Developer Guide

AWS SDK for Swift

AWS SDK for Swift: Developer Guide

Table of Contents

AWS SDK for Swift Developer Guide

What is the Amazon SDK for Swift?

Welcome to the AWS SDK for Swift, a pure Swift SDK that makes it easier to develop tools that take advantage of AWS services, including Amazon S3, Amazon EC2, DynamoDB, and more, all using the Swift programming language.

Development using the SDK for Swift is currently supported on Mac and Linux systems, with Windows support coming soon. Supported targets include Apple platforms and Linux systems. Support for Windows targets is also coming soon.

Supported Apple target operating systems include:

- macOS
- iOS
- iPadOS
- watchOS *(Coming soon)*
- tvOS *(Coming soon)*

Prerelease documentation

This is prerelease documentation for an SDK in preview release. It may be incomplete and is subject to change.
In addition, versions of the SDK prior to version 1.0.0 may have flaws, and no guarantee is made about the API's stability. Changes can and will occur that break compatibility during the prerelease stage. **These releases are not intended for use in production code!**

Get started with the SDK

To get started with the SDK, follow the *Get started* tutorial.

To set up your development environment, see Setting up. Then you can test drive the SDK for Swift by creating your first project in Getting started with the AWS SDK for Swift.

For information on making requests to Amazon S3, DynamoDB, Amazon EC2, and other AWS services, see *Use the SDK*.

About this guide

The AWS SDK for Swift Developer Guide covers how to install, configure, and use the preview release of the AWS SDK for Swift to create applications and tools in Swift that make use of AWS services.

This guide contains the following sections:

Set up

Covers installing the Swift toolchain if you don't already have it installed and configuring your system for use with the SDK and to have access to your AWS account for development and testing purposes.

Get started

Explains how to create a project that imports the SDK for Swift using the Swift Package Manager in a shell environment on Linux and macOS, as well as how to add the SDK package to an Xcode project. Also included is a guide to building a project that uses Amazon Cognito Identity to do a few basic operations on identity pools.

Use the SDK

Guides covering typical usage scenarios including creating service clients, performing common tasks, and more.

Code examples

Code examples demonstrating how to use various features of the SDK for Swift, as well as how to achieve specific tasks using the SDK.

Security

Guides covering security topics in general, as well as considerations surrounding using the SDK for Swift in various contexts and while performing specific tasks.

Document history

History of this document and of the SDK.

Maintenance and support for SDK major versions

For information about maintenance and support for SDK major versions and their underlying dependencies, see the following in the AWS SDKs and Tools Reference Guide.

- AWS SDKs and Tools Maintenance Policy
- AWS SDKs and Tools Version Support Matrix

Additional resources

In addition to this guide, the following are valuable online resources for AWS SDK for Swift developers:

- AWS SDK for Swift Reference
- AWS SDK for Swift code examples
- AWS SDK for Swift on GitHub

Contributing to the SDK

Developers can also contribute feedback through the following channels:

- Report bugs in the AWS SDK for Swift

Set up the AWS SDK for Swift

The AWS SDK for Swift is a cross-platform, open source Swift package that lets applications and tools built using Swift make full use of the services offered by AWS. Using the SDK, you can build Swift applications that work with Amazon S3, Amazon EC2, DynamoDB, and more.

The SDK package is imported into your project using the Swift Package Manager (SPM), which is part of the standard Swift toolchain.

Topics

Prerelease documentation

This is prerelease documentation for an SDK in preview release. It may be incomplete and is subject to change.
In addition, versions of the SDK prior to version 1.0.0 may have flaws, and no guarantee is made about the API's stability. Changes can and will occur that break compatibility during the prerelease stage. **These releases are not intended for use in production code!**

When you've finished following the steps in this article, or have confirmed that everything is configured as described, you're ready to begin developing using the AWS SDK for Swift.

Overview

To make requests to AWS using the AWS SDK for Swift, you need the following:

- An active AWS account.
- A user in IAM Identity Center with permission to use the AWS services and resources your application will access.
- A development environment with version 5.7 or later of the Swift toolchain. If you don't have this, you'll install it as part of the steps below.

- Xcode users need version 14 or later of the Xcode application.

After finishing these steps, you’re ready to use the SDK to develop Swift projects that access AWS services.

Set up AWS access

Before installing the Swift tools, configure your environment to let your project access AWS services. This section covers creating and configuring your AWS account, preparing IAM Identity Center for use, and setting the environment variables used by the SDK for Swift to fetch your access credentials.

Sign up for an AWS account

If you do not have an AWS account, complete the following steps to create one.

To sign up for an AWS 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.

   When you sign up for an AWS account, an *AWS account root user* is created. The root user has access to all AWS services and resources in the account. As a security best practice, assign administrative access to a user, and use only the root user to perform tasks that require root user access.

AWS sends you a confirmation email after the sign-up process is complete. At any time, you can view your current account activity and manage your account by going to https://aws.amazon.com/ and choosing **My Account**.

Create a user with administrative access

After you sign up for an AWS account, secure your AWS account root user, enable AWS IAM Identity Center, and create an administrative user so that you don't use the root user for everyday tasks.

Secure your AWS account root user

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

   For help signing in by using root user, see Signing in as the root user in the *AWS Sign-In User Guide*.

2. Turn on multi-factor authentication (MFA) for your root user.

   For instructions, see Enable a virtual MFA device for your AWS account root user (console) in the *IAM User Guide*.

