = new byte[(int)byteMessage.getBodyLength()];
            byteMessage.readBytes(bytes);
            System.out.println( "\t" +  Base64.encodeAsString( bytes ) );
        } else if( message instanceof ObjectMessage ) {
            ObjectMessage objMessage = (ObjectMessage) message;
            System.out.println( "\t" + objMessage.getObject() );
        }
    }
}
```

Supported JMS 1.1 implementations

The Amazon SQS Java Messaging Library supports the following JMS 1.1 implementations. For more information about the supported features and capabilities of the Amazon SQS Java Messaging Library, see the Amazon SQS FAQ.

Supported common interfaces

- `Connection`
- `ConnectionFactory`
- `Destination`

- `Session`
- `MessageConsumer`
- `MessageProducer`

Supported message types

- `ByteMessage`
- `ObjectMessage`
- `TextMessage`

Supported message acknowledgment modes

- `AUTO_ACKNOWLEDGE`
- `CLIENT_ACKNOWLEDGE`
- `DUPS_OK_ACKNOWLEDGE`
- `UNORDERED_ACKNOWLEDGE`

> **Note**
> The `UNORDERED_ACKNOWLEDGE` mode isn't part of the JMS 1.1 specification. This mode helps Amazon SQS allow a JMS client to explicitly acknowledge a message.

JMS-defined headers and reserved properties

For sending messages

When you send messages, you can set the following headers and properties for each message:

- `JMSXGroupID` (required for FIFO queues, not allowed for standard queues)
- `JMS_SQS_DeduplicationId` (optional for FIFO queues, not allowed for standard queues)

After you send messages, Amazon SQS sets the following headers and properties for each message:

- `JMSMessageID`
- `JMS_SQS_SequenceNumber` (only for FIFO queues)

For receiving messages

When you receive messages, Amazon SQS sets the following headers and properties for each message:

- `JMSDestination`
- `JMSMessageID`
- `JMSRedelivered`
- `JMSXDeliveryCount`
- `JMSXGroupID` (only for FIFO queues)
- `JMS_SQS_DeduplicationId` (only for FIFO queues)
- `JMS_SQS_SequenceNumber` (only for FIFO queues)

Amazon SQS tutorials

This section provides tutorials that you can use to explore Amazon SQS features and functionality.

Topics

Creating an Amazon SQS queue (AWS CloudFormation)

You can use the AWS CloudFormation console and a JSON (or YAML) template to create an Amazon SQS queue. For more information, see Working with AWS CloudFormation Templates and the `AWS::SQS::Queue` Resource in the *AWS CloudFormation User Guide*.

To use AWS CloudFormation to create an Amazon SQS queue.

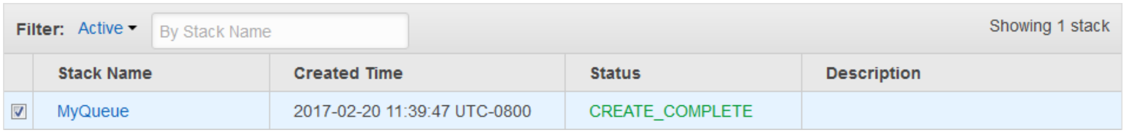
1. Copy the following JSON code to a file named `MyQueue.json`. To create a standard queue, omit the `FifoQueue` and `ContentBasedDeduplication` properties. For more information on content-based deduplication, see Exactly-once processing (p. 29).

   Note
   The name of a FIFO queue must end with the `.fifo` suffix.

```
{
   "AWSTemplateFormatVersion": "2010-09-09",
   "Resources": {
      "MyQueue": {
         "Properties": {
            "QueueName": "MyQueue.fifo",
            "FifoQueue": true,
            "ContentBasedDeduplication": true
             },
         "Type": "AWS::SQS::Queue"
         }
      },
   "Outputs": {
      "QueueName": {
         "Description": "The name of the queue",
         "Value": {
            "Fn::GetAtt": [
               "MyQueue",
               "QueueName"
            ]
         }
      },
      "QueueURL": {
         "Description": "The URL of the queue",
         "Value": {
            "Ref": "MyQueue"
         }
      },
      "QueueARN": {
         "Description": "The ARN of the queue",
         "Value": {
            "Fn::GetAtt": [
               "MyQueue",
               "Arn"
            ]
         }
      }
   }
}
```

2. Sign in to the AWS CloudFormation console, and then choose **Create Stack**.
3. On the **Specify Template** panel, choose **Upload a template file**, choose your `MyQueue.json` file, and then choose **Next**.
4. On the **Specify Details** page, type `MyQueue` for **Stack Name**, and then choose **Next**.
5. On the **Options** page, choose **Next**.
6. On the **Review** page, choose **Create**.

   AWS CloudFormation begins to create the `MyQueue` stack and displays the **CREATE_IN_PROGRESS** status. When the process is complete, AWS CloudFormation displays the **CREATE_COMPLETE** status.



Filter: Active ▾ By Stack Name Showing 1 stack

	Stack Name	Created Time	Status	Description
✓	MyQueue	2017-02-20 11:39:47 UTC-0800	CREATE_COMPLETE	

7. (Optional) To display the name, URL, and ARN of the queue, choose the name of the stack and then on the next page expand the **Outputs** section.

Tutorial: Sending a message to an Amazon SQS queue from Amazon Virtual Private Cloud

In this tutorial, you learn how to send messages to an Amazon SQS queue over a secure, private network. This network consists of a VPC that contains an Amazon EC2 instance. The instance connects to Amazon SQS through an *interface VPC endpoint*, allowing you to connect to the Amazon EC2 instance and send messages to the Amazon SQS queue even though the network is disconnected from the public internet. For more information, see Amazon Virtual Private Cloud endpoints for Amazon SQS (p. 112).

Important

- You can use Amazon Virtual Private Cloud only with HTTPS Amazon SQS endpoints.
- When you configure Amazon SQS to send messages from Amazon VPC, you must enable private DNS and specify endpoints in the format `sqs.`*`us-east-2`*`.amazonaws.com`.
- Private DNS doesn't support legacy endpoints such as `queue.amazonaws.com` or *`us-east-2`*`.queue.amazonaws.com`.

Topics

Step 1: Create an Amazon EC2 key pair

A *key pair* lets you connect to an Amazon EC2 instance. It consists of a public key that encrypts your login information and a private key that decrypts it.

1. Sign in to the Amazon EC2 console.
2. On the navigation menu, under **Network & Security**, choose **Key Pairs**.
3. Choose **Create Key Pair**.
4. In the **Create Key Pair** dialog box, for **Key pair name**, enter `SQS-VPCE-Tutorial-Key-Pair`, and then choose **Create**.
5. Your browser downloads the private key file `SQS-VPCE-Tutorial-Key-Pair.pem` automatically.

   Important
   Save this file in a safe place. EC2 does not generate a `.pem` file for the same key pair a second time.
6. To allow an SSH client to connect to your EC2 instance, set the permissions for your private key file so that only your user can have read permissions for it, for example:

```
chmod 400 SQS-VPCE-Tutorial-Key-Pair.pem
```

Step 2: Create AWS resources

To set up the necessary infrastructure, you must use an AWS CloudFormation *template*, which is a blueprint for creating a *stack* comprised of AWS resources, such as Amazon EC2 instances and Amazon SQS queues.

The stack for this tutorial includes the following resources:

- A VPC and the associated networking resources, including a subnet, a security group, an internet gateway, and a route table
- An Amazon EC2 instance launched into the VPC subnet
- An Amazon SQS queue

1. Download the AWS CloudFormation template named `SQS-VPCE-Tutorial-CloudFormation.yaml` from GitHub.
2. Sign in to the AWS CloudFormation console.
3. Choose **Create Stack**.
4. On the **Select Template** page, choose **Upload a template to Amazon S3**, select the `SQS-VPCE-SQS-Tutorial-CloudFormation.yaml` file, and then choose **Next**.
5. On the **Specify Details** page, do the following:

   a. For **Stack name**, enter `SQS-VPCE-Tutorial-Stack`.
   b. For **KeyName**, choose **SQS-VPCE-Tutorial-Key-Pair**.
   c. Choose **Next**.
6. On the **Options** page, choose **Next**.
7. On the **Review** page, in the **Capabilities** section, choose **I acknowledge that AWS CloudFormation might create IAM resources with custom names.**, and then choose **Create**.

AWS CloudFormation begins to create the stack and displays the **CREATE_IN_PROGRESS** status. When the process is complete, AWS CloudFormation displays the **CREATE_COMPLETE** status.

Step 3: Confirm that your EC2 instance isn't publicly accessible

Your AWS CloudFormation template launches an EC2 instance named `SQS-VPCE-Tutorial-EC2-Instance` into your VPC. This EC2 instance doesn't allow outbound traffic and isn't able to send messages to Amazon SQS. To verify this, you must connect to the instance, try to connect to a public endpoint, and then try to message Amazon SQS.

1. Sign in to the Amazon EC2 console.
2. On the navigation menu, under **Instances**, choose **Instances**.
3. Select **SQS-VPCE-Tutorial-EC2Instance**.
4. Copy the hostname under **Public DNS (IPv4)**, for example, **ec2-203-0-113-0.us-west-2.compute.amazonaws.com**.
5. From the directory that contains the key pair that you created earlier (p. 95), connect to the instance using the following command, for example:

```
ssh -i SQS-VPCE-Tutorial-KeyPair.pem ec2-user@ec2-203-0-113-0.us-
east-2.compute.amazonaws.com
```

6. Try to connect to any public endpoint, for example:

```
ping amazon.com
```

   The connection attempt fails, as expected.
7. Sign in to the Amazon SQS console.
8. From the list of queues, select the queue created by your AWS CloudFormation template, for example, **VPCE-SQS-Tutorial-Stack-CFQueue-1ABCDEFGH2IJK**.
9. On the **Details** table, copy the URL, for example, **https://sqs.us-east-2.amazonaws.com/123456789012/**.
10. From your EC2 instance, try to publish a message to the queue using the following command, for example:

```
aws sqs send-message --region us-east-2 --endpoint-url https://sqs.us-
east-2.amazonaws.com/ --queue-url https://sqs.us-east-2.amazonaws.com/123456789012/ --
message-body "Hello from Amazon SQS."
```

   The sending attempt fails, as expected.

   Important
   Later, when you create a VPC endpoint for Amazon SQS, your sending attempt will succeed.

Step 4: Create an Amazon VPC endpoint for Amazon SQS

To connect your VPC to Amazon SQS, you must define an interface VPC endpoint. After you add the endpoint, you can use the Amazon SQS API from the EC2 instance in your VPC. This allows you to send messages to a queue within the AWS network without crossing the public internet.

Note
The EC2 instance still doesn't have access to other AWS services and endpoints on the internet.

1. Sign in to the Amazon VPC console.

2. On the navigation menu, choose **Endpoints**.
3. Choose **Create Endpoint**.
4. On the **Create Endpoint** page, for **Service Name**, choose the service name for Amazon SQS.

   Note
   The service names vary based on the current AWS Region. For example, if you are in US East (Ohio), the service name is **com.amazonaws.*us-east-2*.sqs**.
5. For **VPC**, choose **SQS-VPCE-Tutorial-VPC**.
6. For **Subnets**, choose the subnet whose **Subnet ID** contains **SQS-VPCE-Tutorial-Subnet**.
7. For **Security group**, choose **Select security groups**, and then choose the security group whose **Group Name** contains **SQS VPCE Tutorial Security Group**.
8. Choose **Create endpoint**.

   The interface VPC endpoint is created and its ID is displayed, for example, **vpce-0ab1cdef2ghi3j456k**.
9. Choose **Close**.

   The Amazon VPC console opens the **Endpoints** page.

Amazon VPC begins to create the endpoint and displays the **pending** status. When the process is complete, Amazon VPC displays the **available** status.

Step 5: Send a message to your Amazon SQS queue

Now that your VPC includes an endpoint for Amazon SQS, you can connect to your EC2 instance and send messages to your queue.

1. Reconnect to your EC2 instance, for example:

```
ssh -i SQS-VPCE-Tutorial-KeyPair.pem ec2-user@ec2-203-0-113-0.us-
east-2.compute.amazonaws.com
```

2. Try to publish a message to the queue again using the following command, for example:

```
aws sqs send-message --region us-east-2 --endpoint-url https://sqs.us-
east-2.amazonaws.com/ --queue-url https://sqs.us-east-2.amazonaws.com/123456789012/ --
message-body "Hello from Amazon SQS."
```

   The sending attempt succeeds and the MD5 digest of the message body and the message ID are displayed, for example:

```
{
 "MD5OfMessageBody": "a1bcd2ef3g45hi678j90klmn12p34qr5",
 "MessageId": "12345a67-8901-2345-bc67-d890123e45fg"
}
```

For information about receiving and deleting the message from the queue created by your AWS CloudFormation template (for example, **VPCE-SQS-Tutorial-Stack-CFQueue-1ABCDEFGH2IJK**), see Receiving and deleting messages (console) (p. 20).

For information about deleting your resources, see the following:

- Deleting a VPC Endpoint in the *Amazon VPC User Guide*
- Deleting an Amazon SQS queue (p. 21)

- Terminate Your Instance in the *Amazon EC2 User Guide for Linux Instances*
- Deleting Your VPC in the *Amazon VPC User Guide*
- Deleting a Stack on the AWS CloudFormation Console in the *AWS CloudFormation User Guide*
- Deleting Your Key Pair in the *Amazon EC2 User Guide for Linux Instances*

Amazon SQS quotas

This topic lists quotas within Amazon Simple Queue Service (Amazon SQS).

Topics

Quotas related to queues

The following table lists quotas related to queues.

Quota	Description
Delay queue	The default (minimum) delay for a queue is 0 seconds. The maximum is 15 minutes.
Listed queues	1,000 queues per `ListQueues` request.
Long polling wait time	The maximum long polling wait time is 20 seconds.
Message groups	There is no quota to the number of message groups within a FIFO queue.
Messages per queue (backlog)	The number of messages that an Amazon SQS queue can store is unlimited.
Messages per queue (in flight)	For most standard queues (depending on queue traffic and message backlog), there can be a maximum of approximately 120,000 inflight messages (received from a queue by a consumer, but not yet deleted from the queue). If you reach this quota while using short polling (p. 41), Amazon SQS returns the `OverLimit` error message. If you use long polling (p. 42), Amazon SQS returns no error messages. To avoid reaching the quota, you should delete messages from the queue after they're processed. You can also increase the number of queues you use to process your messages. To request a quota increase, submit a support request.
	For FIFO queues, there can be a maximum of 20,000 inflight messages (received from a queue by a consumer, but not yet deleted from the queue). If you reach this quota, Amazon SQS returns no error messages.
Queue name	A queue name can have up to 80 characters. The following characters are accepted: alphanumeric characters, hyphens (-), and underscores (_).

Quota	Description
	Note Queue names are case-sensitive (for example, `Test-queue` and `test-queue` are different queues).
	The name of a FIFO queue must end with the `.fifo` suffix. The suffix counts towards the 80-character queue name quota. To determine whether a queue is FIFO (p. 26), you can check whether the queue name ends with the suffix.
Queue tag	We don't recommend adding more than 50 tags to a queue.
	The tag `Key` is required, but the tag `Value` is optional.
	The tag `Key` and tag `Value` are case-sensitive.
	The tag `Key` and tag `Value` can include Unicode alphanumeric characters in UTF-8 and whitespaces. The following special characters are allowed: `_ . : / = + - @`
	The tag `Key` or `Value` must not include the reserved prefix `aws:` (you can't delete tag keys or values with this prefix).
	The maximum tag `Key` length is 128 Unicode characters in UTF-8. The tag `Key` must not be empty or null.
	The maximum tag `Value` length is 256 Unicode characters in UTF-8. The tag `Value` may be empty or null.
	Tagging actions are limited to 5 TPS per AWS account. If your application requires a higher throughput, submit a request.

Quotas related to messages

The following table lists quotas related to messages.

Quota	Description
Batched message ID	A batched message ID can have up to 80 characters. The following characters are accepted: alphanumeric characters, hyphens (-), and underscores (_).
Message attributes	A message can contain up to 10 metadata attributes.
Message batch	A single message batch request can include a maximum of 10 messages. For more information, see Configuring AmazonSQSBufferedAsyncClient (p. 166) in the Amazon SQS batch actions (p. 164) section.
Message content	A message can include only XML, JSON, and unformatted text. The following Unicode characters are allowed: `#x9` | `#xA` | `#xD` | `#x20` to `#xD7FF` | `#xE000` to `#xFFFD` | `#x10000` to `#x10FFFF`

Quota	Description
	Any characters not included in this list are rejected. For more information, see the W3C specification for characters.
Message group ID	Consume messages from the backlog to avoid building up a large backlog of messages with the same message group ID (p. 59).
Message retention	By default, a message is retained for 4 days. The minimum is 60 seconds (1 minute). The maximum is 1,209,600 seconds (14 days).
Message throughput	Standard queues support a nearly unlimited number of API calls per second, per API action (`SendMessage`, `ReceiveMessage`, or `DeleteMessage`).
	FIFO queues • Without batching, FIFO queues support up to 300 API calls per second, per API method (`SendMessage`, `ReceiveMessage`, or `DeleteMessage`). • If you use batching (p. 164), FIFO queues support up to 3,000 messages per second, per API method (`SendMessageBatch`, `ReceiveMessage`, or `DeleteMessageBatch`). The 3000 messages per second represent 300 API calls, each with a batch of 10 messages. To request a quota increase, submit a support request.

Quota	Description
	High throughput for FIFO queues (p. 30) • Without batching (`SendMessage`, `ReceiveMessage`, and `DeleteMessage`), high throughput for FIFO queues support up to 3,000 messages per second, per API method. For maximum throughput, increase the number of message group IDs you use for messages sent without batching. • You can increase throughput up to 30,000 messages per second by using batching APIs (`SendMessageBatch` and `DeleteMessageBatch`). The 30,000 messages per second represents 3,000 API calls, each with a batch of 10 messages. To achieve the maximum throughput when using `SendMessageBatch` and `DeleteMessageBatch`, all messages in a batch request must use the same message group ID. For more information, see Partitions and data distribution for high throughput for SQS FIFO queues (p. 30). **Note** The above quotas are available in the following AWS Regions: • US East (Ohio) • US East (N. Virginia) • US West (Oregon) • Europe (Ireland) In all other AWS Regions, maximum throughput is 1,500 (without batching) or 15,000 (using batching) messages per second, per API action.
Message timer	The default (minimum) delay for a message is 0 seconds. The maximum is 15 minutes.
Message size	The minimum message size is 1 byte (1 character). The maximum is 262,144 bytes (256 KB). To send messages larger than 256 KB, you can use the Amazon SQS Extended Client Library for Java. This library allows you to send an Amazon SQS message that contains a reference to a message payload in Amazon S3. The maximum payload size is 2 GB.
Message visibility timeout	The default visibility timeout for a message is 30 seconds. The minimum is 0 seconds. The maximum is 12 hours.
Policy information	The maximum quota is 8,192 bytes, 20 statements, 50 principals, or 10 conditions. For more information, see Quotas related to policies (p. 103).

Quotas related to policies

The following table lists quotas related to policies.

Name	**Maximum**
Bytes	8,192
Conditions	10
Principals	50
Statements	20

Automating and troubleshooting Amazon SQS queues

This section provides information about automating and troubleshooting Amazon SQS queues.

Topics

Automating notifications from AWS services to Amazon SQS using Amazon EventBridge

Amazon EventBridge lets you automate AWS services and respond to system events such as application availability issues or resource changes. Events from AWS services are delivered to EventBridge nearly in real time. You can write simple rules to indicate which events are of interest to you and what automated actions to take when an event matches a rule.

EventBridge lets you set a variety of *targets*—such as Amazon SQS standard and FIFO queues—which receive events in JSON format. For more information, see the *Amazon EventBridge User Guide*.

Troubleshooting Amazon Simple Queue Service queues using AWS X-Ray

AWS X-Ray collects data about requests that your application serves and lets you view and filter data to identify potential issues and opportunities for optimization. For any traced request to your application, you can see detailed information about the request, the response, and the calls that your application makes to downstream AWS resources, microservices, databases and HTTP web APIs.

To send AWS X-Ray trace headers through Amazon SQS, you can do one of the following:

- Use the `X-Amzn-Trace-Id` tracing header.
- Use the `AWSTraceHeader` message system attribute (p. 39).

To collect data on errors and latency, you must instrument the `AmazonSQS` client using the AWS X-Ray SDK.

You can use the AWS X-Ray console to view the map of connections between Amazon SQS and other services that your application uses. You can also use the console to view metrics such as average latency and failure rates. For more information, see Amazon SQS and AWS X-Ray in the *AWS X-Ray Developer Guide*.

Security in Amazon SQS

This section provides information about Amazon SQS security, authentication and access control, and the Amazon SQS Access Policy Language.

Topics

Data protection

The AWS shared responsibility model applies to data protection in Amazon Simple Queue Service. As described in this model, AWS is responsible for protecting the global infrastructure that runs all of the AWS Cloud. You are responsible for maintaining control over your content that is hosted on this infrastructure. This content includes the security configuration and management tasks for the AWS services that you use. For more information about data privacy, see the Data Privacy FAQ. For information about data protection in Europe, see the AWS Shared Responsibility Model and GDPR blog post on the *AWS Security Blog*.

For data protection purposes, we recommend that you protect AWS account credentials and set up individual user accounts with AWS Identity and Access Management (IAM). That way each user is given only the permissions necessary to fulfill their job duties. We also recommend that you secure your data in the following ways:

- Use multi-factor authentication (MFA) with each account.
- Use SSL/TLS to communicate with AWS resources. We recommend TLS 1.2 or later.
- Set up API and user activity logging with AWS CloudTrail.
- Use AWS encryption solutions, along with all default security controls within AWS services.
- Use advanced managed security services such as Amazon Macie, which assists in discovering and securing personal data that is stored in Amazon S3.
- If you require FIPS 140-2 validated cryptographic modules when accessing AWS through a command line interface or an API, use a FIPS endpoint. For more information about the available FIPS endpoints, see Federal Information Processing Standard (FIPS) 140-2.

We strongly recommend that you never put confidential or sensitive information, such as your customers' email addresses, into tags or free-form fields such as a **Name** field. This includes when you work with Amazon SQS or other AWS services using the console, API, AWS CLI, or AWS SDKs. Any data that you enter into tags or free-form fields used for names may be used for billing or diagnostic logs. If you provide a URL to an external server, we strongly recommend that you do not include credentials information in the URL to validate your request to that server.

The following sections provide information about data protection in Amazon SQS.

Topics

Data encryption

Data protection refers to protecting data while in-transit (as it travels to and from Amazon SQS) and at rest (while it is stored on disks in Amazon SQS data centers). You can protect data in transit using Secure Sockets Layer (SSL) or client-side encryption. You can protect data at rest by requesting Amazon SQS to encrypt your messages before saving them to disk in its data centers and then decrypt them when the messages are received.

Topics

Encryption at rest

Server-side encryption (SSE) lets you transmit sensitive data in encrypted queues. SSE protects the contents of messages in queues using keys managed in AWS Key Management Service (AWS KMS). For information about managing SSE using the AWS Management Console, see Configuring server-side encryption (SSE) for a queue (console) (p. 14).

For information about managing SSE using the AWS SDK for Java (and the `CreateQueue`, `SetQueueAttributes`, and `GetQueueAttributes` actions), see the following examples:

- Using server-side encryption (SSE) (p. 61)
- Configure KMS permissions for AWS services (p. 109)

SSE encrypts messages as soon as Amazon SQS receives them. The messages are stored in encrypted form and Amazon SQS decrypts messages only when they are sent to an authorized consumer.

Important
All requests to queues with SSE enabled must use HTTPS and Signature Version 4.
An encrypted queue (p. 106) that uses the default key (AWS managed CMK for Amazon SQS) cannot invoke a Lambda function in a different AWS account.
Some features of AWS services that can send notifications to Amazon SQS using the AWS Security Token Service `AssumeRole` action are compatible with SSE but work *only with standard queues:*

- Auto Scaling Lifecycle Hooks
- AWS Lambda Dead-Letter Queues

For information about compatibility of other services with encrypted queues, see Configure KMS permissions for AWS services (p. 109) and your service documentation.

AWS KMS combines secure, highly available hardware and software to provide a key management system scaled for the cloud. When you use Amazon SQS with AWS KMS, the data keys (p. 107) that encrypt your message data are also encrypted and stored with the data they protect.

The following are benefits of using AWS KMS:

- You can create and manage customer master keys (CMKs) (p. 107) yourself.
- You can also use the AWS managed CMK for Amazon SQS, which is unique for each account and region.

- The AWS KMS security standards can help you meet encryption-related compliance requirements.

For more information, see What is AWS Key Management Service? in the *AWS Key Management Service Developer Guide*.

Topics

Encryption scope

SSE encrypts the body of a message in an Amazon SQS queue.

SSE doesn't encrypt the following:

- Queue metadata (queue name and attributes)
- Message metadata (message ID, timestamp, and attributes)
- Per-queue metrics

Encrypting a message makes its contents unavailable to unauthorized or anonymous users. This doesn't affect the normal functioning of Amazon SQS:

- A message is encrypted only if it is sent after the encryption of a queue is enabled. Amazon SQS doesn't encrypt backlogged messages.
- Any encrypted message remains encrypted even if the encryption of its queue is disabled.

Moving a message to a dead-letter queue (p. 43) doesn't affect its encryption:

- When Amazon SQS moves a message from an encrypted source queue to an unencrypted dead-letter queue, the message remains encrypted.
- When Amazon SQS moves a message from an unencrypted source queue to an encrypted dead-letter queue, the message remains unencrypted.

Key terms

The following key terms can help you better understand the functionality of SSE. For detailed descriptions, see the *Amazon Simple Queue Service API Reference*.

Data key

The data encryption key (DEK) responsible for encrypting the contents of Amazon SQS messages.

For more information, see Data Keys in the *AWS Key Management Service Developer Guide* in the *AWS Encryption SDK Developer Guide*.

Data key reuse period

The length of time, in seconds, for which Amazon SQS can reuse a data key to encrypt or decrypt messages before calling AWS KMS again. An integer representing seconds, between 60 seconds (1 minute) and 86,400 seconds (24 hours). The default is 300 (5 minutes). For more information, see Understanding the data key reuse period (p. 110).

Note
In the unlikely event of being unable to reach AWS KMS, Amazon SQS continues to use the cached data key until a connection is reestablished.

Customer master key ID

The alias, alias ARN, key ID, or key ARN of an AWS managed customer master key (CMK) or a custom CMK—in your account or in another account. While the alias of the AWS managed CMK for Amazon SQS is always `alias/aws/sqs`, the alias of a custom CMK can, for example, be `alias/MyAlias`. You can use these CMKs to protect the messages in Amazon SQS queues.

Note
Keep the following in mind:

- If you don't specify a custom CMK, Amazon SQS uses the AWS managed CMK for Amazon SQS.
- The first time you use the AWS Management Console to specify the AWS managed CMK for Amazon SQS for a queue, AWS KMS creates the AWS managed CMK for Amazon SQS.
- Alternatively, the first time you use the `SendMessage` or `SendMessageBatch` action on a queue with SSE enabled, AWS KMS creates the AWS managed CMK for Amazon SQS.

You can create CMKs, define the policies that control how CMKs can be used, and audit CMK usage using the **Customer managed keys** section of the AWS KMS console or the `CreateKey` AWS KMS action. For more information, see Customer Master Keys (CMKs) and Creating Keys in the *AWS Key Management Service Developer Guide*. For more examples of CMK identifiers, see KeyId in the *AWS Key Management Service API Reference*. For information about finding CMK identifiers, see Find the Key ID and ARN in the *AWS Key Management Service Developer Guide*.

Important
There are additional charges for using AWS KMS. For more information, see Estimating AWS KMS costs (p. 111) and AWS Key Management Service Pricing.

Envelope Encryption

The security of your encrypted data depends in part on protecting the data key that can decrypt it. Amazon SQS uses the CMK to encrypt the data key and then the encrypted data key is stored with the encrypted message. This practice of using a master key to encrypt data keys is known as envelope encryption.

For more information, see Envelope Encryption in the *AWS Encryption SDK Developer Guide*.

Key management

Amazon SQS integrates with the AWS Key Management Service to manage customer master keys (CMKs) for server-side encryption (SSE). See Encryption at rest (p. 106) for SSE information and key management definitions. Amazon SQS uses CMKs to validate and secure the data keys that encrypt and decrypt the messages. The following sections provide information about working with CMKs and data keys in the Amazon SQS service.

Topics

Configuring AWS KMS permissions

Every CMK must have a key policy. Note that you cannot modify the key policy of an AWS managed CMK for Amazon SQS. The policy for this CMK includes permissions for all principals in the account (that are authorized to use Amazon SQS) to use encrypted queues.

For a customer managed CMK, you must configure the key policy to add permissions for each queue producer and consumer. To do this, you name the producer and consumer as users in the CMK key policy. For more information about AWS KMS permissions, see AWS KMS resources and operations or AWS KMS API permissions reference in the *AWS Key Management Service Developer Guide*.

Alternatively, you can specify the required permissions in an IAM policy assigned to the principals that produce and consume encrypted messages. For more information, see Using IAM Policies with AWS KMS in the *AWS Key Management Service Developer Guide*.

> **Note**
> While you can configure global permissions to send to and receive from Amazon SQS, AWS KMS requires explicitly naming the full ARN of CMKs in specific regions in the `Resource` section of an IAM policy.

Configure KMS permissions for AWS services

Several AWS services act as event sources that can send events to Amazon SQS queues. To allow these event sources to work with encrypted queues, you must create a customer managed CMK and add permissions in the key policy for the service to use the required AWS KMS API methods. Perform the following steps to configure the permissions.

1. Create a customer managed CMK. For more information, see Creating Keys in the *AWS Key Management Service Developer Guide*.
2. To allow the AWS service event source to use the `kms:GenerateDataKey` and `kms:Decrypt` API methods, add the following statement to the CMK key policy.