Create a user with administrative access

1. Enable IAM Identity Center.

   For instructions, see Enabling AWS IAM Identity Center in the *AWS IAM Identity Center User Guide*.

2. In IAM Identity Center, grant administrative access to a user.

   For a tutorial about using the IAM Identity Center directory as your identity source, see Configure user access with the default IAM Identity Center directory in the *AWS IAM Identity Center User Guide*.

Sign in as the user with administrative access

- To sign in with your IAM Identity Center user, use the sign-in URL that was sent to your email address when you created the IAM Identity Center user.

  For help signing in using an IAM Identity Center user, see Signing in to the AWS access portal in the *AWS Sign-In User Guide*.

Assign access to additional users

1. In IAM Identity Center, create a permission set that follows the best practice of applying least-privilege permissions.

   For instructions, see Create a permission set in the *AWS IAM Identity Center User Guide*.

2. Assign users to a group, and then assign single sign-on access to the group.

   For instructions, see Add groups in the *AWS IAM Identity Center User Guide*.

Grant programmatic AWS account access

Users need programmatic access if they want to interact with AWS outside of the AWS Management Console. The way to grant programmatic access depends on the type of user that's accessing AWS.

To grant users programmatic access, choose one of the following options.

Which user needs programmatic access?	**To**	**By**
Workforce identity (Users managed in IAM Identity Center)	Use temporary credentials to sign programmatic requests to the AWS CLI, AWS SDKs, or AWS APIs.	Following the instructions for the interface that you want to use. • For the AWS CLI, see Configuring the AWS CLI to use AWS IAM Identity Center in the *AWS Command Line Interface User Guide*. • For AWS SDKs, tools, and AWS APIs, see IAM Identity Center authentication in the *AWS SDKs and Tools Reference Guide*.
IAM	Use temporary credentials to sign programmatic requests to the AWS CLI, AWS SDKs, or AWS APIs.	Following the instructions in Using temporary credentials with AWS resources in the *IAM User Guide*.

Which user needs programmatic access?	To	By
IAM	(Not recommended) Use long-term credentials to sign programmatic requests to the AWS CLI, AWS SDKs, or AWS APIs.	Following the instructions for the interface that you want to use. • For the AWS CLI, see Authenticating using IAM user credentials in the *AWS Command Line Interface User Guide*. • For AWS SDKs and tools, see Authenticate using long-term credentials in the *AWS SDKs and Tools Reference Guide*. • For AWS APIs, see Managing access keys for IAM users in the *IAM User Guide*.

For more advanced cases regarding configuring the credentials and Region, see The .aws/credentials and .aws/config files, AWS Region, and Using environment variables in the AWS SDKs and Tools Reference Guide.

Note

If you plan to develop a macOS desktop application, keep in mind that due to sandbox restrictions, the SDK is unable to access your `~/.aws/config` and `~/.aws/credentials` files, as there is no entitlement available to grant access to the `~/.aws` directory. See the section called "Security and authentication when testing on macOS" for details.

Set up your Swift development environment

The SDK for Swift requires at least version 5.7 of Swift. This can be installed either standalone or as part of the Xcode development environment on macOS.

- Swift 5.7 toolchain or later.
- If you're developing on macOS using Xcode, you need a minimum of Xcode 14.
- An AWS account. If you don’t have one already, you can create one using the AWS portal.

Prepare to install Swift

The Swift install process for Linux doesn't automatically install `libcrypto` version 1.1, even though it's required by the compiler. To install it, be sure to install OpenSSL 1.1 or later, as well as its development package. Using the `yum` package manager, for example:

```
$ sudo yum install openssl openssl-devel
```

Using the `apt` package manager:

```
$ sudo apt install openssl libssl-dev
```

This isn't necessary on macOS.

Install Swift

On macOS, the easiest way to install Swift is to simply install Apple’s Xcode IDE, which includes Swift and all the standard libraries and tools that go with it. This can be found on the macOS App Store.

If you’re using Linux or Windows, or don’t want to install Xcode on macOS, the Swift organization’s web site has detailed instructions to install and set up the Swift toolchain.

Check the Swift tools version number

If Swift is already installed, you can verify the version number using the command `swift --version`. The output will look similar to one of the following examples.

Checking the Swift version on macOS

```
$ swift --version
swift-driver version: 1.87.1 Apple Swift version 5.9 (swiftlang-5.9.0.128.108
 clang-1500.0.40.1)
Target: x86_64-apple-macosx14.0
```

Checking the Swift version on Linux

```
$ swift --version
Swift version 5.8.1 (swift-5.8.1-RELEASE)
Target: x86_64-unknown-linux-gnu
```

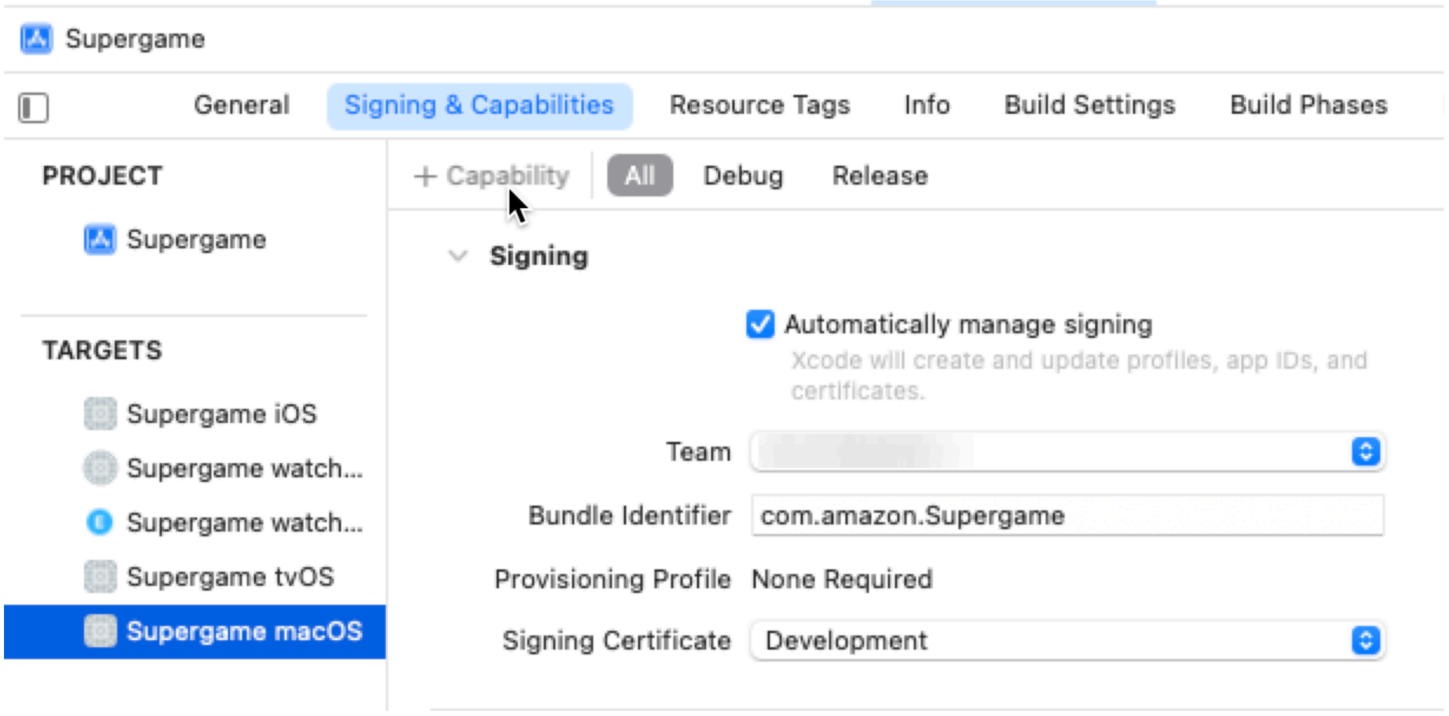
For more information about the configuration and credentials files shared among the AWS Command Line Interface and the various AWS SDKs, see the AWS SDKs and Tools Reference Guide.

Security and authentication when testing on macOS

Configuring the App Sandbox

If your SDK for Swift project is a desktop application that you're building in Xcode, you will need to enable the App Sandbox capability and turn on the "Outgoing Connections (Client)" entitlement so that the SDK can communicate with AWS.

First, open the macOS target's **Signing & Capabilities** panel, shown below.



Automatically manage signing
Xcode will create and update profiles, app IDs, and certificates.