```
{
   "Version": "2012-10-17",
      "Statement": [{
         "Effect": "Allow",
         "Principal": {
            "Service": "service.amazonaws.com"
         },
         "Action": [
            "kms:GenerateDataKey",
            "kms:Decrypt"
         ],
         "Resource": "*"
       }]
}
```

   Replace "service" in the above example with the *Service name* of the event source. Event sources include the following services.

Event source	Service name
Amazon CloudWatch Events	`events.amazonaws.com`
Amazon S3 event notifications	`s3.amazonaws.com`
Amazon SNS topic subscriptions	`sns.amazonaws.com`

3. configure an existing SSE queue (p. 14) using the ARN of your CMK.
4. Provide the ARN of the encrypted queue to the event source.

Configure KMS permissions for producers

When the data key reuse period (p. 110) expires, the producer's next call to `SendMessage` or `SendMessageBatch` also triggers calls to `kms:GenerateDataKey` and `kms:Decrypt`. The call to `kms:Decrypt` is to verify the integrity of the new data key before using it. Therefore, the producer must have the `kms:GenerateDataKey` and `kms:Decrypt` permissions for the customer master key (CMK).

Add the following statement to the IAM policy of the producer. Remember to use the correct ARN values for the key resource and the queue resource.

```
{
   "Version": "2012-10-17",
      "Statement": [{
         "Effect": "Allow",
         "Action": [
            "kms:GenerateDataKey",
            "kms:Decrypt"
         ],
         "Resource":  "arn:aws:kms:us-
east-2:123456789012:key/1234abcd-12ab-34cd-56ef-1234567890ab"
         }, {
         "Effect": "Allow",
         "Action": [
            "sqs:SendMessage"
         ],
         "Resource": "arn:aws:sqs:*:123456789012:MyQueue"
      }]
}
```

Configure KMS permissions for consumers

When the data key reuse period expires, the consumer's next call to `ReceiveMesssage` also triggers a call to `kms:Decrypt`, to verify the integrity of the new data key before using it. Therefore, the consumer must have the `kms:Decrypt` permission for any customer master key (CMK) that is used to encrypt the messages in the specified queue. If the queue acts as a dead-letter queue (p. 43), the consumer must also have the `kms:Decrypt` permission for any CMK that is used to encrypt the messages in the source queue. Add the following statement to the IAM policy of the consumer. Remember to use the correct ARN values for the key resource and the queue resource.

```
{
   "Version": "2012-10-17",
      "Statement": [{
         "Effect": "Allow",
         "Action": [
            "kms:Decrypt"
         ],
         "Resource": "arn:aws:kms:us-
east-2:123456789012:key/1234abcd-12ab-34cd-56ef-1234567890ab"
         }, {
         "Effect": "Allow",
         "Action": [
            "sqs:ReceiveMessage"
         ],
         "Resource": "arn:aws:sqs:*:123456789012:MyQueue"
      }]
}
```

Understanding the data key reuse period

The data key reuse period (p. 107) defines the maximum duration for Amazon SQS to reuse the same data key. When the data key reuse period ends, Amazon SQS generates a new data key. Note the following guidelines about the reuse period.

- A shorter reuse period provides better security but results in more calls to AWS KMS, which might incur charges beyond the Free Tier.

- Although the data key is cached separately for encryption and for decryption, the reuse period applies to both copies of the data key.
- When the data key reuse period ends, the next call to `SendMessage` or `SendMessageBatch` typically triggers a call to the AWS KMS `GenerateDataKey` method to get a new data key. Also, the next calls to `SendMessage` and `ReceiveMessage` will each trigger a call to AWS KMS `Decrypt` to verify the integrity of the data key before using it.
- Principals (AWS accounts or IAM users) don't share data keys (messages sent by unique principals always get unique data keys). Thus, the volume of calls to AWS KMS is a multiple of the number of unique principals in use during the data key reuse period:

Estimating AWS KMS costs

To predict costs and better understand your AWS bill, you might want to know how often Amazon SQS uses your customer master key (CMK).

> **Note**
> Although the following formula can give you a very good idea of expected costs, actual costs might be higher because of the distributed nature of Amazon SQS.

To calculate the number of API requests (`R`) *per queue*, use the following formula:

```
R = B / D * (2 * P + C)
```

`B` is the billing period (in seconds).

`D` is the data key reuse period (p. 107) (in seconds).

`P` is the number of producing principals that send to the Amazon SQS queue.

`C` is the number of consuming principals that receive from the Amazon SQS queue.

> **Important**
> In general, producing principals incur double the cost of consuming principals. For more information, see Understanding the data key reuse period (p. 110).
> If the producer and consumer have different IAM users, the cost increases.

The following are example calculations. For exact pricing information, see AWS Key Management Service Pricing.

Example 1: Calculating the number of AWS KMS API calls for 2 principals and 1 queue

This example assumes the following:

- The billing period is January 1-31 (2,678,400 seconds).
- The data key reuse period is set to 5 minutes (300 seconds).
- There is 1 queue.
- There is 1 producing principal and 1 consuming principal.

```
2,678,400 / 300 * (2 * 1 + 1) = 26,784
```

Example 2: Calculating the number of AWS KMS API calls for multiple producers and consumers and 2 queues

This example assumes the following:

- The billing period is February 1-28 (2,419,200 seconds).
- The data key reuse period is set to 24 hours (86,400 seconds).
- There are 2 queues.
- The first queue has 3 producing principals and 1 consuming principal.
- The second queue has 5 producing principals and 2 consuming principals.

```
(2,419,200 / 86,400 * (2 * 3 + 1)) + (2,419,200 / 86,400 * (2 * 5 + 2)) = 532
```

AWS KMS errors

When you work with Amazon SQS and AWS KMS, you might encounter errors. The following references describe the errors and possible troubleshooting solutions.

- Common AWS KMS errors
- AWS KMS Decrypt errors
- AWS KMS GenerateDataKey errors

Internetwork traffic privacy

An Amazon Virtual Private Cloud (Amazon VPC) endpoint for Amazon SQS is a logical entity within a VPC that allows connectivity only to Amazon SQS. The VPC routes requests to Amazon SQS and routes responses back to the VPC. The following sections provide information about working with VPC endpoints and creating VPC endpoint policies.

Topics

- Amazon Virtual Private Cloud endpoints for Amazon SQS (p. 112)
- Creating an Amazon VPC endpoint policy for Amazon SQS (p. 113)

Amazon Virtual Private Cloud endpoints for Amazon SQS

If you use Amazon VPC to host your AWS resources, you can establish a connection between your VPC and Amazon SQS. You can use this connection to send messages to your Amazon SQS queues without crossing the public internet.

Amazon VPC lets you launch AWS resources in a custom virtual network. You can use a VPC to control your network settings, such as the IP address range, subnets, route tables, and network gateways. For more information about VPCs, see the *Amazon VPC User Guide*.

To connect your VPC to Amazon SQS, you must first define an *interface VPC endpoint*, which lets you connect your VPC to other AWS services. The endpoint provides reliable, scalable connectivity to Amazon SQS without requiring an internet gateway, network address translation (NAT) instance, or VPN connection. For more information, see Tutorial: Sending a message to an Amazon SQS queue from Amazon Virtual Private Cloud (p. 94) and Example 5: Deny access if it isn't from a VPC endpoint (p. 137) in this guide and Interface VPC Endpoints (AWS PrivateLink) in the *Amazon VPC User Guide*.

Important

- You can use Amazon Virtual Private Cloud only with HTTPS Amazon SQS endpoints.
- When you configure Amazon SQS to send messages from Amazon VPC, you must enable private DNS and specify endpoints in the format `sqs.`*`us-east-2`*`.amazonaws.com`.

- Private DNS doesn't support legacy endpoints such as `queue.amazonaws.com` or *us-east-2*`.queue.amazonaws.com`.

Creating an Amazon VPC endpoint policy for Amazon SQS

You can create a policy for Amazon VPC endpoints for Amazon SQS in which you specify the following:

- The principal that can perform actions.
- The actions that can be performed.
- The resources on which actions can be performed.

For more information, see Controlling Access to Services with VPC Endpoints in the *Amazon VPC User Guide*

The following example VPC endpoint policy specifies that the IAM user `MyUser` is allowed to send messages to the Amazon SQS queue `MyQueue`.

```
{
   "Statement": [{
      "Action": ["sqs:SendMessage"],
      "Effect": "Allow",
      "Resource": "arn:aws:sqs:us-east-2:123456789012:MyQueue",
      "Principal": {
        "AWS": "arn:aws:iam:123456789012:user/MyUser"
      }
   }]
}
```

The following are denied:

- Other Amazon SQS API actions, such as `sqs:CreateQueue` and `sqs:DeleteQueue`.
- Other IAM users and rules which attempt to use this VPC endpoint.
- `MyUser` sending messages to a different Amazon SQS queue.

Note
The IAM user can still use other Amazon SQS API actions from *outside* the VPC. For more information, see Example 5: Deny access if it isn't from a VPC endpoint (p. 137).

Identity and access management in Amazon SQS

Access to Amazon SQS requires credentials that AWS can use to authenticate your requests. These credentials must have permissions to access AWS resources, such an Amazon SQS queues and messages. The following sections provide details on how you can use AWS Identity and Access Management (IAM) and Amazon SQS to help secure your resources by controlling access to them.

Topics

- Using custom policies with the Amazon SQS Access Policy Language (p. 128)
- Using temporary security credentials with Amazon SQS (p. 138)
- Amazon SQS API permissions: Actions and resource reference (p. 140)

Authentication

You can access AWS as any of the following types of identities:

- **AWS account root user** – When you first create an AWS account, you begin with a single sign-in identity that has complete access to all AWS services and resources in the account. This identity is called the AWS account *root user* and is accessed by signing in with the email address and password that you used to create the account. We strongly recommend that you do not use the root user for your everyday tasks, even the administrative ones. Instead, adhere to the best practice of using the root user only to create your first IAM user. Then securely lock away the root user credentials and use them to perform only a few account and service management tasks.
- **IAM user** – An IAM user is an identity within your AWS account that has specific custom permissions (for example, permissions to create a queue in Amazon SQS). You can use an IAM user name and password to sign in to secure AWS webpages like the AWS Management Console, AWS Discussion Forums, or the AWS Support Center.

  In addition to a user name and password, you can also generate access keys for each user. You can use these keys when you access AWS services programmatically, either through one of the several SDKs or by using the AWS Command Line Interface (CLI). The SDK and CLI tools use the access keys to cryptographically sign your request. If you don't use AWS tools, you must sign the request yourself. Amazon SQS supports *Signature Version 4*, a protocol for authenticating inbound API requests. For more information about authenticating requests, see Signature Version 4 signing process in the *AWS General Reference*.

- **IAM role** – An IAM role is an IAM identity that you can create in your account that has specific permissions. An IAM role is similar to an IAM user in that it is an AWS identity with permissions policies that determine what the identity can and cannot do in AWS. However, instead of being uniquely associated with one person, a role is intended to be assumable by anyone who needs it. Also, a role does not have standard long-term credentials such as a password or access keys associated with it. Instead, when you assume a role, it provides you with temporary security credentials for your role session. IAM roles with temporary credentials are useful in the following situations:

  - **Federated user access** – Instead of creating an IAM user, you can use existing identities from AWS Directory Service, your enterprise user directory, or a web identity provider. These are known as *federated users*. AWS assigns a role to a federated user when access is requested through an identity provider. For more information about federated users, see Federated users and roles in the *IAM User Guide*.

  - **AWS service access** – A service role is an IAM role that a service assumes to perform actions on your behalf. An IAM administrator can create, modify, and delete a service role from within IAM. For more information, see Creating a role to delegate permissions to an AWS service in the *IAM User Guide*.

  - **Applications running on Amazon EC2** – You can use an IAM role to manage temporary credentials for applications that are running on an EC2 instance and making AWS CLI or AWS API requests. This is preferable to storing access keys within the EC2 instance. To assign an AWS role to an EC2 instance and make it available to all of its applications, you create an instance profile that is attached to the instance. An instance profile contains the role and enables programs that are running on the EC2 instance to get temporary credentials. For more information, see Using an IAM role to grant permissions to applications running on Amazon EC2 instances in the *IAM User Guide*.

Access control

Amazon SQS has its own resource-based permissions system that uses policies written in the same language used for AWS Identity and Access Management (IAM) policies. This means that you can achieve similar things with Amazon SQS policies and IAM policies.

Note
It is important to understand that all AWS accounts can delegate their permissions to users under their accounts. Cross-account access allows you to share access to your AWS resources without having to manage additional users. For information about using cross-account access, see Enabling Cross-Account Access in the *IAM User Guide*.
Cross-account permissions don't apply to the following actions:

- `AddPermission`
- `CreateQueue`
- `DeleteQueue`
- `ListQueues`
- `ListQueueTags`
- `RemovePermission`
- `SetQueueAttributes`
- `TagQueue`
- `UntagQueue`

Currently, Amazon SQS supports only a limited subset of the condition keys available in IAM. For more information, see Amazon SQS API permissions: Actions and resource reference (p. 140).

Overview of managing access in Amazon SQS

Every AWS resource is owned by an AWS account, and permissions to create or access a resource are governed by permissions policies. An account administrator can attach permissions policies to IAM identities (users, groups, and roles), and some services (such as Amazon SQS) also support attaching permissions policies to resources.

Note
An *account administrator* (or administrator user) is a user with administrative privileges. For more information, see IAM Best Practices in the *IAM User Guide*.

When granting permissions, you specify what users get permissions, the resource they get permissions for, and the specific actions that you want to allow on the resource.

Topics

Amazon Simple Queue Service resource and operations

In Amazon SQS, the only resource is the *queue*. In a policy, use an Amazon Resource Name (ARN) to identify the resource that the policy applies to. The following resource has a unique ARN associated with it:

Resource type	ARN format
Queue	`arn:aws:sqs:region:account_id:queue_name`

The following are examples of the ARN format for queues:

- An ARN for a queue named `my_queue` in the US East (Ohio) region, belonging to AWS Account 123456789012:

```
arn:aws:sqs:us-east-2:123456789012:my_queue
```

- An ARN for a queue named `my_queue` in each of the different regions that Amazon SQS supports:

```
arn:aws:sqs:*:123456789012:my_queue
```

- An ARN that uses `*` or `?` as a wildcard for the queue name. In the following examples, the ARN matches all queues prefixed with `my_prefix_`:

```
arn:aws:sqs:*:123456789012:my_prefix_*
```

You can get the ARN value for an existing queue by calling the `GetQueueAttributes` action. The value of the `QueueArn` attribute is the ARN of the queue. For more information about ARNs, see IAM ARNs in the *IAM User Guide*.

Amazon SQS provides a set of actions that work with the queue resource. For more information, see Amazon SQS API permissions: Actions and resource reference (p. 140).

Understanding resource ownership

The AWS account owns the resources that are created in the account, regardless of who created the resources. Specifically, the resource owner is the AWS account of the *principal entity* (that is, the root account, an IAM user, or an IAM role) that authenticates the resource creation request. The following examples illustrate how this works:

- If you use the root account credentials of your AWS account to create an Amazon SQS queue, your AWS account is the owner of the resource (in Amazon SQS, the resource is the Amazon SQS queue).
- If you create an IAM user in your AWS account and grant permissions to create a queue to the user, the user can create the queue. However, your AWS account (to which the user belongs) owns the queue resource.
- If you create an IAM role in your AWS account with permissions to create an Amazon SQS queue, anyone who can assume the role can create a queue. Your AWS account (to which the role belongs) owns the queue resource.

Managing access to resources

A *permissions policy* describes the permissions granted to accounts. The following section explains the available options for creating permissions policies.

Note
This section discusses using IAM in the context of Amazon SQS. It doesn't provide detailed information about the IAM service. For complete IAM documentation, see What is IAM? in the *IAM User Guide*. For information about IAM policy syntax and descriptions, see AWS IAM Policy Reference in the *IAM User Guide*.

Policies attached to an IAM identity are referred to as *identity-based* policies (IAM polices) and policies attached to a resource are referred to as *resource-based* policies.

Identity-based policies (IAM policies and Amazon SQS policies)

There are two ways to give your users permissions to your Amazon SQS queues: using the Amazon SQS policy system and using the IAM policy system. You can use either system, or both, to attach policies to users or roles. In most cases, you can achieve the same result using either system. For example, you can do the following:

- **Attach a permission policy to a user or a group in your account** – To grant user permissions to create an Amazon SQS queue, attach a permissions policy to a user or group that the user belongs to.
- **Attach a permission policy to a user in another AWS account** – To grant user permissions to create an Amazon SQS queue, attach an Amazon SQS permissions policy to a user in another AWS account.

  Cross-account permissions don't apply to the following actions:
  - `AddPermission`
  - `CreateQueue`
  - `DeleteQueue`
  - `ListQueues`
  - `ListQueueTags`
  - `RemovePermission`
  - `SetQueueAttributes`
  - `TagQueue`
  - `UntagQueue`
- **Attach a permission policy to a role (grant cross-account permissions)** – To grant cross-account permissions, attach an identity-based permissions policy to an IAM role. For example, the AWS account A administrator can create a role to grant cross-account permissions to AWS account B (or an AWS service) as follows:
  - The account A administrator creates an IAM role and attaches a permissions policy—that grants permissions on resources in account A—to the role.
  - The account A administrator attaches a trust policy to the role that identifies account B as the principal who can assume the role.
  - The account B administrator delegates the permission to assume the role to any users in account B. This allows users in account B to create or access queues in account A.

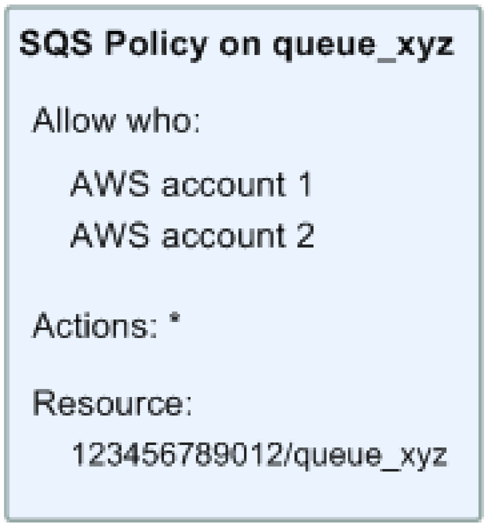
    Note
    If you want to grant the permission to assume the role to an AWS service, the principal in the trust policy can also be an AWS service principal.

For more information about using IAM to delegate permissions, see Access Management in the *IAM User Guide*.

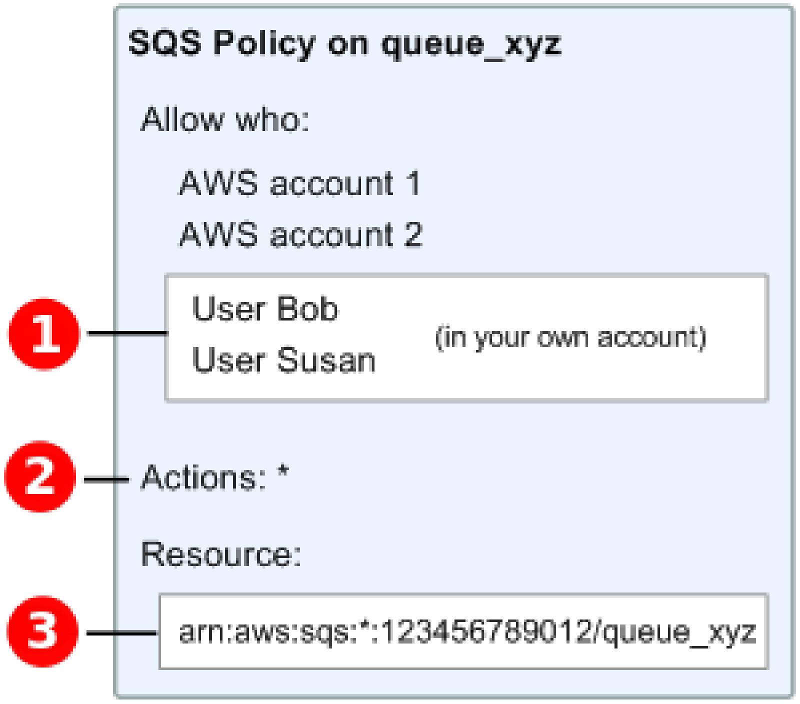
While Amazon SQS works with IAM policies, it has its own policy infrastructure. You can use an Amazon SQS policy with a queue to specify which AWS Accounts have access to the queue. You can specify the type of access and conditions (for example, a condition that grants permissions to use `SendMessage`, `ReceiveMessage` if the request is made before December 31, 2010). The specific actions you can grant permissions for are a subset of the overall list of Amazon SQS actions. When you write an Amazon SQS policy and specify `*` to "allow all Amazon SQS actions," it means that a user can perform all actions in this subset.

The following diagram illustrates the concept of one of these basic Amazon SQS policies that covers the subset of actions. The policy is for `queue_xyz`, and it gives AWS Account 1 and AWS Account 2 permissions to use any of the allowed actions with the specified queue.

> **Note**
> The resource in the policy is specified as `123456789012/queue_xyz`, where `123456789012` is the AWS Account ID of the account that owns the queue.



With the introduction of IAM and the concepts of *Users* and *Amazon Resource Names (ARNs)*, a few things have changed about SQS policies. The following diagram and table describe the changes.



❶ For information about giving permissions to users in different accounts, see Tutorial: Delegate Access Across AWS Accounts Using IAM Roles in the *IAM User Guide*.

❷ The subset of actions included in * has expanded. For a list of allowed actions, see Amazon SQS API permissions: Actions and resource reference (p. 140).

❸ You can specify the resource using the Amazon Resource Name (ARN), the standard means of specifying resources in IAM policies. For information about the ARN format for Amazon SQS queues, see Amazon Simple Queue Service resource and operations (p. 116).

For example, according to the Amazon SQS policy in the preceding diagram, anyone who possesses the security credentials for AWS Account 1 or AWS Account 2 can access `queue_xyz`. In addition, Users Bob and Susan in your own AWS Account (with ID `123456789012`) can access the queue.

Before the introduction of IAM, Amazon SQS automatically gave the creator of a queue full control over the queue (that is, access to all of the possible Amazon SQS actions on that queue). This is no longer true, unless the creator uses AWS security credentials. Any user who has permissions to create a queue must also have permissions to use other Amazon SQS actions in order to do anything with the created queues.

The following is an example policy that allows a user to use all Amazon SQS actions, but only with queues whose names are prefixed with the literal string `bob_queue_`.

```
{
   "Version": "2012-10-17",
   "Statement": [{
      "Effect": "Allow",
      "Action": "sqs:*",
      "Resource": "arn:aws:sqs:*:123456789012:bob_queue_*"
   }]
}
```

For more information, see Using identity-based policies with Amazon SQS (p. 120), and Identities (Users, Groups, and Roles) in the *IAM User Guide*.

Specifying policy elements: Actions, effects, resources, and principals

For each Amazon Simple Queue Service resource (p. 116), the service defines a set of actions. To grant permissions for these actions, Amazon SQS defines a set of actions that you can specify in a policy.

> **Note**
> Performing an action can require permissions for more than one action. When granting permissions for specific actions, you also identify the resource for which the actions are allowed or denied.

The following are the most basic policy elements:

- **Resource** – In a policy, you use an Amazon Resource Name (ARN) to identify the resource to which the policy applies.
- **Action** – You use action keywords to identify resource actions that you want to allow or deny. For example, the `sqs:CreateQueue` permission allows the user to perform the Amazon Simple Queue Service `CreateQueue` action.
- **Effect** – You specify the effect when the user requests the specific action—this can be either allow or deny. If you don't explicitly grant access to a resource, access is implicitly denied. You can also explicitly deny access to a resource, which you might do to make sure that a user can't access it, even if a different policy grants access.
- **Principal** – In identity-based policies (IAM policies), the user that the policy is attached to is the implicit principal. For resource-based policies, you specify the user, account, service, or other entity that you want to receive permissions (applies to resource-based policies only).

To learn more about Amazon SQS policy syntax and descriptions, see AWS IAM Policy Reference in the *IAM User Guide*.

For a table of all Amazon Simple Queue Service actions and the resources that they apply to, see Amazon SQS API permissions: Actions and resource reference (p. 140).

Specifying conditions in a policy

When you grant permissions, you can use the Amazon SQS Access Policy Language to specify the conditions for when a policy should take effect. For example, you might want a policy to be applied only after a specific date. For more information about specifying conditions in a policy language, see Condition in the *IAM User Guide*.

To express conditions, you use predefined condition keys. There are no condition keys specific to Amazon SQS. However, there are AWS-wide condition keys that you can use with Amazon SQS. Currently, Amazon SQS supports only a limited subset of the condition keys available in IAM. See the section called "API permissions reference" (p. 140).

Using identity-based policies with Amazon SQS

This topic provides examples of identity-based policies in which an account administrator can attach permissions policies to IAM identities (users, groups, and roles).

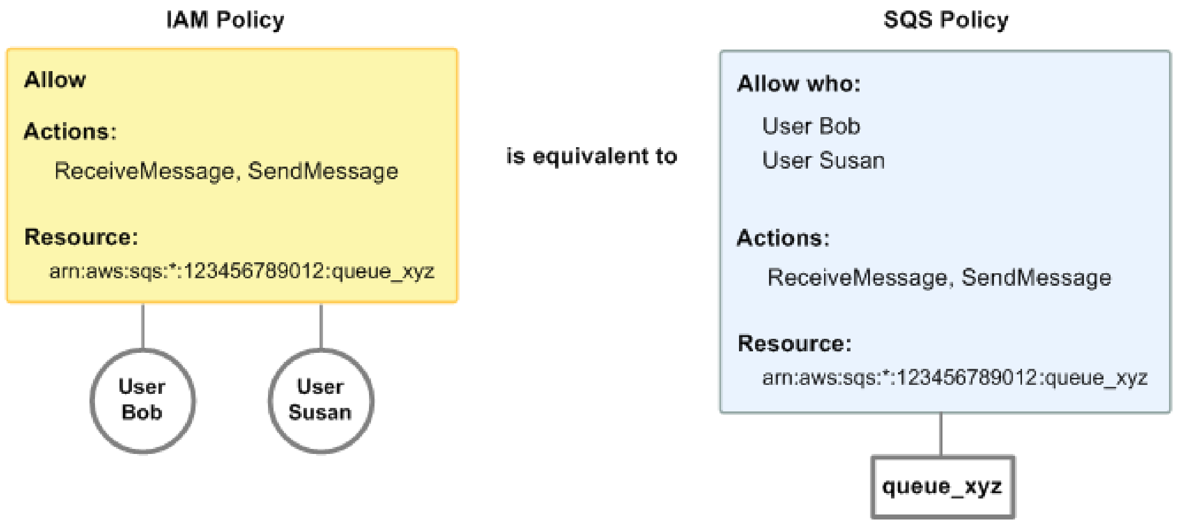
Important
We recommend that you first review the introductory topics that explain the basic concepts and options available for you to manage access to your Amazon Simple Queue Service resources. For more information, see Overview of managing access in Amazon SQS (p. 115).
With the exception of `ListQueues`, all Amazon SQS actions support resource-level permissions. For more information, see Amazon SQS API permissions: Actions and resource reference (p. 140).

Topics

Using Amazon SQS and IAM policies

There are two ways to give your users permissions to your Amazon SQS resources: using the Amazon SQS policy system and using the IAM policy system. You can use one or the other, or both. For the most part, you can achieve the same result with either one.

For example, the following diagram shows an IAM policy and an Amazon SQS policy equivalent to it. The IAM policy grants the rights to the Amazon SQS `ReceiveMessage` and `SendMessage` actions for the queue called `queue_xyz` in your AWS Account, and the policy is attached to users named Bob and Susan (Bob and Susan have the permissions stated in the policy). This Amazon SQS policy also gives Bob and Susan rights to the `ReceiveMessage` and `SendMessage` actions for the same queue.

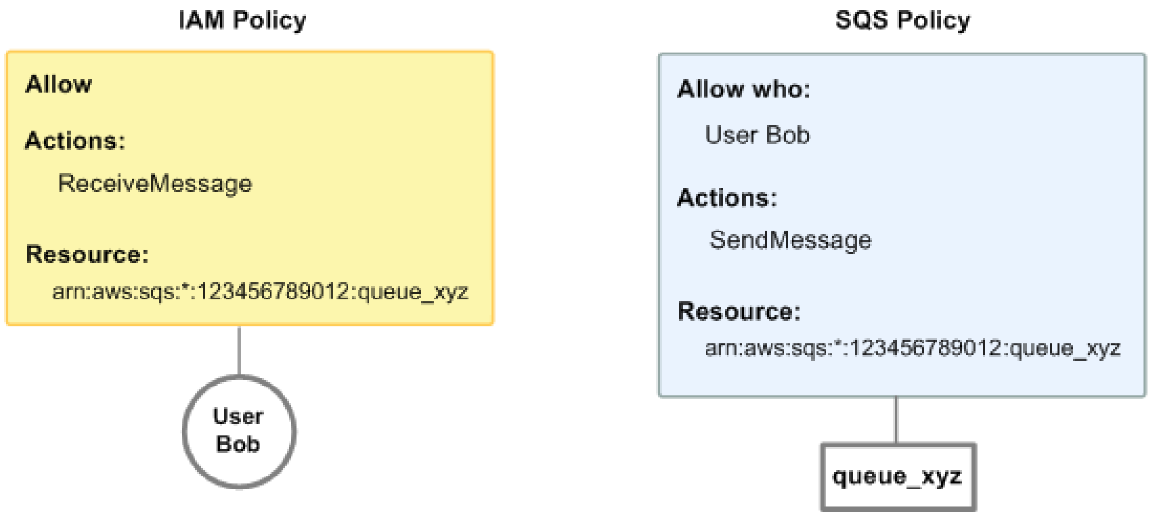


Note
This example shows simple policies without conditions. You can specify a particular condition in either policy and get the same result.

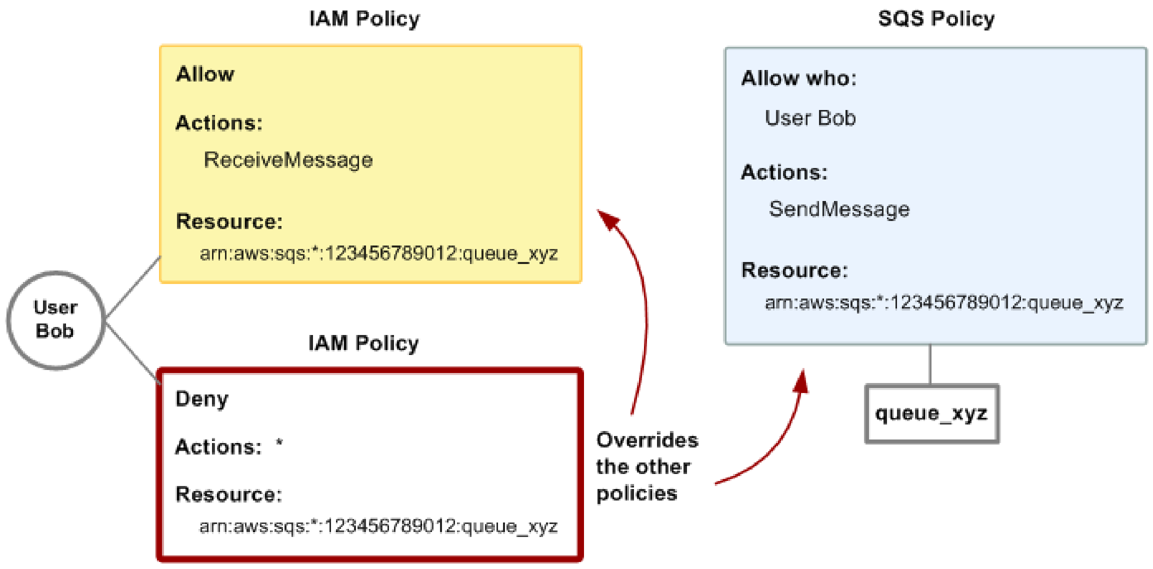
There is one major difference between IAM and Amazon SQS policies: the Amazon SQS policy system lets you grant permission to other AWS Accounts, whereas IAM doesn't.

It is up to you how you use both of the systems together to manage your permissions. The following examples show how the two policy systems work together.

- In the first example, Bob has both an IAM policy and an Amazon SQS policy that apply to his account. The IAM policy grants his account permission for the `ReceiveMessage` action on `queue_xyz`, whereas the Amazon SQS policy gives his account permission for the `SendMessage` action on the same queue. The following diagram illustrates the concept.



  If Bob sends a `ReceiveMessage` request to `queue_xyz`, the IAM policy allows the action. If Bob sends a `SendMessage` request to `queue_xyz`, the Amazon SQS policy allows the action.
- In the second example, Bob abuses his access to `queue_xyz`, so it becomes necessary to remove his entire access to the queue. The easiest thing to do is to add a policy that denies him access to all actions for the queue. This policy overrides the other two because an explicit `deny` always overrides an `allow`. For more information about policy evaluation logic, see Using custom policies with the Amazon SQS Access Policy Language (p. 128). The following diagram illustrates the concept.



You can also add an additional statement to the Amazon SQS policy that denies Bob any type of access to the queue. It has the same effect as adding an IAM policy that denies Bob access to the queue. For examples of policies that cover Amazon SQS actions and resources, see Basic examples of Amazon SQS policies (p. 124). For more information about writing Amazon SQS policies, see Using custom policies with the Amazon SQS Access Policy Language (p. 128).

Permissions required to use the Amazon SQS console

A user who wants to work with the Amazon SQS console must have the minimum set of permissions to work with the Amazon SQS queues in the user's AWS account. For example, the user must have the permission to call the `ListQueues` action to be able to list queues, or the permission to call the `CreateQueue` action to be able to create queues. In addition to Amazon SQS permissions, to subscribe an Amazon SQS queue to an Amazon SNS topic, the console also requires permissions for Amazon SNS actions.

If you create an IAM policy that is more restrictive than the minimum required permissions, the console might not function as intended for users with that IAM policy.

You don't need to allow minimum console permissions for users that make calls only to the AWS CLI or Amazon SQS actions.

AWS managed (predefined) policies for Amazon SQS

AWS addresses many common use cases by providing standalone AWS managed IAM policies. These AWS managed policies simplify working with permissions by granting the permissions necessary for common use cases. For more information, see AWS Managed Policies in the *IAM User Guide*.

The following AWS managed policies (that you can attach to users in your account) are specific to Amazon SQS:

- **AmazonSQSReadOnlyAccess** – Grants read-only access to Amazon SQS queues using the AWS Management Console.
- **AmazonSQSFullAccess** – Grants full access to Amazon SQS queues using the AWS Management Console.

You can search and review available policies on the IAM console. You can also create your own custom IAM policies to allow permissions for Amazon SQS actions and queues. You can attach these custom policies to the IAM users or groups that require permissions.

Basic examples of IAM policies for Amazon SQS

The following examples provide an introduction to Amazon SQS permission policies.

Note
When you configure lifecycle hooks for Amazon EC2 Auto Scaling, you don't need to write a policy to send messages to an Amazon SQS queue. For more information, see Amazon EC2 Auto Scaling Lifecycle Hooks in the *Amazon EC2 User Guide for Linux Instances*.

Example 1: Allow a user to create queues

In the following example, we create a policy for Bob that lets him access all Amazon SQS actions, but only with queues whose names are prefixed with the literal string `alice_queue_`.

Amazon SQS doesn't automatically grant the creator of a queue permissions to use the queue. Therefore, we must explicitly grant Bob permissions to use all Amazon SQS actions in addition to `CreateQueue` action in the IAM policy.

```
{
   "Version": "2012-10-17",
   "Statement": [{
      "Effect": "Allow",
      "Action": "sqs:*",
      "Resource": "arn:aws:sqs:*:123456789012:alice_queue_*"
   }]
}
```

Example 2: Allow developers to write messages to a shared queue

In the following example, we create a group for developers and attach a policy that lets the group use the Amazon SQS `SendMessage` action, but only with the queue that belongs to the specified AWS account and is named `MyCompanyQueue`.

```
{
   "Version": "2012-10-17",
   "Statement": [{
      "Effect": "Allow",
      "Action": "sqs:SendMessage",
      "Resource": "arn:aws:sqs:*:123456789012:MyCompanyQueue"
   }]
}
```

You can use `*` instead of `SendMessage` to grant the following actions to a principal on a shared queue: `ChangeMessageVisibility`, `DeleteMessage`, `GetQueueAttributes`, `GetQueueUrl`, `ReceiveMessage`, and `SendMessage`.

Note
Although `*` includes access provided by other permission types, Amazon SQS considers permissions separately. For example, it is possible to grant both `*` and `SendMessage` permissions to a user, even though a `*` includes the access provided by `SendMessage`.
This concept also applies when you remove a permission. If a principal has only a `*` permission, requesting to remove a `SendMessage` permission *doesn't* leave the principal with an *everything-but* permission. Instead, the request has no effect, because the principal doesn't possess an

explicit `SendMessage` permission. To leave the principal with only the `ReceiveMessage` permission, first add the `ReceiveMessage` permission and then remove the `*` permission.

Example 3: Allow managers to get the general size of queues

In the following example, we create a group for managers and attach a policy that lets the group use the Amazon SQS `GetQueueAttributes` action with all of the queues that belong to the specified AWS account.

```
{
   "Version": "2012-10-17",
   "Statement": [{
      "Effect": "Allow",
      "Action": "sqs:GetQueueAttributes",
      "Resource": "*"
   }]
}
```

Example 4: Allow a partner to send messages to a specific queue

You can accomplish this task using an Amazon SQS policy or an IAM policy. If your partner has an AWS account, it might be easier to use an Amazon SQS policy. However, any user in the partner's company who possesses the AWS security credentials can send messages to the queue. If you want to limit access to a particular user or application, you must treat the partner like a user in your own company and use an IAM policy instead of an Amazon SQS policy.

This example performs the following actions:

1. Create a group called WidgetCo to represent the partner company.
2. Create a user for the specific user or application at the partner's company who needs access.
3. Add the user to the group.
4. Attach a policy that gives the group access only to the `SendMessage` action for only the queue named `WidgetPartnerQueue`.

```
{
   "Version": "2012-10-17",
   "Statement": [{
         "Effect": "Allow",
         "Action": "sqs:SendMessage",
         "Resource": "arn:aws:sqs:*:123456789012:WidgetPartnerQueue"
   }]
}
```

Basic examples of Amazon SQS policies

This section shows example policies for common Amazon SQS use cases.

You can use the console to verify the effects of each policy as you attach the policy to the user. Initially, the user doesn't have permissions and won't be able to do anything in the console. As you attach policies to the user, you can verify that the user can perform various actions in the console.

Note
We recommend that you use two browser windows: one to grant permissions and the other to sign into the AWS Management Console using the user's credentials to verify permissions as you grant them to the user.

Example 1: Grant one permission to one AWS account

The following example policy grants AWS account number `111122223333` the `SendMessage` permission for the queue named `444455556666/queue1` in the US East (Ohio) region.

```
{
   "Version": "2012-10-17",
   "Id": "Queue1_Policy_UUID",
   "Statement": [{
      "Sid":"Queue1_SendMessage",
      "Effect": "Allow",
      "Principal": {
         "AWS": [
            "111122223333"
         ]
      },
      "Action": "sqs:SendMessage",
      "Resource": "arn:aws:sqs:us-east-2:444455556666:queue1"
   }]
}
```

Example 2: Grant two permissions to one AWS account

The following example policy grants AWS account number `111122223333` both the `SendMessage` and `ReceiveMessage` permission for the queue named `444455556666/queue1`.

```
{
   "Version": "2012-10-17",
   "Id": "Queue1_Policy_UUID",
   "Statement": [{
      "Sid":"Queue1_Send_Receive",
      "Effect": "Allow",
      "Principal": {
         "AWS": [
            "111122223333"
         ]
      },
      "Action": [
         "sqs:SendMessage",
         "sqs:ReceiveMessage"
      ],
      "Resource": "arn:aws:sqs:*:444455556666:queue1"
   }]
}
```

Example 3: Grant all permissions to two AWS accounts

The following example policy grants two different AWS accounts numbers (`111122223333` and `444455556666`) permission to use all actions to which Amazon SQS allows shared access for the queue named `123456789012/queue1` in the US East (Ohio) region.

```
{
   "Version": "2012-10-17",
   "Id": "Queue1_Policy_UUID",
   "Statement": [{
      "Sid":"Queue1_AllActions",
      "Effect": "Allow",
      "Principal": {
         "AWS": [
            "111122223333",
            "444455556666"
         ]
      },
      "Action": "sqs:*",
      "Resource": "arn:aws:sqs:us-east-2:123456789012:queue1"
   }]
}
```

Example 4: Grant cross-account permissions to a role and a user name

The following example policy grants `role1` and `username1` under AWS account number `111122223333` cross-account permission to use all actions to which Amazon SQS allows shared access for the queue named `123456789012/queue1` in the US East (Ohio) region.

Cross-account permissions don't apply to the following actions:

- `AddPermission`
- `CreateQueue`
- `DeleteQueue`
- `ListQueues`
- `ListQueueTags`
- `RemovePermission`
- `SetQueueAttributes`
- `TagQueue`
- `UntagQueue`

```
{
   "Version": "2012-10-17",
   "Id": "Queue1_Policy_UUID",
   "Statement": [{
      "Sid":"Queue1_AllActions",
      "Effect": "Allow",
      "Principal": {
         "AWS": [
            "arn:aws:iam::111122223333:role/role1",
            "arn:aws:iam::111122223333:user/username1"
         ]
      },
      "Action": "sqs:*",
      "Resource": "arn:aws:sqs:us-east-2:123456789012:queue1"
   }]
}
```

Example 5: Grant a permission to all users

The following example policy grants all users (anonymous users) `ReceiveMessage` permission for the queue named `111122223333/queue1`.