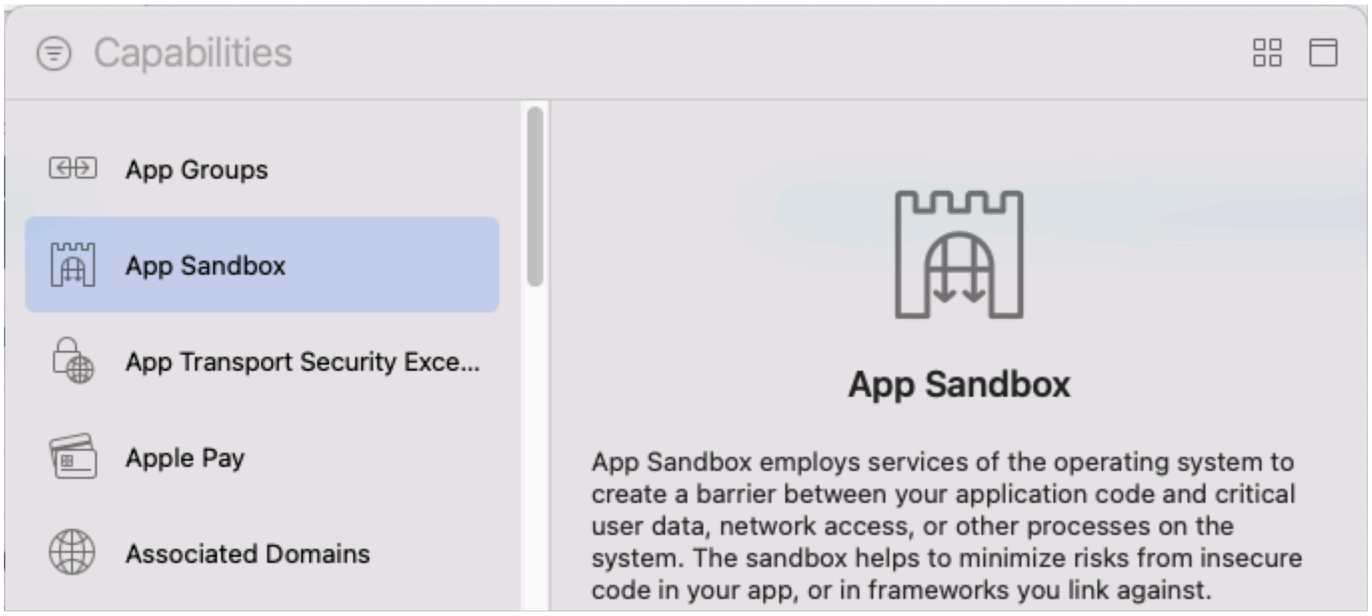
Team

Bundle Identifier: com.amazon.Supergame

Provisioning Profile: None Required

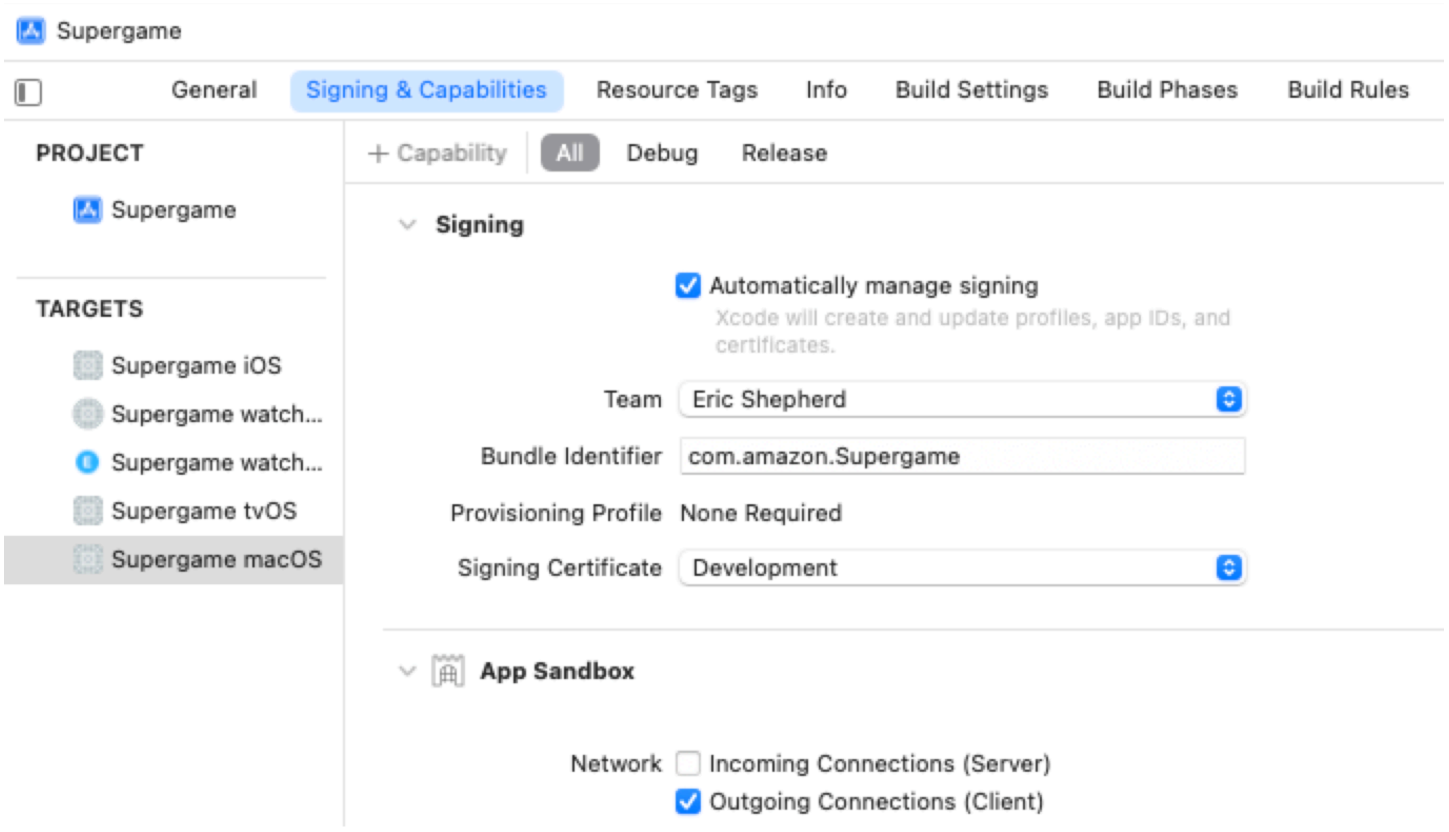
Signing Certificate: Development

Click the **+ Capability** button near the top left of this panel to bring up the box listing the available capabilities. In this box, locate the "App Sandbox" capability and double-click on it to add it to your target.



App Sandbox employs services of the operating system to create a barrier between your application code and critical user data, network access, or other processes on the system. The sandbox helps to minimize risks from insecure code in your app, or in frameworks you link against.

Next, back in your target's **Signing & Capabilities** panel, find the new **App Sandbox** section and make sure that next to **Network**, the **Outgoing Connections (Client)** checkbox is selected in the following image.



Automatically manage signing ✓
Xcode will create and update profiles, app IDs, and certificates.