```
{
   "Version": "2012-10-17",
   "Id": "Queue1_Policy_UUID",
   "Statement": [{
      "Sid":"Queue1_AnonymousAccess_ReceiveMessage",
      "Effect": "Allow",
      "Principal": "*",
      "Action": "sqs:ReceiveMessage",
      "Resource": "arn:aws:sqs:*:111122223333:queue1"
   }]
}
```

Example 6: Grant a time-limited permission to all users

The following example policy grants all users (anonymous users) `ReceiveMessage` permission for the queue named `111122223333/queue1`, but only between 12:00 p.m. (noon) and 3:00 p.m. on January 31, 2009.

```
{
   "Version": "2012-10-17",
   "Id": "Queue1_Policy_UUID",
   "Statement": [{
      "Sid":"Queue1_AnonymousAccess_ReceiveMessage_TimeLimit",
      "Effect": "Allow",
      "Principal": "*",
      "Action": "sqs:ReceiveMessage",
      "Resource": "arn:aws:sqs:*:111122223333:queue1",
      "Condition" : {
         "DateGreaterThan" : {
            "aws:CurrentTime":"2009-01-31T12:00Z"
         },
         "DateLessThan" : {
            "aws:CurrentTime":"2009-01-31T15:00Z"
         }
      }
   }]
}
```

Example 7: Grant all permissions to all users in a CIDR range

The following example policy grants all users (anonymous users) permission to use all possible Amazon SQS actions that can be shared for the queue named `111122223333/queue1`, but only if the request comes from the `192.168.143.0/24` CIDR range.

```
{
   "Version": "2012-10-17",
   "Id": "Queue1_Policy_UUID",
   "Statement": [{
      "Sid":"Queue1_AnonymousAccess_AllActions_AllowlistIP",
      "Effect": "Allow",
      "Principal": "*",
      "Action": "sqs:*",
      "Resource": "arn:aws:sqs:*:111122223333:queue1",
      "Condition" : {
         "IpAddress" : {
            "aws:SourceIp":"192.168.143.0/24"
         }
      }
   }]
}
```

Example 8: Allowlist and blocklist permissions for users in different CIDR ranges

The following example policy has two statements:

- The first statement grants all users (anonymous users) in the `192.168.143.0/24` CIDR range (except for `192.168.143.188`) permission to use the `SendMessage` action for the queue named `111122223333`/queue1.
- The second statement blocks all users (anonymous users) in the `10.1.2.0/24` CIDR range from using the queue.

```
{
   "Version": "2012-10-17",
   "Id": "Queue1_Policy_UUID",
   "Statement": [{
      "Sid":"Queue1_AnonymousAccess_SendMessage_IPLimit",
      "Effect": "Allow",
      "Principal": "*",
      "Action": "sqs:SendMessage",
      "Resource": "arn:aws:sqs:*:111122223333:queue1",
      "Condition" : {
         "IpAddress" : {
            "aws:SourceIp":"192.168.143.0/24"
         },
         "NotIpAddress" : {
            "aws:SourceIp":"192.168.143.188/32"
         }
      }
   }, {
      "Sid":"Queue1_AnonymousAccess_AllActions_IPLimit_Deny",
      "Effect": "Deny",
      "Principal": "*",
      "Action": "sqs:*",
      "Resource": "arn:aws:sqs:*:111122223333:queue1",
      "Condition" : {
         "IpAddress" : {
            "aws:SourceIp":"10.1.2.0/24"
         }
      }
   }]
}
```

Using custom policies with the Amazon SQS Access Policy Language

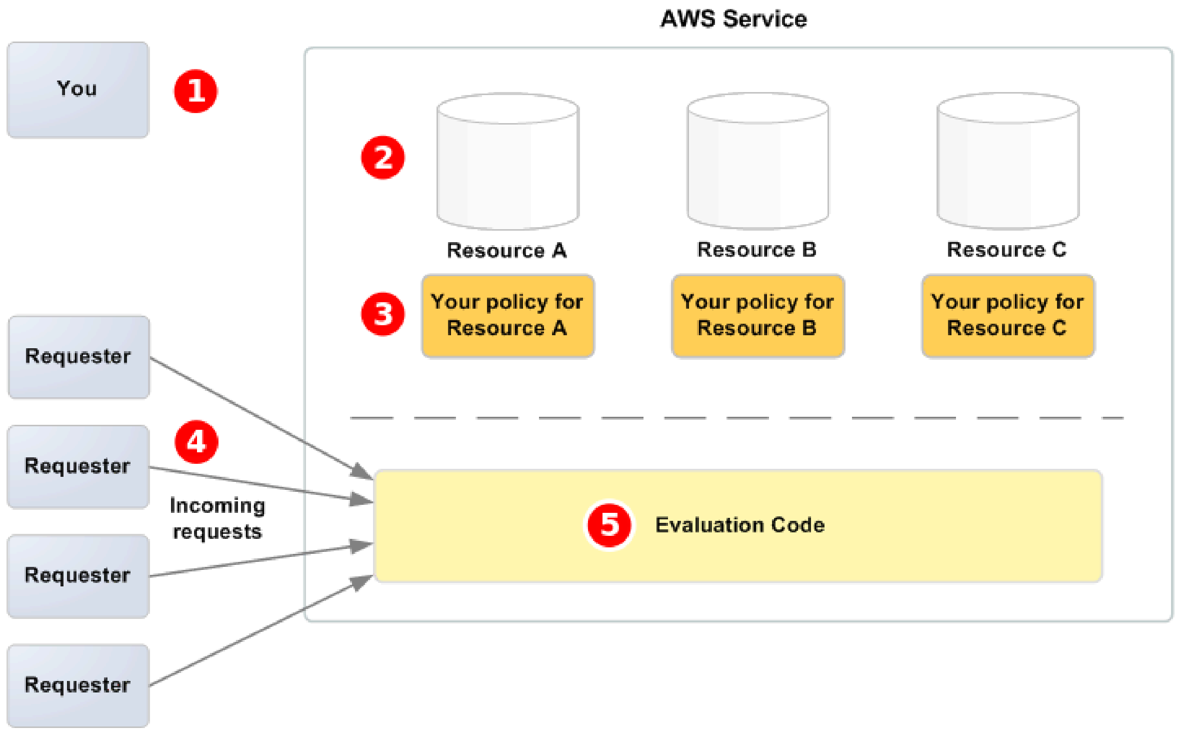
If you want to allow Amazon SQS access based only on an AWS account ID and basic permissions (such as for `SendMessage` or `ReceiveMessage`), you don't need to write your own policies. You can just use the Amazon SQS `AddPermission` action.

If you want to explicitly deny or allow access based on more specific conditions (such as the time the request comes in or the IP address of the requester), you need to write your own Amazon SQS policies and upload them to the AWS system using the Amazon SQS `SetQueueAttributes` action.

Topics

Amazon SQS access control architecture

The following diagram describes the access control for your Amazon SQS resources.



❶ You, the resource owner.

❷ Your resources contained within the AWS service (for example, Amazon SQS queues).

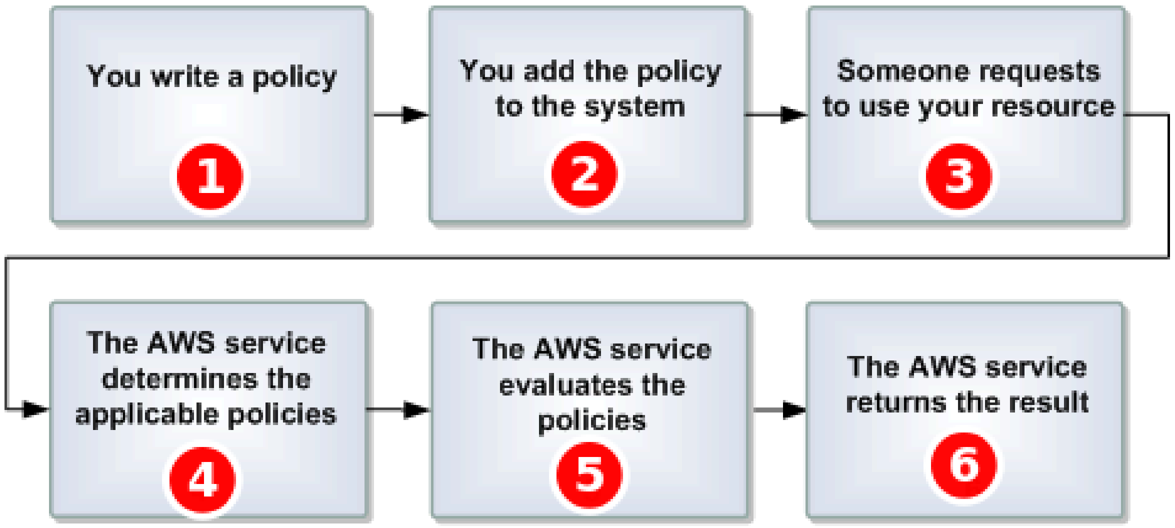
❸ Your policies. It is a good practice to have one policy per resource. The AWS service provides an API you use to upload and manage your policies.

❹ Requesters and their incoming requests to the AWS service.

❺ The access policy language evaluation code. This is the set of code within the AWS service that evaluates incoming requests against the applicable policies and determines whether the requester is allowed access to the resource.

Amazon SQS access control process workflow

The following diagram describes the general workflow of access control with the Amazon SQS access policy language.


You write a policy
1
You add the policy to the system
2
Someone requests to use your resource
3
The AWS service determines the applicable policies
4
The AWS service evaluates the policies
5
The AWS service returns the result
6

❶ You write an Amazon SQS policy for your queue.

❷ You upload your policy to AWS. The AWS service provides an API that you use to upload your policies. For example, you use the Amazon SQS `SetQueueAttributes` action to upload a policy for a particular Amazon SQS queue.

❸ Someone sends a request to use your Amazon SQS queue.

❹ Amazon SQS examines all available Amazon SQS policies and determines which ones are applicable.

❺ Amazon SQS evaluates the policies and determines whether the requester is allowed to use your queue.

❻ Based on the policy evaluation result, Amazon SQS either returns an `Access denied` error to the requester or continues to process the request.

Amazon SQS Access Policy Language key concepts

To write your own policies, you must be familiar with JSON and a number of key concepts.

Allow

The result of a **Statement** (p. 131) that has **Effect** (p. 130) set to `allow`.

Action

The activity that the **Principal** (p. 131) has permission to perform, typically a request to AWS.

Default-deny

The result of a **Statement** (p. 131) that has no **Allow** (p. 130) or **Explicit-deny** (p. 131) settings.

Condition

Any restriction or detail about a **Permission** (p. 131). Typical conditions are related to date and time and IP addresses.

Effect

The result that you want the **Statement** (p. 131) of a **Policy** (p. 131) to return at evaluation time. You specify the `deny` or `allow` value when you write the policy statement. There can be three possible results at policy evaluation time: **Default-deny** (p. 130), **Allow** (p. 130), and **Explicit-deny** (p. 131).

Explicit-deny

The result of a **Statement** (p. 131) that has **Effect** (p. 130) set to `deny`.

Evaluation

The process that Amazon SQS uses to determine whether an incoming request should be denied or allowed based on a **Policy** (p. 131).

Issuer

The user who writes a **Policy** (p. 131) to grant permissions to a resource. The issuer, by definition is always the resource owner. AWS doesn't permit Amazon SQS users to create policies for resources they don't own.

Key

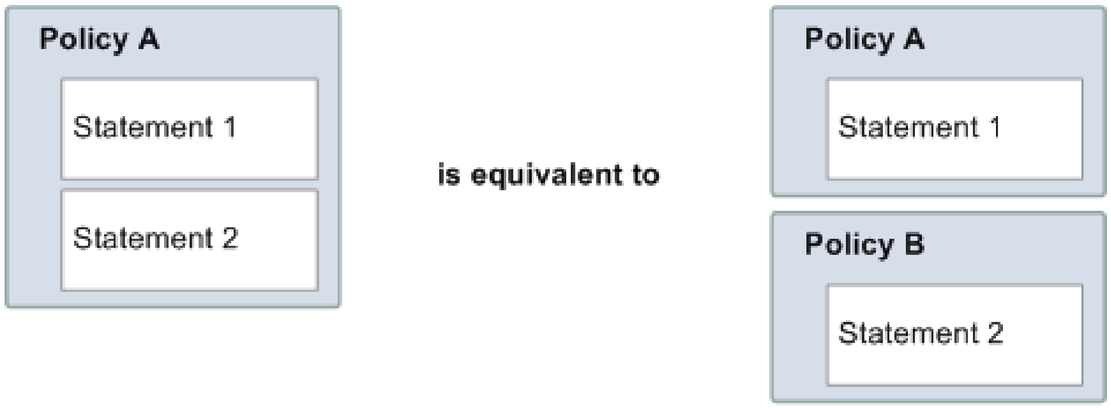
The specific characteristic that is the basis for access restriction.

Permission

The concept of allowing or disallowing access to a resource using a **Condition** (p. 130) and a **Key** (p. 131).

Policy

The document that acts as a container for one or more **statements (p. 131)**.



Amazon SQS uses the policy to determine whether to grant access to a user for a resource.

Principal

The user who receives **Permission** (p. 131) in the **Policy** (p. 131).

Resource

The object that the **Principal** (p. 131) requests access to.

Statement

The formal description of a single permission, written in the access policy language as part of a broader **Policy** (p. 131) document.

Requester

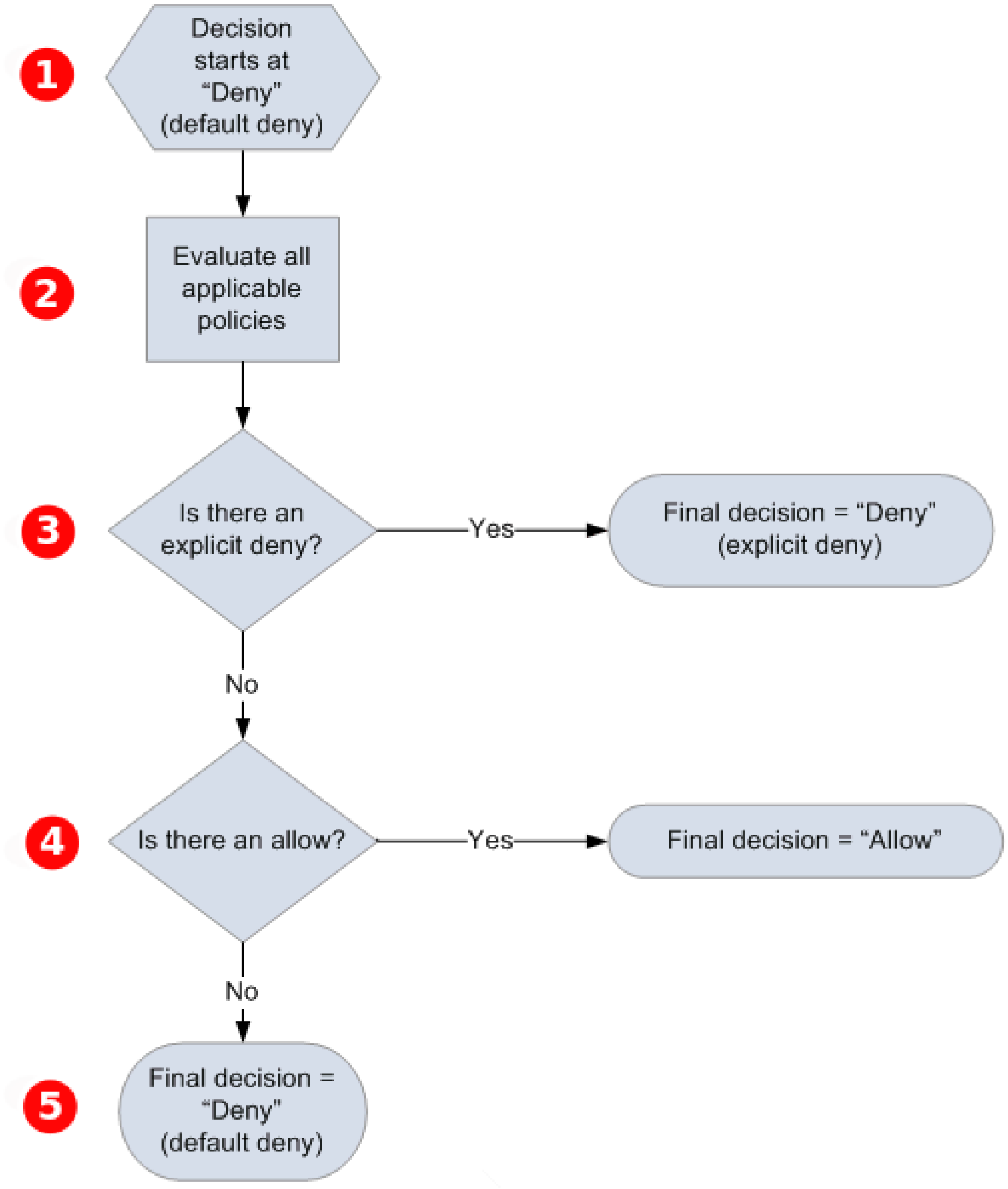
The user who sends a request for access to a **Resource** (p. 131).

Amazon SQS Access Policy Language evaluation logic

At evaluation time, Amazon SQS determines whether a request from someone other than the resource owner should be allowed or denied. The evaluation logic follows several basic rules:

- By default, all requests to use your resource coming from anyone but you are denied.
- An ***Allow*** *(p. 130)* overrides any ***Default-deny*** *(p. 130)*.
- An ***Explicit-deny*** *(p. 131)* overrides any **allow**.
- The order in which the policies are evaluated isn't important.

The following diagram describes in detail how Amazon SQS evaluates decisions about access permissions.


1
Decision starts at "Deny" (default deny)
2
Evaluate all applicable policies
3
Is there an explicit deny?
Yes
Final decision = "Deny" (explicit deny)
No
4
Is there an allow?
Yes
Final decision = "Allow"
No
5
Final decision = "Deny" (default deny)

❶ The decision starts with a **default-deny**.

❷ The enforcement code evaluates all the policies that are applicable to the request (based on the resource, principal, action, and conditions). The order in which the enforcement code evaluates the policies isn't important.

❸ The enforcement code looks for an **explicit-deny** instruction that can apply to the request. If it finds even one, the enforcement code returns a decision of **deny** and the process finishes.

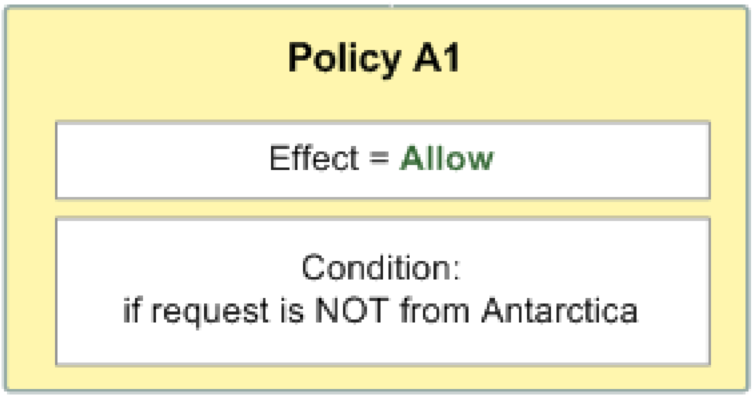
❹ If no **explicit-deny** instruction is found, the enforcement code looks for any **allow** instructions that can apply to the request. If it finds even one, the enforcement code returns a decision of **allow** and the process finishes (the service continues to process the request).

❺ If no **allow** instruction is found, then the final decision is **deny** (because there is no **explicit-deny** or **allow**, this is considered a **default-deny**).

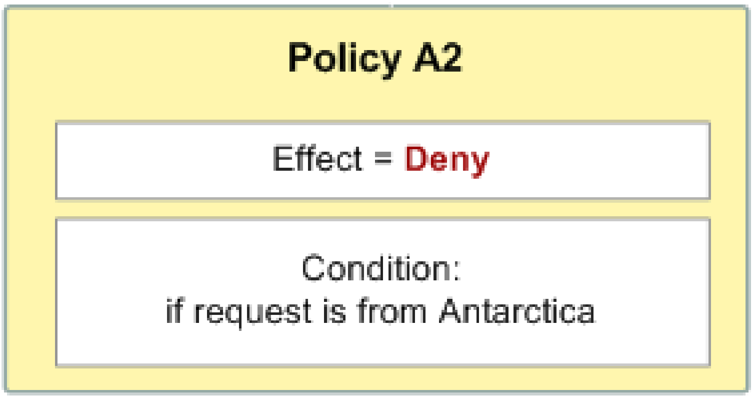
Relationships between explicit and default denials in the Amazon SQS Access Policy Language

If an Amazon SQS policy doesn't directly apply to a request, the request results in a ***Default-deny*** *(p. 130)*. For example, if a user requests permission to use Amazon SQS but the only policy that applies to the user can use DynamoDB, the requests results in a **default-deny**.

If a condition in a statement isn't met, the request results in a **default-deny**. If all conditions in a statement are met, the request results in either an ***Allow*** *(p. 130)* or an ***Explicit-deny*** *(p. 131)* based on the value of the ***Effect*** *(p. 130)* element of the policy. Policies don't specify what to do if a condition isn't met, so the default result in this case is a **default-deny**. For example, you want to prevent requests that come from Antarctica. You write Policy A1 that allows a request only if it doesn't come from Antarctica. The following diagram illustrates the Amazon SQS policy.

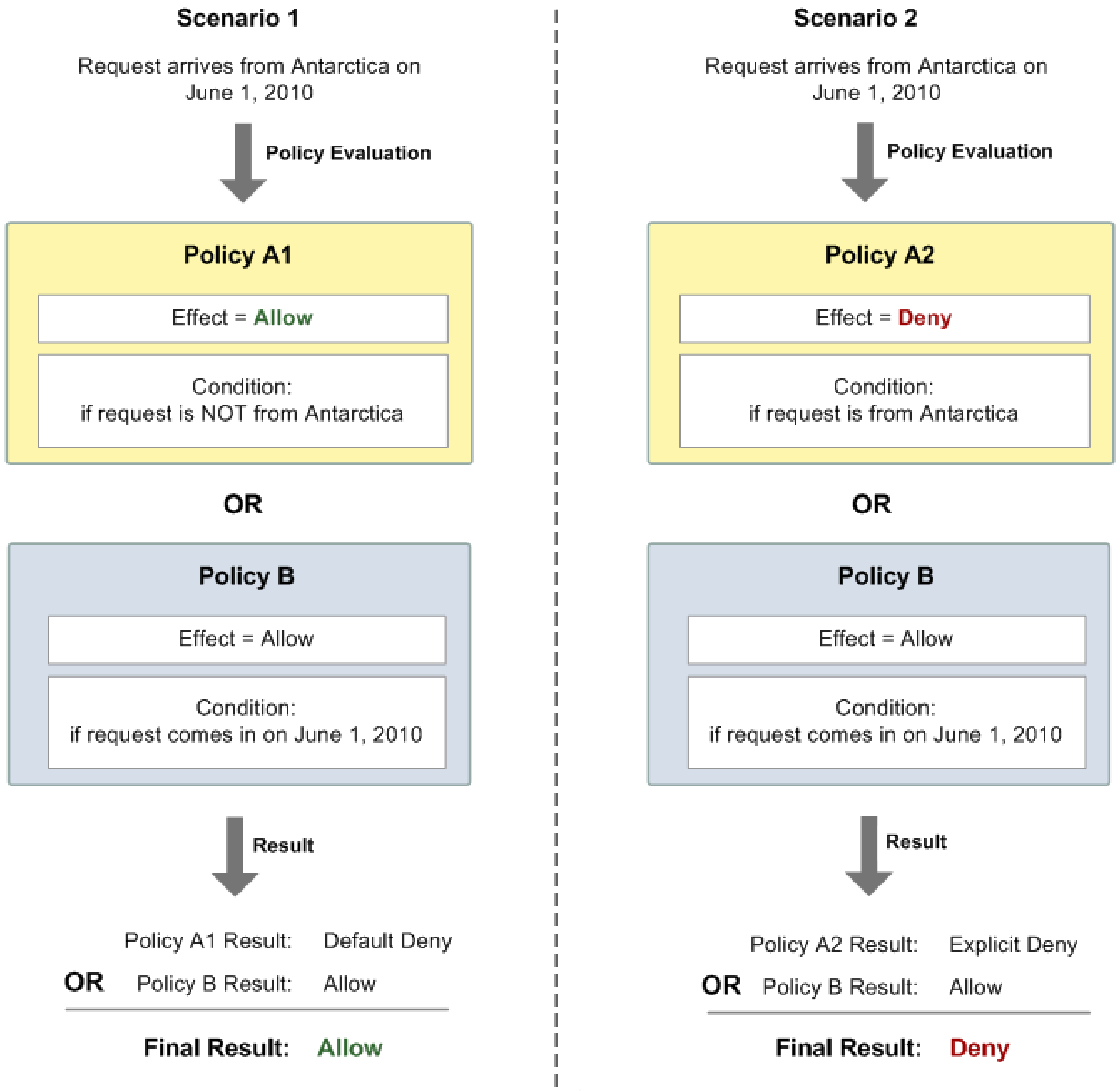


If a user sends a request from the U.S., the condition is met (the request isn't from Antarctica), and the request results in an **allow**. However, if a user sends a request from Antarctica, the condition isn't met and the request defaults to a **default-deny**. You can change the result to an **explicit-deny** by writing Policy A2 that explicitly denies a request if it comes from Antarctica. The following diagram illustrates the policy.



If a user sends a request from Antarctica, the condition is met and the request results in an **explicit-deny**.

The distinction between a **default-deny** and an **explicit-deny** is important because an **allow** can overwrite the former but not the latter. For example, Policy B allows requests if they arrive on June 1, 2010. The following diagram compares combining this policy with Policy A1 and Policy A2.


Scenario 1
Request arrives from Antarctica on June 1, 2010
Policy Evaluation
Policy A1
Effect = Allow
Condition: if request is NOT from Antarctica
OR
Policy B
Effect = Allow
Condition: if request comes in on June 1, 2010
Result
Policy A1 Result: Default Deny
OR Policy B Result: Allow
Final Result: Allow
Scenario 2
Request arrives from Antarctica on June 1, 2010
Policy Evaluation
Policy A2
Effect = Deny
Condition: if request is from Antarctica
OR
Policy B
Effect = Allow
Condition: if request comes in on June 1, 2010
Result
Policy A2 Result: Explicit Deny
OR Policy B Result: Allow
Final Result: Deny

In Scenario 1, Policy A1 results in a **default-deny** and Policy B results in an **allow** because the policy allows requests that come in on June 1, 2010. The **allow** from Policy B overrides the **default-deny** from Policy A1, and the request is allowed.

In Scenario 2, Policy B2 results in an **explicit-deny** and Policy B results in an **allow**. The **explicit-deny** from Policy A2 overrides the **allow** from Policy B, and the request is denied.

Custom Amazon SQS Access Policy Language examples

The following are examples of typical Amazon SQS access policies.

Example 1: Give permission to one account

The following example Amazon SQS policy gives AWS account 111122223333 permission to send to and receive from `queue2` owned by AWS account 444455556666.