Team: Eric Shepherd
Bundle Identifier: com.amazon.Supergame
Provisioning Profile: None Required
Signing Certificate: Development

Network: Incoming Connections (Server) ☐
Outgoing Connections (Client) ✓

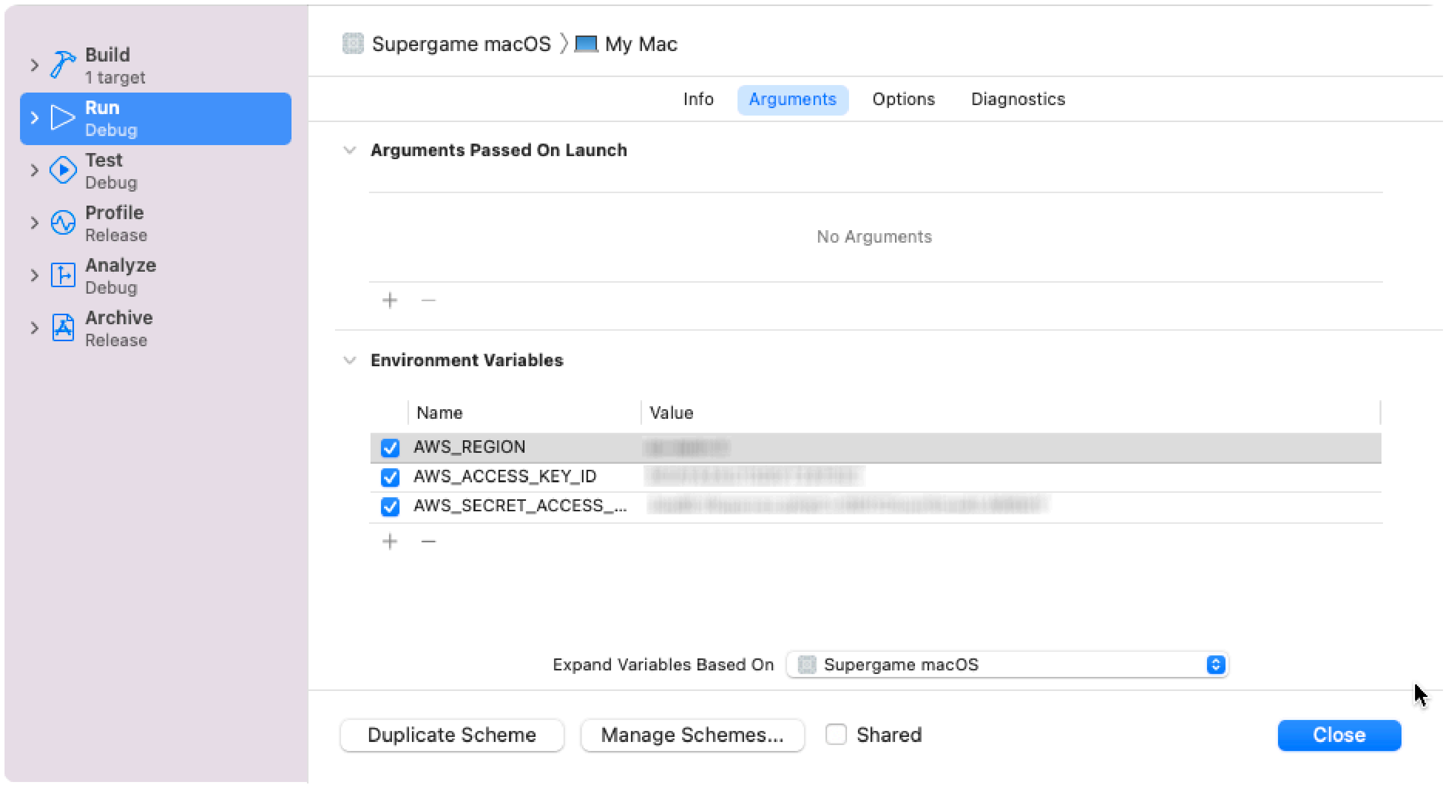
Using AWS access keys on macOS

Although shipping applications should use AWS IAM Identity Center, Amazon Cognito Identity, or similar technologies to handle authentication instead of requiring the direct use of AWS access keys, you may need to use these low-level credentials during development and testing.

macOS security features for desktop applications don't allow applications to access files without express user permission, so the SDK can't automatically configure clients using the contents of the CLI's `~/.aws/config` and `~/.aws/credentials` files. Instead, you need to use the `AWS_ACCESS_KEY_ID` and `AWS_SECRET_ACCESS_KEY` environment variables to specify the authentication keys for your AWS account. This is already done if you followed the guidance in *Get started*. If not, look there for details on setting these up.

There is a special case: when running projects from within Xcode, the environment you have set up for your shell is not automatically inherited. Because of this, if you want to test your code using your AWS account's access key ID and secret access key, you need to set up the runtime environment for your application in the Xcode scheme for your development device. To configure the environment for a particular target in your Xcode project, switch to that target, then choose **Edit Scheme** in Xcode's **Product** menu.

This will open the scheme editor window for your project. Click on the **Run** phase in the left sidebar, then **Arguments** in the tab bar near the top of the window.



Arguments Passed On Launch

No Arguments

Environment Variables

	Name	Value
✓	AWS_REGION	[redacted]
✓	AWS_ACCESS_KEY_ID	[redacted]
✓	AWS_SECRET_ACCESS_...	[redacted]

Expand Variables Based On: Supergame macOS

Under **Environment Variables**, click the **+** icon to add `AWS_REGION` and set its value to the desired region (in the screenshot above, it's set to "us-east-2"). Then add `AWS_ACCESS_KEY_ID` and its value, then `AWS_SECRET_ACCESS_KEY` and its value. Close the window once you have these configured and your scheme's Run configuration looks similar to the above.