```
{
   "Version": "2012-10-17",
   "Id": "UseCase1",
   "Statement" : [{
      "Sid": "1",
      "Effect": "Allow",
      "Principal": {
         "AWS": [
            "111122223333"
         ]
      },
      "Action": [
         "sqs:SendMessage",
         "sqs:ReceiveMessage"
      ],
      "Resource": "arn:aws:sqs:us-east-2:444455556666:queue2"
   }]
}
```

Example 2: Give permission to one or more accounts

The following example Amazon SQS policy gives one or more AWS accounts access to queues owned by your account for a specific time period. It is necessary to write this policy and to upload it to Amazon SQS using the `SetQueueAttributes` action because the `AddPermission` action doesn't permit specifying a time restriction when granting access to a queue.

```
{
   "Version": "2012-10-17",
   "Id": "UseCase2",
   "Statement" : [{
      "Sid": "1",
      "Effect": "Allow",
      "Principal": {
         "AWS": [
            "111122223333",
            "444455556666"
         ]
      },
      "Action": [
         "sqs:SendMessage",
         "sqs:ReceiveMessage"
      ],
      "Resource": "arn:aws:sqs:us-east-2:444455556666:queue2",
      "Condition": {
         "DateLessThan": {
            "AWS:CurrentTime": "2009-06-30T12:00Z"
         }
      }
   }]
}
```

Example 3: Give permission to requests from Amazon EC2 instances

The following example Amazon SQS policy gives access to requests that come from Amazon EC2 instances. This example builds on the "Example 2: Give permission to one or more accounts (p. 136)" example: it restricts access to before June 30, 2009 at 12 noon (UTC), it restricts access to the IP range `203.0.113.0/24`. It is necessary to write this policy and to upload it to Amazon SQS using the `SetQueueAttributes` action because the `AddPermission` action doesn't permit specifying an IP address restriction when granting access to a queue.

```
{
   "Version": "2012-10-17",
   "Id": "UseCase3",
   "Statement" : [{
      "Sid": "1",
      "Effect": "Allow",
      "Principal": {
         "AWS": [
            "111122223333"
         ]
      },
      "Action": [
         "sqs:SendMessage",
         "sqs:ReceiveMessage"
      ],
      "Resource": "arn:aws:sqs:us-east-2:444455556666:queue2",
      "Condition": {
         "DateLessThan": {
            "AWS:CurrentTime": "2009-06-30T12:00Z"
         },
         "IpAddress": {
            "AWS:SourceIp": "203.0.113.0/24"
         }
      }
   }]
}
```

Example 4: Deny access to a specific account

The following example Amazon SQS policy denies a specific AWS account access to your queue. This example builds on the "Example 1: Give permission to one account (p. 135)" example: it denies access to the specified AWS account. It is necessary to write this policy and to upload it to Amazon SQS using the `SetQueueAttributes` action because the `AddPermission` action doesn't permit deny access to a queue (it allows only granting access to a queue).

```
{
   "Version": "2012-10-17",
   "Id": "UseCase4",
   "Statement" : [{
      "Sid": "1",
      "Effect": "Deny",
      "Principal": {
         "AWS": [
            "111122223333"
         ]
      },
      "Action": [
         "sqs:SendMessage",
         "sqs:ReceiveMessage"
      ],
      "Resource": "arn:aws:sqs:us-east-2:444455556666:queue2"
   }]
}
```

Example 5: Deny access if it isn't from a VPC endpoint

The following example Amazon SQS policy restricts access to `queue1`: 111122223333 can perform the `SendMessage` and `ReceiveMessage` actions only from the VPC endpoint ID `vpce-1a2b3c4d` (specified using the `aws:sourceVpce` condition). For more information, see Amazon Virtual Private Cloud endpoints for Amazon SQS (p. 112).

Note

- The `aws:sourceVpce` condition doesn't require an ARN for the VPC endpoint resource, only the VPC endpoint ID.

- You can modify the following example to restrict all actions to a specific VPC endpoint by denying all Amazon SQS actions (`sqs:*`) in the second statement. However, such a policy statement would stipulate that all actions (including administrative actions needed to modify queue permissions) must be made through the specific VPC endpoint defined in the policy, potentially preventing the user from modifying queue permissions in the future.

```
{
   "Version": "2012-10-17",
   "Id": "UseCase5",
   "Statement": [{
      "Sid": "1",
      "Effect": "Allow",
      "Principal": {
         "AWS": [
            "111122223333"
         ]
      },
      "Action": [
         "sqs:SendMessage",
         "sqs:ReceiveMessage"
      ],
         "Resource": "arn:aws::sqs:us-east-2:111122223333:queue1"
      },
      {
         "Sid": "2",
         "Effect": "Deny",
         "Principal": "*",
         "Action": [
            "sqs:SendMessage",
            "sqs:ReceiveMessage"
         ],
         "Resource": "arn:aws::sqs:us-east-2:111122223333:queue1",
         "Condition": {
            "StringNotEquals": {
               "aws:sourceVpce": "vpce-1a2b3c4d"
            }
         }
      }
   ]
}
```

Using temporary security credentials with Amazon SQS

In addition to creating IAM users with their own security credentials, IAM also allows you to grant temporary security credentials to any user, allowing the user to access your AWS services and resources. You can manage users who have AWS accounts (IAM users). You can also manage users for your system who don't have AWS accounts (federated users). In addition, applications that you create to access your AWS resources can also be considered to be "users."

You can use these temporary security credentials to make requests to Amazon SQS. The API libraries compute the necessary signature value using those credentials to authenticate your request. If you send requests using expired credentials, Amazon SQS denies the request.

Note
You can't set a policy based on temporary credentials.

Prerequisites

1. Use IAM to create temporary security credentials:
   - Security token
   - Access Key ID
   - Secret Access Key
2. Prepare your string to sign with the temporary Access Key ID and the security token.
3. Use the temporary Secret Access Key instead of your own Secret Access Key to sign your Query API request.

Note
When you submit the signed Query API request, use the temporary Access Key ID instead of your own Access Key ID and to include the security token. For more information about IAM support for temporary security credentials, see Granting Temporary Access to Your AWS Resources in the *IAM User Guide*.

To call an Amazon SQS Query API action using temporary security credentials

1. Request a temporary security token using AWS Identity and Access Management. For more information, see Creating Temporary Security Credentials to Enable Access for IAM Users in the *IAM User Guide*.

   IAM returns a security token, an Access Key ID, and a Secret Access Key.
2. Prepare your query using the temporary Access Key ID instead of your own Access Key ID and include the security token. Sign your request using the temporary Secret Access Key instead of your own.
3. Submit your signed query string with the temporary Access Key ID and the security token.

   The following example demonstrates how to use temporary security credentials to authenticate an Amazon SQS request. The structure of *AUTHPARAMS* depends on the signature of the API request. For more information, see Signing AWS API Requests in the *Amazon Web Services General Reference*.

```
https://sqs.us-east-2.amazonaws.com/
?Action=CreateQueue
&DefaultVisibilityTimeout=40
&QueueName=MyQueue
&Attribute.1.Name=VisibilityTimeout
&Attribute.1.Value=40
&Expires=2020-12-18T22%3A52%3A43PST
&SecurityToken=wJalrXUtnFEMI/K7MDENG/bPxRfiCYEXAMPLEKEY
&AWSAccessKeyId=AKIAIOSFODNN7EXAMPLE
&Version=2012-11-05
&AUTHPARAMS
```

   The following example uses temporary security credentials to send two messages using the `SendMessageBatch` action.

```
https://sqs.us-east-2.amazonaws.com/
?Action=SendMessageBatch
&SendMessageBatchRequestEntry.1.Id=test_msg_001
&SendMessageBatchRequestEntry.1.MessageBody=test%20message%20body%201
&SendMessageBatchRequestEntry.2.Id=test_msg_002
&SendMessageBatchRequestEntry.2.MessageBody=test%20message%20body%202
&SendMessageBatchRequestEntry.2.DelaySeconds=60
```

```
&Expires=2020-12-18T22%3A52%3A43PST
&SecurityToken=je7MtGbClwBF/2Zp9Utk/h3yCo8nvbEXAMPLEKEY
&AWSAccessKeyId=AKIAI44QH8DHBEXAMPLE
&Version=2012-11-05
&AUTHPARAMS
```

Amazon SQS API permissions: Actions and resource reference

When you set up Access control (p. 115) and write permissions policies that you can attach to an IAM identity, you can use the following table as a reference. The list includes each Amazon Simple Queue Service action, the corresponding actions for which you can grant permissions to perform the action, and the AWS resource for which you can grant the permissions.

Specify the actions in the policy's `Action` field, and the resource value in the policy's `Resource` field. To specify an action, use the `sqs:` prefix followed by the action name (for example, `sqs:CreateQueue`).

Currently, Amazon SQS supports only a limited subset of the condition keys available in IAM:

- `aws:CurrentTime`
- `aws:EpochTime`
- `aws:SecureTransport`
- `aws:SourceAccount`
- `aws:SourceArn`

  Note
  This condition ensures that AWS services grant access only on behalf of resources that your AWS account owns. You can't specify the ARN of an IAM role as source ARN, because an IAM role is neither a source nor a service.
- `aws:SourceIP`
- `aws:UserAgent`
- `aws:MultiFactorAuthAge`
- `aws:MultiFactorAuthPresent`
- `aws:PrincipalOrgID`
- `aws:RequestTag`
- `aws:sourceVpce`
- `aws:TagKeys`
- `aws:TokenAge`

Amazon Simple Queue Service API and required permissions for actions

AddPermission

  Action(s): `sqs:AddPermission`

  Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

ChangeMessageVisibility

  Action(s): `sqs:ChangeMessageVisibility`

  Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

ChangeMessageVisibilityBatch

Action(s): `sqs:ChangeMessageVisibilityBatch`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

CreateQueue

Action(s): `sqs:CreateQueue`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

DeleteMessage

Action(s): `sqs:DeleteMessage`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

DeleteMessageBatch

Action(s): `sqs:DeleteMessageBatch`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

DeleteQueue

Action(s): `sqs:DeleteQueue`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

GetQueueAttributes

Action(s): `sqs:GetQueueAttributes`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

GetQueueUrl

Action(s): `sqs:GetQueueUrl`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

ListDeadLetterSourceQueues

Action(s): `sqs:ListDeadLetterSourceQueues`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

ListQueues

Action(s): `sqs:ListQueues`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

ListQueueTags

Action(s): `sqs:ListQueueTags`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

PurgeQueue

Action(s): `sqs:PurgeQueue`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

ReceiveMessage

Action(s): `sqs:ReceiveMessage`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

RemovePermission

Action(s): `sqs:RemovePermission`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

SendMessage and SendMessageBatch

Action(s): `sqs:SendMessage`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

SetQueueAttributes

Action(s): `sqs:SetQueueAttributes`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

TagQueue

Action(s): `sqs:TagQueue`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

UntagQueue

Action(s): `sqs:UntagQueue`

Resource: `arn:aws:sqs:`*`region`*`:`*`account_id`*`:`*`queue_name`*

Logging and monitoring in Amazon SQS

This section provides information about logging and monitoring Amazon SQS queues.

Topics

Logging Amazon SQS API calls using AWS CloudTrail

Amazon SQS is integrated with AWS CloudTrail, a service that provides a record of the Amazon SQS calls that a user, role, or AWS service makes. CloudTrail captures API calls related to Amazon SQS queues as events, including calls from the Amazon SQS console and code calls from Amazon SQS APIs. For more information about CloudTrail, see the *AWS CloudTrail User Guide*.

Note
CloudTrail logging is supported for both standard and FIFO queues.

Using the information that CloudTrail collects, you can identify a specific request to an Amazon SQS API, the IP address of the requester, the requester's identity, the date and time of the request, and so on. If you configure a *trail*, you can enable continuous delivery of CloudTrail events to an Amazon S3 bucket. If you don't configure a trail, you can view the most recent events in the event history in the CloudTrail console. For more information, see Overview for Creating a Trail in the *AWS CloudTrail User Guide*.

Amazon SQS information in CloudTrail

When you create your AWS account, CloudTrail is enabled. When a supported Amazon SQS event activity occurs, it is recorded in a CloudTrail event with other AWS service events in the event history. You can view, search, and download recent events for your AWS account. For more information, see Viewing Events with CloudTrail Event History in the *AWS CloudTrail User Guide*.

A trail allows CloudTrail to deliver log files to an Amazon S3 bucket. You can create a trail to keep an ongoing record of events in your AWS account. By default, when you create a trail using the AWS Management Console, the trail applies to all AWS Regions. The trail logs events from all AWS Regions and delivers log files to the specified Amazon S3 bucket. You can also configure other AWS services to further analyze and act on the event data collected in CloudTrail logs. For more information, see the following topics in the *AWS CloudTrail User Guide*:

- CloudTrail Supported Services and Integrations
- Configuring Amazon SNS Notifications for CloudTrail
- Receiving CloudTrail Log Files from Multiple Regions
- Receiving CloudTrail Log Files from Multiple Accounts

Amazon SQS supports logging the following actions:

- `AddPermission`
- `CreateQueue`
- `DeleteQueue`
- `PurgeQueue`
- `RemovePermission`
- `SetQueueAttributes`
- `TagQueue`
- `UntagQueue`

Every event or log entry contains information about the requester. This information helps you determine the following:

- Was the request made with root or IAM user credentials?
- Was the request made with temporary security credentials for a role or a federated user?
- Was the request made by another AWS service?

For more information, see CloudTrail userIdentity Element in the *AWS CloudTrail User Guide*.

Example Amazon SQS log file entries

CloudTrail log files contain one or more log entries where each entry is made up of multiple JSON-formatted events. A log entry represents a single request from any source and includes information about the requested action, any parameters, the date and time of the action, and so on. The log entries aren't guaranteed to be in any particular order. That is, they're not an ordered stack trace of the public API calls.

AddPermission

The following example shows a CloudTrail log entry for an `AddPermission` API call.

```
{
   "Records": [
    {
      "eventVersion": "1.06",
      "userIdentity": {
        "type": "IAMUser",
        "principalId": "AKIAI44QH8DHBEXAMPLE",
        "arn": "arn:aws:iam::123456789012:user/Alice",
        "accountId": "123456789012",
        "accessKeyId": "AKIAIOSFODNN7EXAMPLE",
        "userName": "Alice"
      },
      "eventTime": "2018-06-28T22:23:46Z",
      "eventSource": "sqs.amazonaws.com",
      "eventName": "AddPermission",
      "awsRegion": "us-east-2",
      "sourceIPAddress": "203.0.113.0",
      "userAgent": "Mozilla/5.0 (X11; Linux x86_64; rv:24.0) Gecko/20100101 Firefox/24.0",
      "requestParameters": {
        "actions": [
          "SendMessage"
        ],
        "AWSAccountIds": [
          "123456789012"
        ],
        "label": "MyLabel",
        "queueUrl": "https://sqs.us-east-2.amazon.com/123456789012/MyQueue"
      },
      "responseElements": null,
      "requestID": "123abcde-f4gh-50ij-klmn-60o789012p30",
      "eventID": "0987g654-32f1-09e8-d765-c4f3fb2109fa"
    }
  ]
}
```

CreateQueue

The following example shows a CloudTrail log entry for a `CreateQueue` API call.

```
{
   "Records": [
    {
      "eventVersion": "1.06",
      "userIdentity": {
        "type": "IAMUser",
        "principalId": "AKIAI44QH8DHBEXAMPLE",
        "arn": "arn:aws:iam::123456789012:user/Alejandro",
        "accountId": "123456789012",
        "accessKeyId": "AKIAIOSFODNN7EXAMPLE",
        "userName": "Alejandro"
      },
      "eventTime": "2018-06-28T22:23:46Z",
      "eventSource": "sqs.amazonaws.com",
      "eventName": "CreateQueue",
      "awsRegion": "us-east-2",
      "sourceIPAddress": "203.0.113.1",
      "userAgent": "Mozilla/5.0 (X11; Linux x86_64; rv:24.0) Gecko/20100101 Firefox/24.0",
      "requestParameters": {
        "queueName": "MyQueue"
      },
      "responseElements": {
        "queueUrl": "https://sqs.us-east-2.amazon.com/123456789012/MyQueue"
      },
      "requestID": "123abcde-f4gh-50ij-klmn-60o789012p30",
      "eventID": "0987g654-32f1-09e8-d765-c4f3fb2109fa"
    }
```

```
  ]
}
```

DeleteQueue

The following example shows a CloudTrail log entry for a `DeleteQueue` API call.

```
{
   "Records": [
     {
       "eventVersion": "1.06",
       "userIdentity": {
         "type": "IAMUser",
         "principalId": "AKIAI44QH8DHBEXAMPLE",
         "arn": "arn:aws:iam::123456789012:user/Carlos",
         "accountId": "123456789012",
         "accessKeyId": "AKIAIOSFODNN7EXAMPLE",
         "userName": "Carlos"
       },
       "eventTime": "2018-06-28T22:23:46Z",
       "eventSource": "sqs.amazonaws.com",
       "eventName": "DeleteQueue",
       "awsRegion": "us-east-2",
       "sourceIPAddress": "203.0.113.2",
       "userAgent": "Mozilla/5.0 (X11; Linux x86_64; rv:24.0) Gecko/20100101 Firefox/24.0",
       "requestParameters": {
         "queueUrl": "https://sqs.us-east-2.amazon.com/123456789012/MyQueue"
       },
       "responseElements": null,
       "requestID": "123abcde-f4gh-50ij-klmn-60o789012p30",
       "eventID": "0987g654-32f1-09e8-d765-c4f3fb2109fa"
     }
   ]
}
```

RemovePermission

The following example shows a CloudTrail log entry for a `RemovePermission` API call.

```
{
   "Records": [
     {
       "eventVersion": "1.06",
       "userIdentity": {
         "type": "IAMUser",
         "principalId": "AKIAI44QH8DHBEXAMPLE",
         "arn": "arn:aws:iam::123456789012:user/Jane",
         "accountId": "123456789012",
         "accessKeyId": "AKIAIOSFODNN7EXAMPLE",
         "userName": "Jane"
       },
       "eventTime": "2018-06-28T22:23:46Z",
       "eventSource": "sqs.amazonaws.com",
       "eventName": "RemovePermission",
       "awsRegion": "us-east-2",
       "sourceIPAddress": "203.0.113.3",
       "userAgent": "Mozilla/5.0 (X11; Linux x86_64; rv:24.0) Gecko/20100101 Firefox/24.0",
       "requestParameters": {
         "label": "label",
         "queueUrl": "https://sqs.us-east-2.amazon.com/123456789012/MyQueue"
       },
       "responseElements": null,
       "requestID": "123abcde-f4gh-50ij-klmn-60o789012p30",
       "eventID": "0987g654-32f1-09e8-d765-c4f3fb2109fa"
     }
   ]
 }
```

SetQueueAttributes

The following example shows a CloudTrail log entry for `SetQueueAttributes`:

```
{
   "Records": [
     {
        "eventVersion": "1.06",
        "userIdentity": {
          "type": "IAMUser",
          "principalId": "AKIAI44QH8DHBEXAMPLE",
          "arn": "arn:aws:iam::123456789012:user/Maria",
          "accountId": "123456789012",
          "accessKeyId": "AKIAIOSFODNN7EXAMPLE",
          "userName": "Maria"
        },
        "eventTime": "2018-06-28T22:23:46Z",
        "eventSource": "sqs.amazonaws.com",
        "eventName": "SetQueueAttributes",
        "awsRegion": "us-east-2",
        "sourceIPAddress": "203.0.113.4",
        "userAgent": "Mozilla/5.0 (X11; Linux x86_64; rv:24.0) Gecko/20100101 Firefox/24.0",
        "requestParameters": {
          "attributes": {
            "VisibilityTimeout": "100"
          },
          "queueUrl": "https://sqs.us-east-2.amazon.com/123456789012/MyQueue"
        },
        "responseElements": null,
        "requestID": "123abcde-f4gh-50ij-klmn-60o789012p30",
        "eventID": "0987g654-32f1-09e8-d765-c4f3fb2109fa"
      }
    ]
 }
```

Monitoring Amazon SQS queues using CloudWatch

Amazon SQS and Amazon CloudWatch are integrated so you can use CloudWatch to view and analyze metrics for your Amazon SQS queues. You can view and analyze your queues' metrics from the Amazon SQS console (p. 147), the CloudWatch console (p. 147), using the AWS CLI (p. 148), or using the CloudWatch API (p. 148). You can also set CloudWatch alarms (p. 149) for Amazon SQS metrics.

CloudWatch metrics for your Amazon SQS queues are automatically collected and pushed to CloudWatch at one-minute intervals. These metrics are gathered on all queues that meet the CloudWatch guidelines for being *active*. CloudWatch considers a queue to be active for up to six hours if it contains any messages or if any action accesses it.

Note

- There is no charge for the Amazon SQS metrics reported in CloudWatch. They're provided as part of the Amazon SQS service.
- CloudWatch metrics are supported for both standard and FIFO queues.

Topics

- Creating CloudWatch alarms for Amazon SQS metrics (p. 149)
- Available CloudWatch metrics for Amazon SQS (p. 149)

Accessing CloudWatch metrics for Amazon SQS

Amazon SQS and Amazon CloudWatch are integrated so you can use CloudWatch to view and analyze metrics for your Amazon SQS queues. You can view and analyze your queues' metrics from the Amazon SQS console (p. 147), the CloudWatch console (p. 147), using the AWS CLI (p. 148), or using the CloudWatch API (p. 148). You can also set CloudWatch alarms (p. 149) for Amazon SQS metrics.

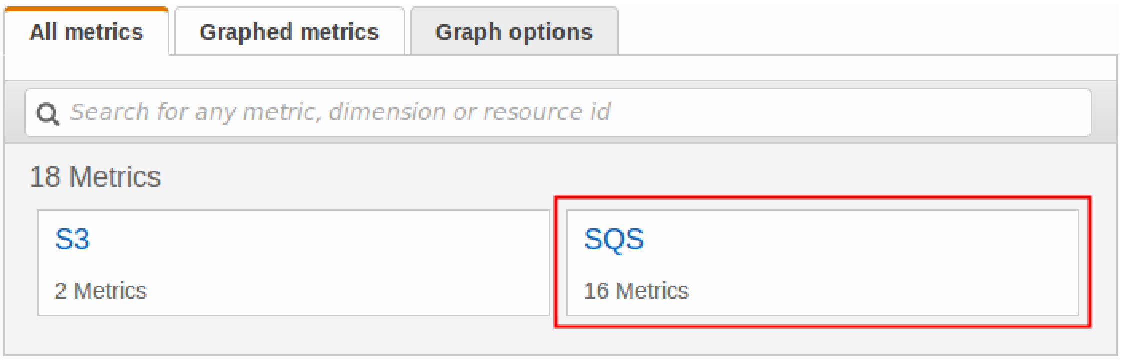
Amazon SQS console

1. Sign in to the Amazon SQS console.
2. In the list of queues, choose (check) the boxes for the queues that you want to access metrics for. You can show metrics for up to 10 queues.
3. Choose the **Monitoring** tab.

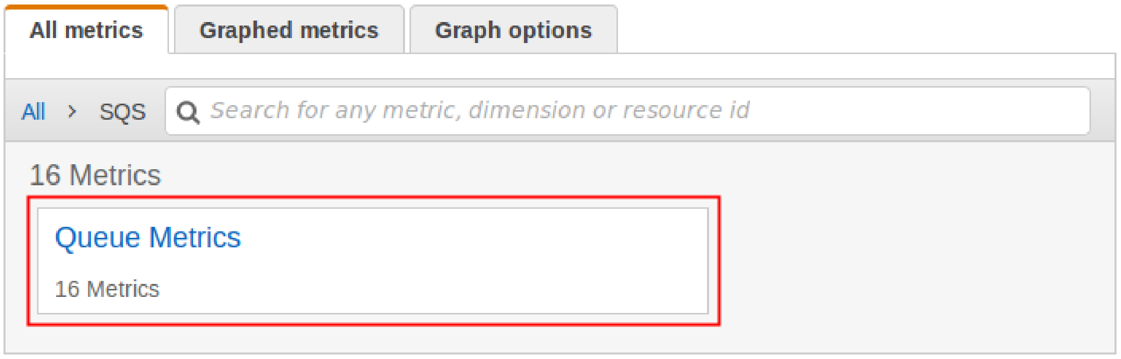
   Various graphs are displayed in the **SQS metrics** section.
4. To understand what a particular graph represents, hover over ℹ next to the desired graph, or see Available CloudWatch metrics for Amazon SQS (p. 149).
5. To change the time range for all of the graphs at the same time, for **Time Range**, choose the desired time range (for example, **Last Hour**).
6. To view additional statistics for an individual graph, choose the graph.
7. In the **CloudWatch Monitoring Details** dialog box, select a **Statistic**, (for example, **Sum**). For a list of supported statistics, see Available CloudWatch metrics for Amazon SQS (p. 149).
8. To change the time range and time interval that an individual graph displays (for example, to show a time range of the last 24 hours instead of the last 5 minutes, or to show a time period of every hour instead of every 5 minutes), with the graph's dialog box still displayed, for **Time Range**, choose the desired time range (for example, **Last 24 Hours**). For **Period**, choose the desired time period within the specified time range (for example, **1 Hour**). When you're finished looking at the graph, choose **Close**.
9. (Optional) To work with additional CloudWatch features, on the **Monitoring** tab, choose **View all CloudWatch metrics**, and then follow the instructions in the Amazon CloudWatch console (p. 147) procedure.

Amazon CloudWatch console

1. Sign in to the CloudWatch console.
2. On the navigation panel, choose **Metrics**.
3. Select the **SQS** metric namespace.

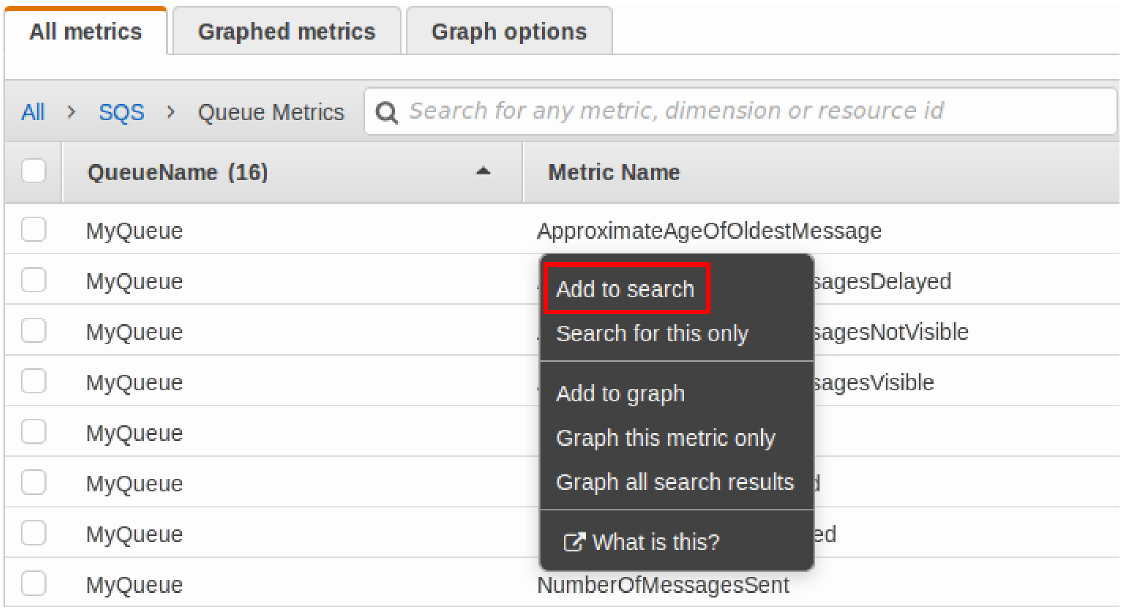


4. Select the **Queue Metrics** metric dimension.



5. You can now examine your Amazon SQS metrics:

   - To sort the metrics, use the column heading.
   - To graph a metric, select the check box next to the metric.
   - To filter by metric, choose the metric name and then choose **Add to search**.



QueueName (16)	Metric Name
MyQueue	ApproximateAgeOfOldestMessage
MyQueue	sagesDelayed
MyQueue	sagesNotVisible
MyQueue	sagesVisible
MyQueue	
MyQueue	l
MyQueue	ed
MyQueue	NumberOfMessagesSent

For more information and additional options, see Graph Metrics and Using Amazon CloudWatch Dashboards in the *Amazon CloudWatch User Guide*.

AWS Command Line Interface

To access Amazon SQS metrics using the AWS CLI, run the `get-metric-statistics` command.

For more information, see Get Statistics for a Metric in the *Amazon CloudWatch User Guide*.

CloudWatch API

To access Amazon SQS metrics using the CloudWatch API, use the `GetMetricStatistics` action.

For more information, see Get Statistics for a Metric in the *Amazon CloudWatch User Guide*.

Creating CloudWatch alarms for Amazon SQS metrics

CloudWatch lets you trigger alarms based on a metric threshold. For example, you can create an alarm for the `NumberOfMessagesSent` metric. For example, if more than 100 messages are sent to the `MyQueue` queue in 1 hour, an email notification is sent out. For more information, see Creating Amazon CloudWatch Alarms in the *Amazon CloudWatch User Guide*.

1. Sign in to the AWS Management Console and open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. Choose **Alarms**, and then choose **Create Alarm**.
3. In the **Select Metric** section of the **Create Alarm** dialog box, choose **Browse Metrics**, **SQS**.
4. For **SQS > Queue Metrics**, choose the **QueueName** and **Metric Name** for which to set an alarm, and then choose **Next**. For a list of available metrics, see Available CloudWatch metrics for Amazon SQS (p. 149).

   In the following example, the selection is for an alarm for the `NumberOfMessagesSent` metric for the `MyQueue` queue. The alarm triggers when the number of sent messages exceeds 100.
5. In the **Define Alarm** section of the **Create Alarm** dialog box, do the following:

   a. Under **Alarm Threshold**, type the **Name** and **Description** for the alarm.
   b. Set **is** to **> 100**.
   c. Set **for** to **1 out of 1 datapoints**.
   d. Under **Alarm preview**, set **Period** to **1 Hour**.
   e. Set **Statistic** to **Standard**, **Sum**.
   f. Under **Actions**, set **Whenever this alarm** to **State is ALARM**.

      If you want CloudWatch to send a notification when the alarm is triggered, select an existing Amazon SNS topic or choose **New list** and enter email addresses separated by commas.

      Note
      If you create a new Amazon SNS topic, the email addresses must be verified before they receive any notifications. If the alarm state changes before the email addresses are verified, the notifications aren't delivered.
6. Choose **Create Alarm**.

   The alarm is created.

Available CloudWatch metrics for Amazon SQS

Amazon SQS sends the following metrics to CloudWatch.

Note
For standard queues, the result is approximate because of the distributed architecture of Amazon SQS. In most cases, the count should be close to the actual number of messages in the queue.
For FIFO queues, the result is exact.

Amazon SQS metrics

The `AWS/SQS` namespace includes the following metrics.

Metric	Description
`ApproximateAgeOfOldestMessage`	The approximate age of the oldest non-deleted message in the queue.

Metric	Description
	Note • After a message is received three times (or more) and not processed, the message is moved to the back of the queue and the `ApproximateAgeOfOldestMessage` metric points at the second-oldest message that hasn't been received more than three times. This action occurs even if the queue has a redrive policy. • Because a single poison-pill message (received multiple times but never deleted) can distort this metric, the age of a poison-pill message isn't included in the metric until the poison-pill message is consumed successfully. • When the queue has a redrive policy, the message is moved to a dead-letter queue (p. 43) after the configured maximum number of receives. When the message is moved to the dead-letter queue, the `ApproximateAgeOfOldestMessage` metric of the dead-letter queue represents the time when the message was moved to the dead-letter queue (not the original time the message was sent). Reporting Criteria: A non-negative value is reported if the queue is active (p. 146). Units: Seconds Valid Statistics: Average, Minimum, Maximum, Sum, Data Samples (displays as Sample Count in the Amazon SQS console)

Metric	Description
`ApproximateNumberOfMessagesDelayed`	The number of messages in the queue that are delayed and not available for reading immediately. This can happen when the queue is configured as a delay queue or when a message has been sent with a delay parameter. Reporting Criteria: A non-negative value is reported if the queue is active (p. 146). Units: Count Valid Statistics: Average, Minimum, Maximum, Sum, Data Samples (displays as Sample Count in the Amazon SQS console)
`ApproximateNumberOfMessagesNotVisible`	The number of messages that are in flight. Messages are considered to be *in flight* if they have been sent to a client but have not yet been deleted or have not yet reached the end of their visibility window. Reporting Criteria: A non-negative value is reported if the queue is active (p. 146). Units: Count Valid Statistics: Average, Minimum, Maximum, Sum, Data Samples (displays as Sample Count in the Amazon SQS console)
`ApproximateNumberOfMessagesVisible`	The number of messages available for retrieval from the queue. Reporting Criteria: A non-negative value is reported if the queue is active (p. 146). Units: Count Valid Statistics: Average, Minimum, Maximum, Sum, Data Samples (displays as Sample Count in the Amazon SQS console)
`NumberOfEmptyReceives`[1]	The number of `ReceiveMessage` API calls that did not return a message. Reporting Criteria: A non-negative value is reported if the queue is active (p. 146). Units: Count Valid Statistics: Average, Minimum, Maximum, Sum, Data Samples (displays as Sample Count in the Amazon SQS console)

Metric	Description
`NumberOfMessagesDeleted`[1]	The number of messages deleted from the queue. Reporting Criteria: A non-negative value is reported if the queue is active (p. 146). Units: Count Valid Statistics: Average, Minimum, Maximum, Sum, Data Samples (displays as Sample Count in the Amazon SQS console) Amazon SQS emits the `NumberOfMessagesDeleted` metric for every successful deletion operation that uses a valid receipt handle, including duplicate deletions. The following scenarios might cause the value of the `NumberOfMessagesDeleted` metric to be higher than expected: • Calling the `DeleteMessage` action on different receipt handles that belong to the same message: If the message is not processed before the visibility timeout expires, the message becomes available to other consumers that can process it and delete it again, increasing the value of the `NumberOfMessagesDeleted` metric. • Calling the `DeleteMessage` action on the same receipt handle: If the message is processed and deleted but you call the `DeleteMessage` action again using the same receipt handle, a success status is returned, increasing the value of the `NumberOfMessagesDeleted` metric.
`NumberOfMessagesReceived`[1]	The number of messages returned by calls to the `ReceiveMessage` action. Reporting Criteria: A non-negative value is reported if the queue is active (p. 146). Units: Count Valid Statistics: Average, Minimum, Maximum, Sum, Data Samples (displays as Sample Count in the Amazon SQS console)

Metric	Description
`NumberOfMessagesSent`[1]	The number of messages added to a queue. Reporting Criteria: A non-negative value is reported if the queue is active (p. 146). Units: Count Valid Statistics: Average, Minimum, Maximum, Sum, Data Samples (displays as Sample Count in the Amazon SQS console)
`SentMessageSize`[1]	The size of messages added to a queue. Reporting Criteria: A non-negative value is reported if the queue is active (p. 146). Units: Bytes Valid Statistics: Average, Minimum, Maximum, Sum, Data Samples (displays as Sample Count in the Amazon SQS console) **Note** `SentMessageSize` does not display as an available metric in the CloudWatch console until at least one message is sent to the corresponding queue.

[1] These metrics are calculated from a service perspective, and can include retries. Don't rely on the absolute values of these metrics, or use them to estimate current queue status.

Dimensions for Amazon SQS metrics

The only dimension that Amazon SQS sends to CloudWatch is `QueueName`. This means that all available statistics are filtered by `QueueName`.

Compliance validation for Amazon SQS

Third-party auditors assess the security and compliance of Amazon SQS as part of multiple AWS compliance programs, including the following:

- Payment Card Industry Data Security Standard (PCI DSS)
- Health Insurance Portability and Accountability Act (HIPAA)

For a list of AWS services in scope of specific compliance programs, see AWS Services in Scope by Compliance Program. For general information, see AWS Compliance Programs.

You can download third-party audit reports using AWS Artifact. For more information, see Downloading Reports in AWS Artifact.

Your compliance responsibility when using Amazon SQS is determined by the sensitivity of your data, your company's compliance objectives, and applicable laws and regulations. AWS provides the following resources to help with compliance:

- Security and Compliance Quick Start Guides – These deployment guides discuss architectural considerations and provide steps for deploying security- and compliance-focused baseline environments on AWS.
- Architecting for HIPAA Security and Compliance Whitepaper – This whitepaper describes how companies can use AWS to create HIPAA-compliant applications.
- AWS Compliance Resources – This collection of workbooks and guides might apply to your industry and location.
- Evaluating Resources with Rules in the *AWS Config Developer Guide* – The AWS Config service assesses how well your resource configurations comply with internal practices, industry guidelines, and regulations.
- AWS Security Hub – This AWS service provides a comprehensive view of your security state within AWS that helps you check your compliance with security industry standards and best practices.

Resilience in Amazon SQS

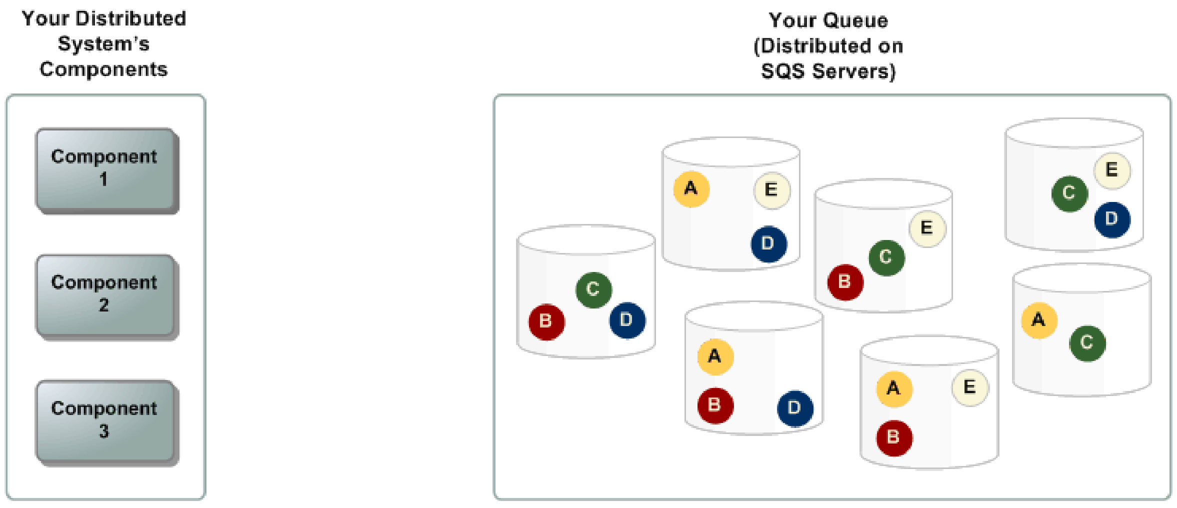
The AWS global infrastructure is built around AWS Regions and Availability Zones. AWS Regions provide multiple physically separated and isolated Availability Zones, which are connected with low-latency, high-throughput, and highly redundant networking. With Availability Zones, you can design and operate applications and databases that automatically fail over between zones without interruption. Availability Zones are more highly available, fault tolerant, and scalable than traditional single or multiple data center infrastructures. For more information about AWS Regions and Availability Zones, see AWS Global Infrastructure.

In addition to the AWS global infrastructure, Amazon SQS offers distributed queues.

Distributed queues

There are three main parts in a distributed messaging system: the components of your distributed system, your queue (distributed on Amazon SQS servers), and the messages in the queue.

In the following scenario, your system has several *producers* (components that send messages to the queue) and *consumers* (components that receive messages from the queue). The queue (which holds messages A through E) redundantly stores the messages across multiple Amazon SQS servers.


Your Distributed System's Components
Component 1
Component 2
Component 3
Your Queue (Distributed on SQS Servers)
A
B
C
D
E

Infrastructure security in Amazon SQS

As a managed service, Amazon SQS is protected by the AWS global network security procedures described in the Amazon Web Services: Overview of Security Processes whitepaper.

You use AWS published API actions to access Amazon SQS through the network. Clients must support Transport Layer Security (TLS) 1.0 or later. We recommend TLS 1.2 or later. Clients must also support cipher suites with Perfect Forward Secrecy (PFS), such as Ephemeral Diffie-Hellman (DHE) or Elliptic Curve Ephemeral Diffie-Hellman (ECDHE).

You must sign requests using an access key ID and a secret access key associated with an IAM principal. Alternatively, you can use the AWS Security Token Service (AWS STS) to generate temporary security credentials for signing requests.

You can call these API actions from any network location, but Amazon SQS supports resource-based access policies, which can include restrictions based on the source IP address. You can also use Amazon SQS policies to control access from specific Amazon VPC endpoints or specific VPCs. This effectively isolates network access to a given Amazon SQS queue from only the specific VPC within the AWS network. For more information, see Example 5: Deny access if it isn't from a VPC endpoint (p. 137).

Amazon SQS security best practices

AWS provides many security features for Amazon SQS, which you should review in the context of your own security policy.

Note
The specific implementation guidance provided is for common use cases and implementations. We suggest that you view these best practices in the context of your specific use case, architecture, and threat model.

Preventative best practices

The following are preventative security best practices for Amazon SQS.

Topics

Make sure that queues aren't publicly accessible

Unless you explicitly require anyone on the internet to be able to read or write to your Amazon SQS queue, you should make sure that your queue isn't publicly accessible (accessible by everyone in the world or by any authenticated AWS user).

- Avoid creating policies with `Principal` set to `""`.
- Avoid using a wildcard (`*`). Instead, name a specific user or users.

Implement least-privilege access

When you grant permissions, you decide who receives them, which queues the permissions are for, and specific API actions that you want to allow for these queues. Implementing least privilege is important to reducing security risks and reducing the effect of errors or malicious intent.

Follow the standard security advice of granting least privilege. That is, grant only the permissions required to perform a specific task. You can implement this using a combination of security policies.

Amazon SQS uses the producer-consumer model, requiring three types of user account access:

- **Administrators** – Access to creating, modifying, and deleting queues. Administrators also control queue policies.
- **Producers** – Access to sending messages to queues.
- **Consumers** – Access to receiving and deleting messages from queues.

For more information, see the following sections:

- Identity and access management in Amazon SQS (p. 113)
- Amazon SQS API permissions: Actions and resource reference (p. 140)
- Using custom policies with the Amazon SQS Access Policy Language (p. 128)

Use IAM roles for applications and AWS services which require Amazon SQS access

For applications or AWS services such as Amazon EC2 to access Amazon SQS queues, they must use valid AWS credentials in their AWS API requests. Because these credentials aren't rotated automatically, you shouldn't store AWS credentials directly in the application or EC2 instance.

You should use an IAM role to manage temporary credentials for applications or services that need to access Amazon SQS. When you use a role, you don't have to distribute long-term credentials (such as a user name, password, and access keys) to an EC2 instance or AWS service such as AWS Lambda. Instead, the role supplies temporary permissions that applications can use when they make calls to other AWS resources.

For more information, see IAM Roles and Common Scenarios for Roles: Users, Applications, and Services in the *IAM User Guide*.

Implement server-side encryption

To mitigate data leakage issues, use encryption at rest to encrypt your messages using a key stored in a different location from the location that stores your messages. Server-side encryption (SSE) provides data encryption at rest. Amazon SQS encrypts your data at the message level when it stores it, and decrypts the messages for you when you access them. SSE uses keys managed in AWS Key Management Service. As long as you authenticate your request and have access permissions, there is no difference between accessing encrypted and unencrypted queues.

For more information, see Encryption at rest (p. 106) and Key management (p. 108).

Enforce encryption of data in transit

Without HTTPS (TLS), a network-based attacker can eavesdrop on network traffic or manipulate it, using an attack such as man-in-the-middle. Allow only encrypted connections over HTTPS (TLS) using the `aws:SecureTransport` condition in the queue policy to force requests to use SSL.

Consider using VPC endpoints to access Amazon SQS

If you have queues that you must be able to interact with but which must absolutely not be exposed to the internet, use VPC endpoints to queue access to only the hosts within a particular VPC. You can use queue policies to control access to queues from specific Amazon VPC endpoints or from specific VPCs.

Amazon SQS VPC endpoints provide two ways to control access to your messages:

- You can control the requests, users, or groups that are allowed through a specific VPC endpoint.
- You can control which VPCs or VPC endpoints have access to your queue using a queue policy.

For more information, see Amazon Virtual Private Cloud endpoints for Amazon SQS (p. 112) and Creating an Amazon VPC endpoint policy for Amazon SQS (p. 113).

Working with Amazon SQS APIs

This section provides information about constructing Amazon SQS endpoints, making Query API requests using the `GET` and `POST` methods, and using batch API actions. For detailed information about Amazon SQS actions—including parameters, errors, examples, and data types—see the *Amazon Simple Queue Service API Reference*.

To access Amazon SQS using a variety of programming languages, you can also use AWS SDKs which contain the following automatic functionality:

- Cryptographically signing your service requests
- Retrying requests
- Handling error responses

For command-line tool information, see the Amazon SQS sections in the *AWS CLI Command Reference* and the *AWS Tools for PowerShell Cmdlet Reference*.

Topics

Making Query API requests

In this section you learn how to construct an Amazon SQS endpoint, make `GET` and `POST` requests and interpret responses.

Topics

Constructing an endpoint

In order to work with Amazon SQS queues, you must construct an endpoint. For information about Amazon SQS endpoints, see the following pages in the *Amazon Web Services General Reference*:

- Regional endpoints
- Amazon Simple Queue Service endpoints and quotas

Every Amazon SQS endpoint is independent. For example, if two queues are named `MyQueue` and one has the endpoint `sqs.us-east-2.amazonaws.com` while the other has the endpoint `sqs.eu-west-2.amazonaws.com`, the two queues don't share any data with each other.

The following is an example of an endpoint which makes a request to create a queue.