Important

Be sure to disable the **Shared** checkbox before pushing your code to any public version control repository such as GitHub. Otherwise, your AWS access key and secret access key will be *included* in the publicly shared content. This is important enough to be worth double-checking regularly.

Your project should now be able to use the SDK to connect to AWS services.

Next steps

Now that your tools and environment are ready for you to begin developing with AWS SDK for Swift, see *Get started*, which demonstrates how to create and build a Swift project using AWS services.

Get started with the SDK for Swift

This chapter explores how to use the Swift Package Manager — part of the standard Swift toolchain — to create and build a small project. The project uses the AWS SDK for Swift to output a list of available Amazon Simple Storage Service (Amazon S3) buckets.

Prerelease documentation

This is prerelease documentation for an SDK in preview release. It might be incomplete and is subject to change.
In addition, versions of the SDK earlier than version 1.0.0 might have flaws, and no guarantee is made about the API's stability. Changes can and will occur that break compatibility during the prerelease stage. **These releases are not intended for use in production code!**

Topics

Create a project using the SDK for Swift

This chapter demonstrates how to create a small program that lists all the Amazon S3 buckets available on the default user account.

Goals for this project:

- Create a project using Swift Package Manager.

- Add the AWS SDK for Swift to the project.
- Configure the project's `Package.swift` file to describe the project and its dependencies.
- Write code that uses Amazon S3 to get a list of the buckets on the default AWS account, then prints them to the screen.

Before we begin, make sure to prepare your development environment as described in Set up. To make sure you're set up properly, use the following command. This makes sure that Swift is available and which version it is.

```
$ swift --version
```

On macOS, you should see output that looks like the following (with possibly different version and build numbers):

```
swift-driver version: 1.87.1 Apple Swift version 5.9 (swiftlang-5.9.0.128.108
 clang-1500.0.40.1)
Target: x86_64-apple-macosx14.0
```

On Linux, the output should look something like the following:

```
Swift version 5.8.1 (swift-5.8.1-RELEASE)
Target: x86_64-unknown-linux-gnu
```

If Swift is not installed, or is earlier than version 5.7, follow the instructions in Set up to install or reinstall the tools.

Get this example on GitHub

You can fork or download this example from the AWS SDK for Swift code examples repository.

Create the project

With the Swift tools installed, open a terminal session using your favorite terminal application (such as Terminal, iTerm, or the integrated terminal in your editor).

At the terminal prompt, go to the directory where you want to create the project. Then, enter the following series of commands to create an empty Swift project for a standard executable program.

```
$ mkdir ListBuckets
$ cd ListBuckets
$ swift package init --type executable
$ mv Sources/main.swift Sources/entry.swift
```

This creates the directory for the example's project, moves into that directory, and initializes that directory with the Swift Package Manager. The result is the basic file system structure for a simple executable program. The Swift source code file `main.swift` is also renamed to `entry.swift` to work around a bug in the Swift tools that involves the use of asynchronous code in the main function of a source file named `main.swift`.

```
ListBuckets/
### Package.swift
### Sources/
   ### entry.swift
```

Open your created project in your preferred text editor or IDE. On macOS, you can open the project in Xcode with the following:

```
$ xed .
```

As another example, you can open the project in Visual Studio Code with the following:

```
$ code .
```

Configure the package

After opening the project in your editor, open the `Package.swift` file. This is a Swift file that defines an SPM Package object that describes the project, its dependencies, and its build rules.

The first line of every `Package.swift` file must be a comment specifying the minimum version of the Swift toolchain needed to build the project. This isn't only informational. The version specified here can change the behavior of the tools for compatibility purposes. The AWS SDK for Swift requires at least version 5.4 of the Swift tools. For this example, it's set to 5.5.

```
// swift-tools-version:5.5
```

Specify supported platforms

For projects whose target operating systems include any Apple platform, add or update the `platforms` property to include a list of the supported Apple platforms and minimum required versions. This list only specifies support for Apple platforms and doesn't preclude building for other platforms.

```
    // Let Xcode know the minimum Apple platforms supported.
    platforms: [
        .macOS(.v11),
        .iOS(.v13)
    ],
```

In this excerpt, the supported Apple platforms are macOS (version 11.0 and higher) and iOS/iPadOS (version 13 and higher).

Set up dependencies

The package dependency list needs to include the AWS SDK for Swift. This tells the Swift compiler to fetch the SDK and its dependencies before attempting to build the project.

```
    dependencies: [
        // Dependencies declare other packages that this package depends on.
        .package(
            url: "https://github.com/awslabs/aws-sdk-swift",
            from: "0.32.0"
        )
    ],
```

Configure the target

Now that the package depends on the AWS SDK for Swift, add a dependency to the executable program's target. Indicate that it relies on Amazon S3, which is offered by the SDK's `AWSS3` product.

```
    targets: [
        // Targets are the basic building blocks of a package, defining a module or a
 test suite.
        // Targets can depend on other targets in this package and products from
 dependencies.
        .executableTarget(
            name: "ListBuckets-Simple",
            dependencies: [
                .product(name: "AWSS3", package: "aws-sdk-swift")
            ],
            path: "Sources")
    ]
```

Use AWS services from Swift code

The example program's Swift code is found in the `Source/main.swift` file. This file begins by importing the needed Swift modules, using the `import` statement.

```
import Foundation
import ClientRuntime
import AWSS3
```

- `Foundation` is the standard Apple Foundation package.
- `ClientRuntime` is a module providing low-level and support features for the AWS SDK for Swift.
- `AWSS3` is the SDK for Swift module that's used to access Amazon S3.