```
https://sqs.eu-west-2.amazonaws.com/
?Action=CreateQueue
&DefaultVisibilityTimeout=40
&QueueName=MyQueue
&Version=2012-11-05
&AUTHPARAMS
```

Note
Queue names and queue URLs are case-sensitive.
The structure of *AUTHPARAMS* depends on the signature of the API request. For more information, see Signing AWS API Requests in the *Amazon Web Services General Reference*.

Making a GET request

An Amazon SQS `GET` request is structured as a URL which consists of the following:

- **Endpoint** – The resource that the request is acting on (the queue name and URL (p. 35)), for example: `https://sqs.us-east-2.amazonaws.com/123456789012/MyQueue`
- **Action** – The action that you want to perform on the endpoint. A question mark (`?`) separates the endpoint from the action, for example: `?Action=SendMessage&MessageBody=Your%20Message%20Text`
- **Parameters** – Any request parameters—each parameter is separated by an ampersand (`&`), for example: `&Version=2012-11-05&AUTHPARAMS`

The following is an example of a `GET` request that sends a message to an Amazon SQS queue.

```
https://sqs.us-east-2.amazonaws.com/123456789012/MyQueue
?Action=SendMessage&MessageBody=Your%20message%20text
&Version=2012-11-05
&AUTHPARAMS
```

Note
Queue names and queue URLs are case-sensitive.
Because `GET` requests are URLs, you must URL-encode all parameter values. Because spaces aren't allowed in URLs, each space is URL-encoded as `%20`. (The rest of the example isn't URL-encoded to make it easier to read.)

Making a POST request

An Amazon SQS `POST` request sends query parameters as a form in the body of an HTTP request.

The following is an example of a HTTP header with `Content-Type` set to `application/x-www-form-urlencoded`.

```
POST /123456789012/MyQueue HTTP/1.1
Host: sqs.us-east-2.amazonaws.com
Content-Type: application/x-www-form-urlencoded
```

The header is followed by a `form-urlencoded` `POST` request that sends a message to an Amazon SQS queue. Each parameter is separated by an ampersand (`&`).

```
Action=SendMessage
```

```
&MessageBody=Your+Message+Text
&Expires=2020-10-15T12%3A00%3A00Z
&Version=2012-11-05
&AUTHPARAMS
```

Note
Only the `Content-Type` HTTP header is required. The *`AUTHPARAMS`* is the same as for the `GET` request.
Your HTTP client might add other items to the HTTP request, according to the client's HTTP version.

Authenticating requests

Authentication is the process of identifying and verifying the party that sends a request. During the first stage of authentication, AWS verifies the identity of the producer and whether the producer is registered to use AWS (for more information, see Step 1: Create an AWS account (p. 4) and Step 2: Create an IAM user (p. 4)). Next, AWS abides by the following procedure:

1. The producer (sender) obtains the necessary credential.
2. The producer sends a request and the credential to the consumer (receiver).
3. The consumer uses the credential to verify whether the producer sent the request.
4. One of the following happens:
   - If authentication succeeds, the consumer processes the request.
   - If authentication fails, the consumer rejects the request and returns an error.

Topics

Basic authentication process with HMAC-SHA

When you access Amazon SQS using the Query API, you must provide the following items to authenticate your request:

- The **AWS Access Key ID** that identifies your AWS account, which AWS uses to look up your Secret Access Key.
- The **HMAC-SHA request signature**, calculated using your Secret Access Key (a shared secret known only to you and AWS—for more information, see RFC2104). The AWS SDK handles the signing process; however, if you submit a query request over HTTP or HTTPS, you must include a signature in every query request.
  1. Derive a Signature Version 4 Signing Key. For more information, see Deriving the Signing Key with Java.

     Note
     Amazon SQS supports Signature Version 4, which provides improved SHA256-based security and performance over previous versions. When you create new applications that use Amazon SQS, use Signature Version 4.
  2. Base64-encode the request signature. The following sample Java code does this:

     ```
     package amazon.webservices.common;
     ```

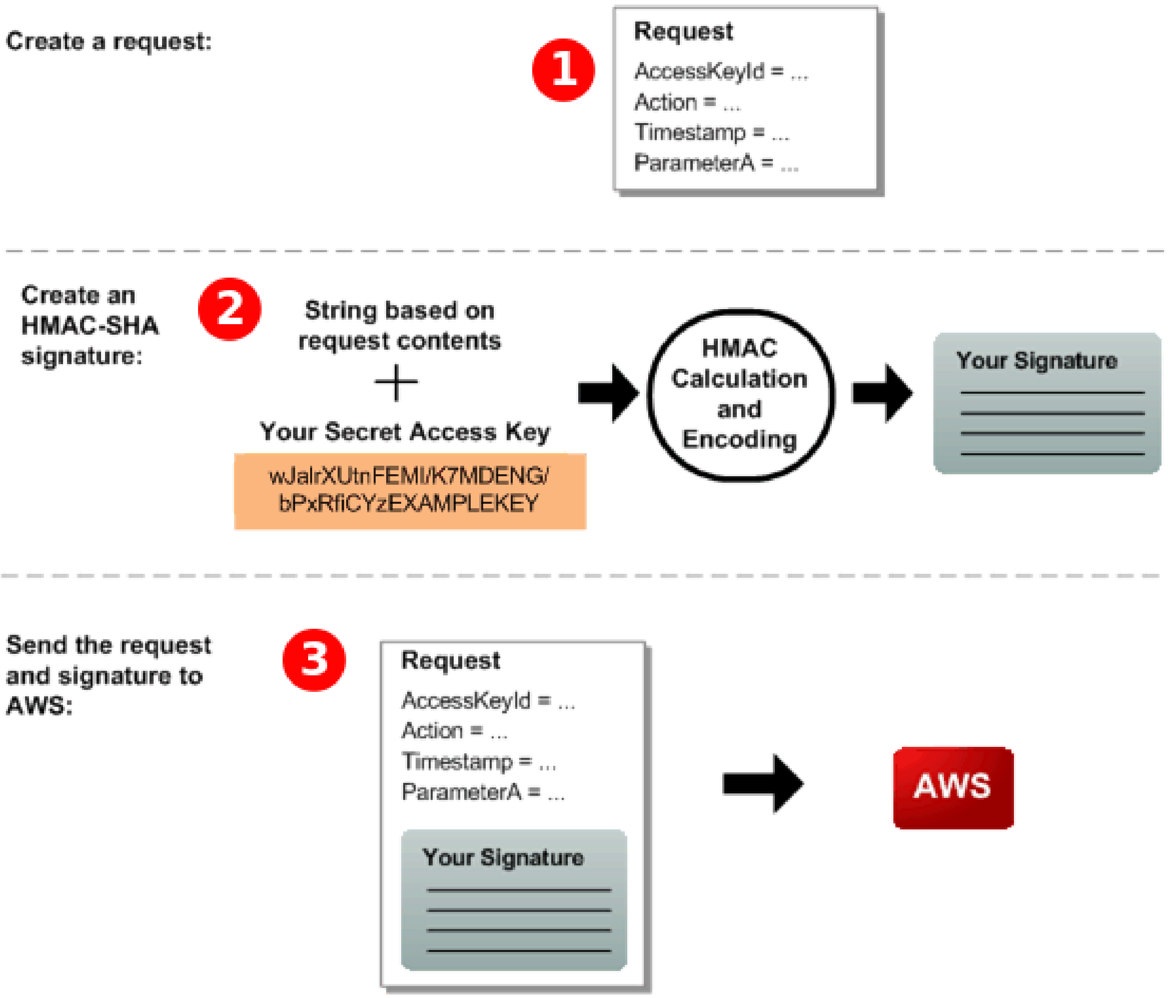
```
// Define common routines for encoding data in AWS requests.
public class Encoding {

    /* Perform base64 encoding of input bytes.
     * rawData is the array of bytes to be encoded.
     * return is the base64-encoded string representation of rawData.
     */
    public static String EncodeBase64(byte[] rawData) {
        return Base64.encodeBytes(rawData);
    }
}
```

- The **timestamp (or expiration)** of the request. The timestamp that you use in the request must be a `dateTime` object, with the complete date, including hours, minutes, and seconds. For example: `2007-01-31T23:59:59Z` Although this isn't required, we recommend providing the object using the Coordinated Universal Time (Greenwich Mean Time) time zone.

  Note
  Make sure that your server time is set correctly. If you specify a timestamp (rather than an expiration), the request automatically expires 15 minutes after the specified time (AWS doesn't process requests with timestamps more than 15 minutes earlier than the current time on AWS servers).
  If you use .NET, you must not send overly specific timestamps (because of different interpretations of how extra time precision should be dropped). In this case, you should manually construct `dateTime` objects with precision of no more than one millisecond.

Part 1: The request from the user

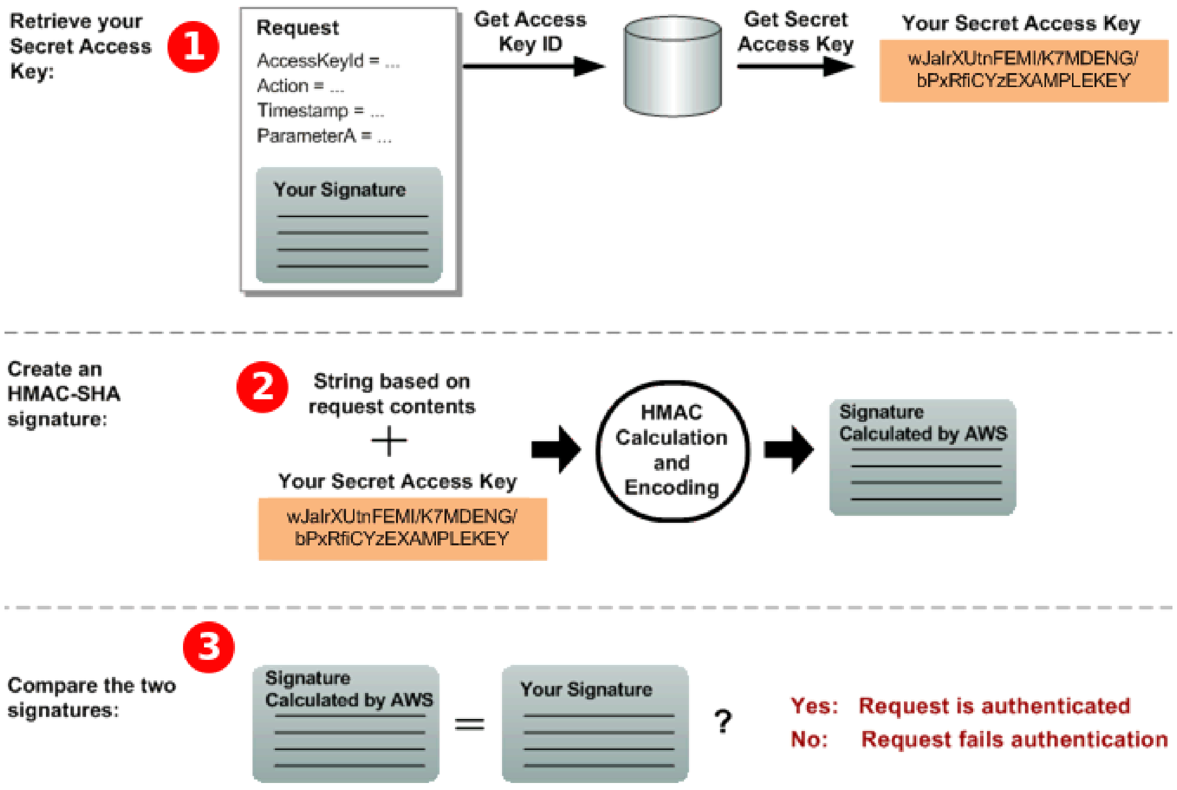
The following is the process you must follow to authenticate AWS requests using an HMAC-SHA request signature.



1. Construct a request to AWS.
2. Calculate a keyed-hash message authentication code (HMAC-SHA) signature using your Secret Access Key.
3. Include the signature and your Access Key ID in the request, and then send the request to AWS.

Part 2: The response from AWS

AWS begins the following process in response.


Retrieve your Secret Access Key:
1
Request
AccessKeyId = ...
Action = ...
Timestamp = ...
ParameterA = ...
Your Signature
Get Access Key ID
Get Secret Access Key
Your Secret Access Key
wJalrXUtnFEMI/K7MDENG/bPxRfiCYzEXAMPLEKEY
Create an HMAC-SHA signature:
2
String based on request contents
Your Secret Access Key
wJalrXUtnFEMI/K7MDENG/bPxRfiCYzEXAMPLEKEY
HMAC Calculation and Encoding
Signature Calculated by AWS
Compare the two signatures:
3
Signature Calculated by AWS
=
Your Signature
?
Yes: Request is authenticated
No: Request fails authentication

1. AWS uses the Access Key ID to look up your Secret Access Key.
2. AWS generates a signature from the request data and the Secret Access Key, using the same algorithm that you used to calculate the signature you sent in the request.
3. One of the following happens:
   - If the signature that AWS generates matches the one you send in the request, AWS considers the request to be authentic.
   - If the comparison fails, the request is discarded, and AWS returns an error.

Interpreting responses

In response to an action request, Amazon SQS returns an XML data structure that contains the results of the request. For more information, see the individual actions in the *Amazon Simple Queue Service API Reference*.

Topics

Successful response structure

If the request is successful, the main response element is named after the action, with `Response` appended (`ActionNameResponse`).

This element contains the following child elements:

- ***ActionName*Result** – Contains an action-specific element. For example, the `CreateQueueResult` element contains the `QueueUrl` element which, in turn, contains the URL of the created queue.
- **ResponseMetadata** – Contains the `RequestId` which, in turn, contains the UUID of the request.

The following is an example successful response in XML format:

```
<CreateQueueResponse
   xmlns=https://sqs.us-east-2.amazonaws.com/doc/2012-11-05/
   xmlns:xsi=http://www.w3.org/2001/XMLSchema-instance
   xsi:type=CreateQueueResponse>
   <CreateQueueResult>
      <QueueUrl>https://sqs.us-east-2.amazonaws.com/770098461991/queue2</QueueUrl>
   </CreateQueueResult>
   <ResponseMetadata>
      <RequestId>cb919c0a-9bce-4afe-9b48-9bdf2412bb67</RequestId>
   </ResponseMetadata>
</CreateQueueResponse>
```

Error response structure

If a request is unsuccessful, Amazon SQS always returns the main response element `ErrorResponse`. This element contains an `Error` element and a `RequestId` element.

The `Error` element contains the following child elements:

- **Type** – Specifies whether the error was a producer or consumer error.
- **Code** – Specifies the type of error.
- **Message** – Specifies the error condition in a readable format.
- **Detail** – (Optional) Specifies additional details about the error.

The `RequestId` element contains the UUID of the request.

The following is an example error response in XML format:

```
<ErrorResponse>
   <Error>
      <Type>Sender</Type>
      <Code>InvalidParameterValue</Code>
      <Message>
         Value (quename_nonalpha) for parameter QueueName is invalid.
         Must be an alphanumeric String of 1 to 80 in length.
      </Message>
   </Error>
   <RequestId>42d59b56-7407-4c4a-be0f-4c88daeea257</RequestId>
</ErrorResponse>
```

Amazon SQS batch actions

To reduce costs or manipulate up to 10 messages with a single action, you can use the following actions:

- `SendMessageBatch`
- `DeleteMessageBatch`
- `ChangeMessageVisibilityBatch`

You can take advantage of batch functionality using the Query API, or an AWS SDK that supports the Amazon SQS batch actions.

Note

The total size of all messages that you send in a single `SendMessageBatch` call can't exceed 262,144 bytes (256 KB).

You can't set permissions for `SendMessageBatch`, `DeleteMessageBatch`, or `ChangeMessageVisibilityBatch` explicitly. Setting permissions for `SendMessage`, `DeleteMessage`, or `ChangeMessageVisibility` sets permissions for the corresponding batch versions of the actions.

The Amazon SQS console doesn't support batch actions.

Topics

Enabling client-side buffering and request batching

The AWS SDK for Java includes `AmazonSQSBufferedAsyncClient` which accesses Amazon SQS. This client allows for simple request batching using client-side buffering—calls made from the client are first buffered and then sent as a batch request to Amazon SQS.

Client-side buffering allows up to 10 requests to be buffered and sent as a batch request, decreasing your cost of using Amazon SQS and reducing the number of sent requests. `AmazonSQSBufferedAsyncClient` buffers both synchronous and asynchronous calls. Batched requests and support for long polling (p. 41) can also help increase throughput. For more information, see Increasing throughput using horizontal scaling and action batching (p. 169).

Because `AmazonSQSBufferedAsyncClient` implements the same interface as `AmazonSQSAsyncClient`, migrating from `AmazonSQSAsyncClient` to `AmazonSQSBufferedAsyncClient` typically requires only minimal changes to your existing code.

Note

The Amazon SQS Buffered Asynchronous Client doesn't currently support FIFO queues.

Topics

Using AmazonSQSBufferedAsyncClient

Before you begin, complete the steps in Setting up Amazon SQS (p. 4).

Important

The AWS SDK for Java 2.x isn't currently compatible with the `AmazonSQSBufferedAsyncClient`.

You can create a new `AmazonSQSBufferedAsyncClient` based on `AmazonSQSAsyncClient`, for example:

```
// Create the basic Amazon SQS async client
final AmazonSQSAsync sqsAsync = new AmazonSQSAsyncClient();

// Create the buffered client
final AmazonSQSAsync bufferedSqs = new AmazonSQSBufferedAsyncClient(sqsAsync);
```

After you create the new `AmazonSQSBufferedAsyncClient`, you can use it to send multiple requests to Amazon SQS (just as you can with `AmazonSQSAsyncClient`), for example:

```
final CreateQueueRequest createRequest = new CreateQueueRequest().withQueueName("MyQueue");

final CreateQueueResult res = bufferedSqs.createQueue(createRequest);

final SendMessageRequest request = new SendMessageRequest();
final String body = "Your message text" + System.currentTimeMillis();
request.setMessageBody( body );
request.setQueueUrl(res.getQueueUrl());

final SendMessageResult sendResult = bufferedSqs.sendMessageAsync(request);

final ReceiveMessageRequest receiveRq = new ReceiveMessageRequest()
    .withMaxNumberOfMessages(1)
    .withQueueUrl(queueUrl);
final ReceiveMessageResult rx = bufferedSqs.receiveMessage(receiveRq);
```

Configuring AmazonSQSBufferedAsyncClient

`AmazonSQSBufferedAsyncClient` is preconfigured with settings that work for most use cases. You can further configure `AmazonSQSBufferedAsyncClient`, for example:

1. Create an instance of the `QueueBufferConfig` class with the required configuration parameters.
2. Provide the instance to the `AmazonSQSBufferedAsyncClient` constructor.

```
// Create the basic Amazon SQS async client
final AmazonSQSAsync sqsAsync = new AmazonSQSAsyncClient();

final QueueBufferConfig config = new QueueBufferConfig()
    .withMaxInflightReceiveBatches(5)
    .withMaxDoneReceiveBatches(15);

// Create the buffered client
final AmazonSQSAsync bufferedSqs = new AmazonSQSBufferedAsyncClient(sqsAsync, config);
```

QueueBufferConfig configuration parameters

Parameter	Default value	Description
`longPoll`	`true`	When `longPoll` is set to `true`, `AmazonSQSBufferedAsyncClient` attempts to use long polling when it consumes messages.
`longPollWaitTimeoutSeconds`	20 s	The maximum amount of time (in seconds) which a `ReceiveMessage` call blocks off on the server, waiting for messages to appear in the queue before returning with an empty receive result. **Note** When long polling is disabled, this setting has no effect.

Parameter	Default value	Description
`maxBatchOpenMs`	200 ms	The maximum amount of time (in milliseconds) that an outgoing call waits for other calls with which it batches messages of the same type. The higher the setting, the fewer batches are required to perform the same amount of work (however, the first call in a batch has to spend a longer time waiting). When you set this parameter to `0`, submitted requests don't wait for other requests, effectively disabling batching.
`maxBatchSize`	10 requests per batch	The maximum number of messages that are batched together in a single request. The higher the setting, the fewer batches are required to carry out the same number of requests. **Note** 10 requests per batch is the maximum allowed value for Amazon SQS.
`maxBatchSizeBytes`	256 KB	The maximum size of a message batch, in bytes, that the client attempts to send to Amazon SQS. **Note** 256 KB is the maximum allowed value for Amazon SQS.

Parameter	Default value	Description
`maxDoneReceiveBatches`	10 batches	The maximum number of receive batches that `AmazonSQSBufferedAsyncClient` prefetches and stores client-side. The higher the setting, the more receive requests can be satisfied without having to make a call to Amazon SQS (however, the more messages are prefetched, the longer they remain in the buffer, causing their own visibility timeout to expire). **Note** `0` indicates that all message prefetching is disabled and messages are consumed only on demand.
`maxInflightOutboundBatches`	5 batches	The maximum number of active outbound batches that can be processed at the same time. The higher the setting, the faster outbound batches can be sent (subject to quotas such as CPU or bandwidth) and the more threads are consumed by `AmazonSQSBufferedAsyncClient`.
`maxInflightReceiveBatches`	10 batches	The maximum number of active receive batches that can be processed at the same time. The higher the setting, the more messages can be received (subject to quotas such as CPU or bandwidth), and the more threads are consumed by `AmazonSQSBufferedAsyncClient`. **Note** `0` indicates that all message prefetching is disabled and messages are consumed only on demand.

Parameter	Default value	Description
`visibilityTimeoutSeconds`	-1	When this parameter is set to a positive, non-zero value, the visibility timeout set here overrides the visibility timeout set on the queue from which messages are consumed. **Note** `-1` indicates that the default setting is selected for the queue. You can't set visibility timeout to `0`.

Increasing throughput using horizontal scaling and action batching

Amazon SQS queues can deliver very high throughput. For information on throughput quotas, see Quotas related to messages (p. 100).

To achieve high throughput, you must scale message producers and consumers horizontally (add more producers and consumers).

Topics

Horizontal scaling

Because you access Amazon SQS through an HTTP request-response protocol, the *request latency* (the interval between initiating a request and receiving a response) limits the throughput that you can achieve from a single thread using a single connection. For example, if the latency from an Amazon EC2-based client to Amazon SQS in the same region averages 20 ms, the maximum throughput from a single thread over a single connection averages 50 TPS.

Horizontal scaling involves increasing the number of message producers (which make `SendMessage` requests) and consumers (which make `ReceiveMessage` and `DeleteMessage` requests) in order to increase your overall queue throughput. You can scale horizontally in three ways:

- Increase the number of threads per client
- Add more clients
- Increase the number of threads per client and add more clients

When you add more clients, you achieve essentially linear gains in queue throughput. For example, if you double the number of clients, you also double the throughput.

Note
As you scale horizontally, make sure that your Amazon SQS client has enough connections or threads to support the number of concurrent message producers and consumers that send requests and receive responses. For example, by default, instances of the AWS SDK for Java

`AmazonSQSClient` class maintain at most 50 connections to Amazon SQS. To create additional concurrent producers and consumers, you must adjust the maximum number of allowable producer and consumer threads on an `AmazonSQSClientBuilder` object, for example:

```
final AmazonSQS sqsClient = AmazonSQSClientBuilder.standard()
        .withClientConfiguration(new ClientConfiguration()
                .withMaxConnections(producerCount + consumerCount))
        .build();
```

For `AmazonSQSAsyncClient`, you also must make sure that enough threads are available.

Action batching

Batching performs more work during each round trip to the service (for example, when you send multiple messages with a single `SendMessageBatch` request). The Amazon SQS batch actions are `SendMessageBatch`, `DeleteMessageBatch`, and `ChangeMessageVisibilityBatch`. To take advantage of batching without changing your producers or consumers, you can use the Amazon SQS Buffered Asynchronous Client (p. 165).

Note
Because `ReceiveMessage` can process 10 messages at a time, there is no `ReceiveMessageBatch` action.

Batching distributes the latency of the batch action over the multiple messages in a batch request, rather than accept the entire latency for a single message (for example, a `SendMessage` request). Because each round trip carries more work, batch requests make more efficient use of threads and connections, improving throughput.

You can combine batching with horizontal scaling to provide throughput with fewer threads, connections, and requests than individual message requests. You can use batched Amazon SQS actions to send, receive, or delete up to 10 messages at a time. Because Amazon SQS charges by the request, batching can substantially reduce your costs.

Batching can introduce some complexity for your application (for example, you application must accumulate messages before sending them, or it sometimes must wait longer for a response). However, batching can be still effective in the following cases:

- Your application generates many messages in a short time, so the delay is never very long.
- A message consumer fetches messages from a queue at its discretion, unlike typical message producers that need to send messages in response to events they don't control.

Important
A batch request might succeed even though individual messages in the batch failed. After a batch request, always check for individual message failures and retry the action if necessary.

Working Java example for single-operation and batch requests

Prerequisites

Add the `aws-java-sdk-sqs.jar`, `aws-java-sdk-ec2.jar`, and `commons-logging.jar` packages to your Java build class path. The following example shows these dependencies in a Maven project `pom.xml` file.

```
<dependencies>
    <dependency>
        <groupId>com.amazonaws</groupId>
        <artifactId>aws-java-sdk-sqs</artifactId>
```

```
            <version>LATEST</version>
        </dependency>
        <dependency>
            <groupId>com.amazonaws</groupId>
            <artifactId>aws-java-sdk-ec2</artifactId>
            <version>LATEST</version>
        </dependency>
        <dependency>
            <groupId>commons-logging</groupId>
            <artifactId>commons-logging</artifactId>
            <version>LATEST</version>
        </dependency>
    </dependencies>
```

SimpleProducerConsumer.java

The following Java code example implements a simple producer-consumer pattern. The main thread spawns a number of producer and consumer threads that process 1 KB messages for a specified time. This example includes producers and consumers that make single-operation requests and those that make batch requests.

```
/*
 * Copyright 2010-2021 Amazon.com, Inc. or its affiliates. All Rights Reserved.
 *
 * Licensed under the Apache License, Version 2.0 (the "License").
 * You may not use this file except in compliance with the License.
 * A copy of the License is located at
 *
 *  https://aws.amazon.com/apache2.0
 *
 * or in the "license" file accompanying this file. This file is distributed
 * on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 * express or implied. See the License for the specific language governing
 * permissions and limitations under the License.
 *
 */

import com.amazonaws.AmazonClientException;
import com.amazonaws.ClientConfiguration;
import com.amazonaws.services.sqs.AmazonSQS;
import com.amazonaws.services.sqs.AmazonSQSClientBuilder;
import com.amazonaws.services.sqs.model.*;
import org.apache.commons.logging.Log;
import org.apache.commons.logging.LogFactory;

import java.math.BigInteger;
import java.util.ArrayList;
import java.util.List;
import java.util.Random;
import java.util.Scanner;
import java.util.concurrent.TimeUnit;
import java.util.concurrent.atomic.AtomicBoolean;
import java.util.concurrent.atomic.AtomicInteger;

/**
 * Start a specified number of producer and consumer threads, and produce-consume
 * for the least of the specified duration and 1 hour. Some messages can be left
 * in the queue because producers and consumers might not be in exact balance.
 */
public class SimpleProducerConsumer {

    // The maximum runtime of the program.
    private final static int MAX_RUNTIME_MINUTES = 60;
    private final static Log log = LogFactory.getLog(SimpleProducerConsumer.class);
    public static void main(String[] args) throws InterruptedException {

        final Scanner input = new Scanner(System.in);

        System.out.print("Enter the queue name: ");
        final String queueName = input.nextLine();

        System.out.print("Enter the number of producers: ");
        final int producerCount = input.nextInt();

        System.out.print("Enter the number of consumers: ");
        final int consumerCount = input.nextInt();

        System.out.print("Enter the number of messages per batch: ");
        final int batchSize = input.nextInt();

        System.out.print("Enter the message size in bytes: ");
        final int messageSizeByte = input.nextInt();

        System.out.print("Enter the run time in minutes: ");
        final int runTimeMinutes = input.nextInt();

        /*
         * Create a new instance of the builder with all defaults (credentials
         * and region) set automatically. For more information, see Creating
         * Service Clients in the AWS SDK for Java Developer Guide.
         */
        final ClientConfiguration clientConfiguration = new ClientConfiguration()
                .withMaxConnections(producerCount + consumerCount);

        final AmazonSQS sqsClient = AmazonSQSClientBuilder.standard()
                .withClientConfiguration(clientConfiguration)
                .build();

        final String queueUrl = sqsClient
                .getQueueUrl(new GetQueueUrlRequest(queueName)).getQueueUrl();

        // The flag used to stop producer, consumer, and monitor threads.
        final AtomicBoolean stop = new AtomicBoolean(false);

        // Start the producers.
        final AtomicInteger producedCount = new AtomicInteger();
        final Thread[] producers = new Thread[producerCount];
        for (int i = 0; i < producerCount; i++) {
            if (batchSize == 1) {
                producers[i] = new Producer(sqsClient, queueUrl, messageSizeByte,
                        producedCount, stop);
            } else {
                producers[i] = new BatchProducer(sqsClient, queueUrl, batchSize,
                        messageSizeByte, producedCount,
                        stop);
            }
            producers[i].start();
        }

        // Start the consumers.
        final AtomicInteger consumedCount = new AtomicInteger();
        final Thread[] consumers = new Thread[consumerCount];
        for (int i = 0; i < consumerCount; i++) {
            if (batchSize == 1) {
                consumers[i] = new Consumer(sqsClient, queueUrl, consumedCount,
                        stop);
            } else {
                consumers[i] = new BatchConsumer(sqsClient, queueUrl, batchSize,
                        consumedCount, stop);
            }
            consumers[i].start();
        }

        // Start the monitor thread.
        final Thread monitor = new Monitor(producedCount, consumedCount, stop);
        monitor.start();

        // Wait for the specified amount of time then stop.
        Thread.sleep(TimeUnit.MINUTES.toMillis(Math.min(runTimeMinutes,
                MAX_RUNTIME_MINUTES)));
        stop.set(true);

        // Join all threads.
        for (int i = 0; i < producerCount; i++) {
            producers[i].join();
        }

        for (int i = 0; i < consumerCount; i++) {
            consumers[i].join();
        }

        monitor.interrupt();
        monitor.join();
    }

    private static String makeRandomString(int sizeByte) {
        final byte[] bs = new byte[(int) Math.ceil(sizeByte * 5 / 8)];
        new Random().nextBytes(bs);
        bs[0] = (byte) ((bs[0] | 64) & 127);
        return new BigInteger(bs).toString(32);
    }

    /**
     * The producer thread uses {@code SendMessage}
     * to send messages until it is stopped.
     */
    private static class Producer extends Thread {
        final AmazonSQS sqsClient;
        final String queueUrl;
        final AtomicInteger producedCount;
        final AtomicBoolean stop;
        final String theMessage;

        Producer(AmazonSQS sqsQueueBuffer, String queueUrl, int messageSizeByte,
                 AtomicInteger producedCount, AtomicBoolean stop) {
            this.sqsClient = sqsQueueBuffer;
            this.queueUrl = queueUrl;
            this.producedCount = producedCount;
            this.stop = stop;
            this.theMessage = makeRandomString(messageSizeByte);
        }

        /*
         * The producedCount object tracks the number of messages produced by
         * all producer threads. If there is an error, the program exits the
         * run() method.
         */
        public void run() {
            try {
                while (!stop.get()) {
                    sqsClient.sendMessage(new SendMessageRequest(queueUrl,
                            theMessage));
                    producedCount.incrementAndGet();
                }
            } catch (AmazonClientException e) {
                /*
                 * By default, AmazonSQSClient retries calls 3 times before
                 * failing. If this unlikely condition occurs, stop.
                 */
                log.error("Producer: " + e.getMessage());
                System.exit(1);
            }
        }
    }

    /**
     * The producer thread uses {@code SendMessageBatch}
     * to send messages until it is stopped.
     */
    private static class BatchProducer extends Thread {
        final AmazonSQS sqsClient;
        final String queueUrl;
        final int batchSize;
        final AtomicInteger producedCount;
        final AtomicBoolean stop;
        final String theMessage;

        BatchProducer(AmazonSQS sqsQueueBuffer, String queueUrl, int batchSize,
                      int messageSizeByte, AtomicInteger producedCount,
                      AtomicBoolean stop) {
            this.sqsClient = sqsQueueBuffer;
            this.queueUrl = queueUrl;
            this.batchSize = batchSize;
            this.producedCount = producedCount;
            this.stop = stop;
            this.theMessage = makeRandomString(messageSizeByte);
        }

        public void run() {
            try {
                while (!stop.get()) {
                    final SendMessageBatchRequest batchRequest =
                            new SendMessageBatchRequest().withQueueUrl(queueUrl);

                    final List<SendMessageBatchRequestEntry> entries =
                            new ArrayList<SendMessageBatchRequestEntry>();
                    for (int i = 0; i < batchSize; i++)
                        entries.add(new SendMessageBatchRequestEntry()
                                .withId(Integer.toString(i))
                                .withMessageBody(theMessage));
                    batchRequest.setEntries(entries);

                    final SendMessageBatchResult batchResult =
                            sqsClient.sendMessageBatch(batchRequest);
                    producedCount.addAndGet(batchResult.getSuccessful().size());

                    /*
                     * Because SendMessageBatch can return successfully, but
                     * individual batch items fail, retry the failed batch items.
                     */
                    if (!batchResult.getFailed().isEmpty()) {
                        log.warn("Producer: retrying sending "
                                + batchResult.getFailed().size() + " messages");
                        for (int i = 0, n = batchResult.getFailed().size();
                             i < n; i++) {
                            sqsClient.sendMessage(new
                                    SendMessageRequest(queueUrl, theMessage));
                            producedCount.incrementAndGet();
                        }
                    }
                }
            } catch (AmazonClientException e) {
                /*
                 * By default, AmazonSQSClient retries calls 3 times before
                 * failing. If this unlikely condition occurs, stop.
                 */
                log.error("BatchProducer: " + e.getMessage());
                System.exit(1);
            }
        }
    }

    /**
     * The consumer thread uses {@code ReceiveMessage} and {@code DeleteMessage}
     * to consume messages until it is stopped.
     */
    private static class Consumer extends Thread {
        final AmazonSQS sqsClient;
        final String queueUrl;
        final AtomicInteger consumedCount;
        final AtomicBoolean stop;

        Consumer(AmazonSQS sqsClient, String queueUrl, AtomicInteger consumedCount,
                 AtomicBoolean stop) {
            this.sqsClient = sqsClient;
            this.queueUrl = queueUrl;
            this.consumedCount = consumedCount;
            this.stop = stop;
        }

        /*
         * Each consumer thread receives and deletes messages until the main
         * thread stops the consumer thread. The consumedCount object tracks the
         * number of messages that are consumed by all consumer threads, and the
         * count is logged periodically.
         */
        public void run() {
            try {
                while (!stop.get()) {
                    try {
                        final ReceiveMessageResult result = sqsClient
                                .receiveMessage(new
                                        ReceiveMessageRequest(queueUrl));

                        if (!result.getMessages().isEmpty()) {
                            final Message m = result.getMessages().get(0);
                            sqsClient.deleteMessage(new
                                    DeleteMessageRequest(queueUrl,
                                    m.getReceiptHandle()));
                            consumedCount.incrementAndGet();
                        }
                    } catch (AmazonClientException e) {
                        log.error(e.getMessage());
                    }
                }
            } catch (AmazonClientException e) {
                /*
                 * By default, AmazonSQSClient retries calls 3 times before
                 * failing. If this unlikely condition occurs, stop.
                 */
                log.error("Consumer: " + e.getMessage());
                System.exit(1);
            }
        }
    }

    /**
```

```
     * The consumer thread uses {@code ReceiveMessage} and {@code
     * DeleteMessageBatch} to consume messages until it is stopped.
     */
    private static class BatchConsumer extends Thread {
        final AmazonSQS sqsClient;
        final String queueUrl;
        final int batchSize;
        final AtomicInteger consumedCount;
        final AtomicBoolean stop;

        BatchConsumer(AmazonSQS sqsClient, String queueUrl, int batchSize,
                      AtomicInteger consumedCount, AtomicBoolean stop) {
            this.sqsClient = sqsClient;
            this.queueUrl = queueUrl;
            this.batchSize = batchSize;
            this.consumedCount = consumedCount;
            this.stop = stop;
        }

        public void run() {
            try {
                while (!stop.get()) {
                    final ReceiveMessageResult result = sqsClient
                            .receiveMessage(new ReceiveMessageRequest(queueUrl)
                                    .withMaxNumberOfMessages(batchSize));

                    if (!result.getMessages().isEmpty()) {
                        final List<Message> messages = result.getMessages();
                        final DeleteMessageBatchRequest batchRequest =
                                new DeleteMessageBatchRequest()
                                        .withQueueUrl(queueUrl);

                        final List<DeleteMessageBatchRequestEntry> entries =
                                new ArrayList<DeleteMessageBatchRequestEntry>();
                        for (int i = 0, n = messages.size(); i < n; i++)
                            entries.add(new DeleteMessageBatchRequestEntry()
                                    .withId(Integer.toString(i))
                                    .withReceiptHandle(messages.get(i)
                                            .getReceiptHandle()));
                        batchRequest.setEntries(entries);

                        final DeleteMessageBatchResult batchResult = sqsClient
                                .deleteMessageBatch(batchRequest);
                        consumedCount.addAndGet(batchResult.getSuccessful().size());

                        /*
                         * Because DeleteMessageBatch can return successfully,
                         * but individual batch items fail, retry the failed
                         * batch items.
                         */
                        if (!batchResult.getFailed().isEmpty()) {
                            final int n = batchResult.getFailed().size();
                            log.warn("Producer: retrying deleting " + n
                                    + " messages");
                            for (BatchResultErrorEntry e : batchResult
                                    .getFailed()) {

                                sqsClient.deleteMessage(
                                        new DeleteMessageRequest(queueUrl,
                                                messages.get(Integer
                                                        .parseInt(e.getId()))
                                                        .getReceiptHandle()));

                                consumedCount.incrementAndGet();
                            }
                        }
                    }
                }
            } catch (AmazonClientException e) {
                /*
                 * By default, AmazonSQSClient retries calls 3 times before
                 * failing. If this unlikely condition occurs, stop.
                 */
                log.error("BatchConsumer: " + e.getMessage());
                System.exit(1);
            }
        }
    }

    /**
     * This thread prints every second the number of messages produced and
     * consumed so far.
     */
    private static class Monitor extends Thread {
        private final AtomicInteger producedCount;
        private final AtomicInteger consumedCount;
        private final AtomicBoolean stop;

        Monitor(AtomicInteger producedCount, AtomicInteger consumedCount,
                AtomicBoolean stop) {
            this.producedCount = producedCount;
            this.consumedCount = consumedCount;
            this.stop = stop;
        }

        public void run() {
            try {
                while (!stop.get()) {
                    Thread.sleep(1000);
                    log.info("produced messages = " + producedCount.get()
                            + ", consumed messages = " + consumedCount.get());
                }
            } catch (InterruptedException e) {
                // Allow the thread to exit.
            }
        }
    }
}
```

Monitoring volume metrics from the example run

Amazon SQS automatically generates volume metrics for sent, received, and deleted messages. You can access those metrics and others through the **Monitoring** tab for your queue or on the CloudWatch console.

Note
The metrics can take up to 15 minutes after the queue starts to become available.

Related Amazon SQS resources

The following table lists related resources that you might find useful as you work with this service.

Resource	Description
Amazon Simple Queue Service API Reference	Descriptions of actions, parameters, and data types and a list of errors that the service returns.
Amazon SQS in the *AWS CLI Command Reference*	Descriptions of the AWS CLI commands that you can use to work with queues.
Regions and Endpoints	Information about Amazon SQS regions and endpoints
Product Page	The primary web page for information about Amazon SQS.
Discussion Forum	A community-based forum for developers to discuss technical questions related to Amazon SQS.
AWS Premium Support Information	The primary web page for information about AWS Premium Support, a one-on-one, fast-response support channel to help you build and run applications on AWS infrastructure services.

Documentation history

The following table describes the important changes to the *Amazon Simple Queue Service Developer Guide* since Jan 2019. For notifications about updates to this documentation, subscribe to the RSS feed.

update-history-change	update-history-description	update-history-date
High throughput for messages in FIFO queues is available	High throughput for Amazon SQS FIFO queues provides a higher number of transactions per second (TPS) for messages in FIFO queues. For information on throughput quotas, see Quotas related to messages.	May 27, 2021
High throughput for messages in FIFO queues is available in preview release	High throughput for Amazon SQS FIFO queues is in preview release and is subject to change. This feature provides a higher number of transactions per second (TPS) for messages in FIFO queues. For information on throughput quotas, see Quotas related to messages.	December 17, 2020
New Amazon SQS console design	To simplify development and production workflows, the Amazon SQS console has a new user experience.	July 8, 2020
Amazon SQS supports pagination for listQueues and listDeadLetterSourceQueues	You can specify the maximum number of results to return from a listQueues or listDeadLetterSourceQueues request.	June 22, 2020
Amazon SQS supports 1-minute Amazon CloudWatch metrics in all AWS Regions, except the AWS GovCloud (US) Regions	The one-minute CloudWatch metric for Amazon SQS is available in all Regions, except the AWS GovCloud (US) Regions.	January 9, 2020
Amazon SQS supports 1-minute CloudWatch metrics	The one-minute CloudWatch metric for Amazon SQS is currently available only in the following Regions: US East (Ohio), Europe (Ireland), Europe (Stockholm), and Asia Pacific (Tokyo).	November 25, 2019
AWS Lambda triggers for Amazon SQS FIFO queues are available	You can configure messages arriving in a FIFO queue as a Lambda function trigger.	November 25, 2019
Server-side encryption (SSE) for Amazon SQS is available in the China Regions	SSE for Amazon SQS is available in the China Regions.	November 13, 2019

FIFO queues are available in the Middle East (Bahrain) Region	FIFO queues are available in the Middle East (Bahrain) Region.	October 10, 2019
Amazon Virtual Private Cloud (Amazon VPC) endpoints for Amazon SQS are available in the AWS GovCloud (US-East) and AWS GovCloud (US-West) Regions	You can send messages to your Amazon SQS queues from Amazon VPC in the AWS GovCloud (US-East) and AWS GovCloud (US-West) Regions.	September 5, 2019
Amazon SQS allows troubleshooting of queues using AWS X-Ray using message system attributes	You can troubleshoot messages passing through Amazon SQS queues using X-Ray. This release adds the `MessageSystemAttribute` request parameter (which lets you send X-Ray trace headers through Amazon SQS) to the `SendMessage` and `SendMessageBatch` API operations, the `AWSTraceHeader` attribute to the `ReceiveMessage` API operation, and the `MessageSystemAttributeValue` data type.	August 28, 2019
You can tag Amazon SQS queues upon creation	You can use a single Amazon SQS API call, AWS SDK function, or AWS Command Line Interface (AWS CLI) command to simultaneously create a queue and specify its tags. In addition, Amazon SQS supports the `aws:TagKeys` and `aws:RequestTag` AWS Identity and Access Management (IAM) keys.	August 22, 2019
The temporary queue client for Amazon SQS is now available	Temporary queues help you save development time and deployment costs when using common message patterns such as *request-response*. You can use the Temporary Queue Client to create high-throughput, cost-effective, application-managed temporary queues.	July 25, 2019
SSE for Amazon SQS is available in the AWS GovCloud (US-East) Region	Server-side encryption (SSE) for Amazon SQS is available in the AWS GovCloud (US-East) Region.	June 20, 2019
FIFO queues are available in the Asia Pacific (Hong Kong), China (Beijing), AWS GovCloud (US-East), and AWS GovCloud (US-West) Regions	FIFO queues are available in the Asia Pacific (Hong Kong), China (Beijing), AWS GovCloud (US-East), and AWS GovCloud (US-West) Regions.	May 15, 2019

Amazon VPC endpoint policies are available for Amazon SQS	You can create Amazon VPC endpoint policies for Amazon SQS.	April 4, 2019
FIFO queues are available in the Europe (Stockholm) and China (Ningxia) Regions	FIFO queues are available in the Europe (Stockholm) and China (Ningxia) Regions.	March 14, 2019
FIFO queues are available in all Regions where Amazon SQS is available	FIFO queues are available in the US East (Ohio), US East (N. Virginia), US West (N. California), US West (Oregon), Asia Pacific (Mumbai), Asia Pacific (Seoul), Asia Pacific (Singapore), Asia Pacific (Sydney), Asia Pacific (Tokyo), Canada (Central), Europe (Frankfurt), Europe (Ireland), Europe (London), Europe (Paris), and South America (São Paulo) Regions.	February 7, 2019

AWS glossary

For the latest AWS terminology, see the AWS glossary in the *AWS General Reference*.