After you add the SDK for Swift to your project and import the service you want to use into your source code, you can create an instance of the client representing the service and use it to issue AWS service requests.

Create a service client object

Each AWS service is represented by a specific client class in the AWS SDK for Swift. For example, while the Amazon DynamoDB client class is called `DynamoDBClient`, the class for Amazon Simple Storage Service is `S3Client`. To use Amazon S3 in this example, first create an `S3Client` object on which to call the SDK's Amazon S3 functions.

```
    let client = try S3Client(region: "us-east-1")
```

Issue AWS service requests

To issue a request to an AWS service, call the corresponding function on the service's client object. Each function's inputs are specified using a function-specific input structure as the value of the function's `input` parameter. For example, when calling [`S3Client.listBuckets(input:)`](), `input` is a structure of type [`ListBucketsInput`]().

```
    let output = try await client.listBuckets(
        input: ListBucketsInput()
    )
```

Functions defined by the AWS SDK for Swift run asynchronously, so the example uses `await` to block the program's execution until the result is available. If SDK functions encounter errors, they throw them so your code can handle them using a `do-catch` statement or by propagating them back to the caller.

Get all bucket names

This example's main program calls `getBucketNames()` to get an array containing all of the bucket names. That function is defined as follows.

```
// Return an array containing the names of all available buckets.
//
// - Returns: An array of strings listing the buckets.
func getBucketNames() async throws -> [String] {
    // Get an S3Client with which to access Amazon S3.
    let client = try S3Client(region: "us-east-1")

    let output = try await client.listBuckets(
        input: ListBucketsInput()
    )

    // Get the bucket names.
    var bucketNames: [String] = []

    guard let buckets = output.buckets else {
        return bucketNames
    }
    for bucket in buckets {
        bucketNames.append(bucket.name ?? "<unknown>")
    }

    return bucketNames
}
```

This function starts by creating an Amazon S3 client and calling its `listBuckets(input:)` function to request a list of all of the available buckets. The list is returned asynchronously. After it's returned, the bucket list is fetched from the output structure's `buckets` property. If it's `nil`, an empty array is immediately returned to the caller. Otherwise, each bucket name is added to the array of bucket name strings, which is then returned to the caller.

Add the example entry point

To allow the use of asynchronous functions from within `main()`, use Swift's `@main` attribute to create an object that contains a static `async` function called `main()`. Swift will use this as the program entry point.

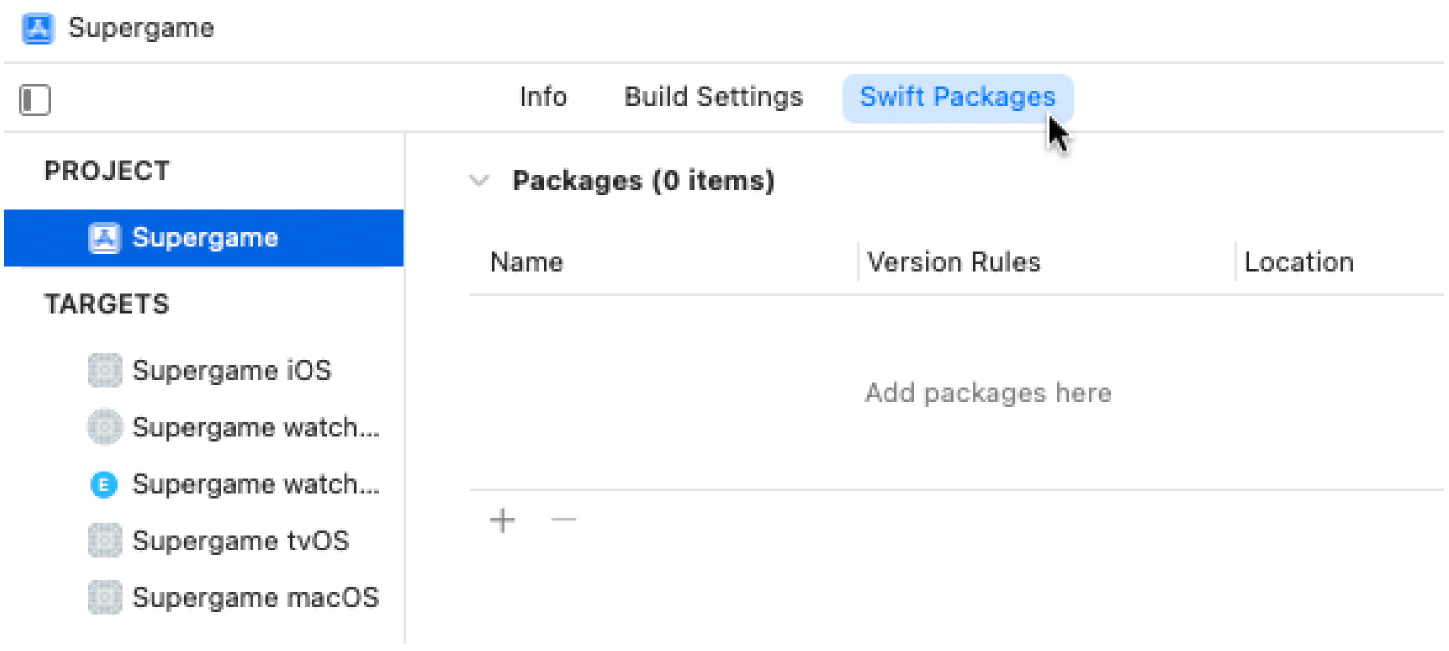
```
/// The program's asynchronous entry point.
@main
struct Main {
    static func main() async {
        do {
            let names = try await getBucketNames()

            print("Found \(names.count) buckets:")
            for name in names {
                print("  \(name)")
            }
        } catch let error as ServiceError {
            print("An Amazon S3 service error occurred: \(error.message ?? "No details
 available")")
        } catch {
            print("An unknown error occurred: \(dump(error))")
        }
    }
}
```

`main()` calls `getBucketNames()`, then outputs the returned list of names. Errors thrown by `getBucketNames()` are caught and handled. Errors of type `ServiceError`, which represent errors reported by the AWS service, are handled specially.

Add the SDK for Swift to an existing Xcode project

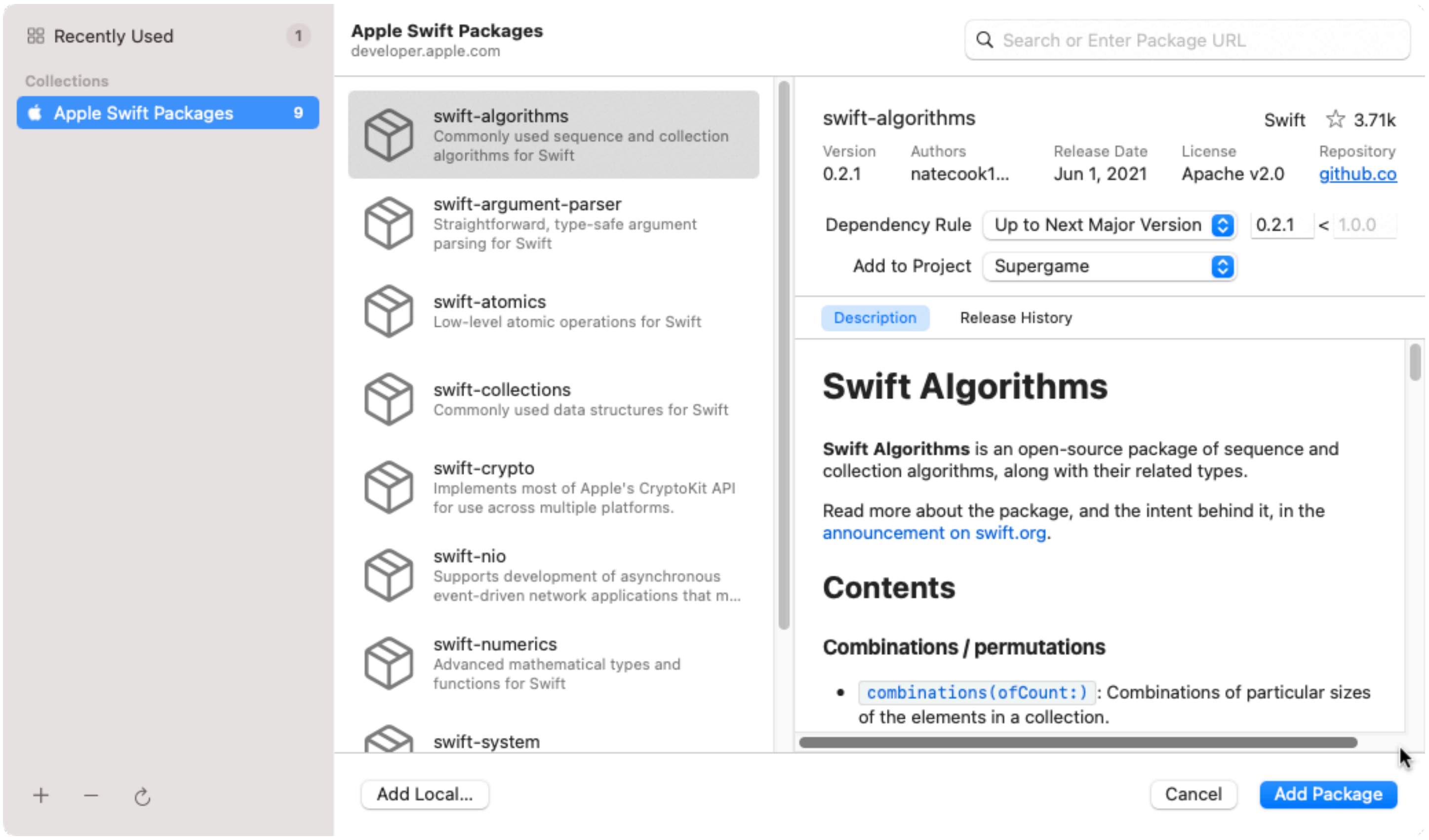
If you have an existing Xcode project, you can add the SDK for Swift to it. Open your project's main configuration pane and choose the **Swift Packages** tab at the right end of the tab bar. The following image shows how to do this for an Xcode project called "Supergame," which will use Amazon S3 to get game data from a server.

Swift Packages tab in Xcode



This shows a list of the Swift packages currently in use by your project. If you haven't added any Swift packages, the list will be empty, as shown in the preceding image. To add the AWS SDK for Swift package to your project, choose the **+** button under the package list.

Find and select packages to import



Recently Used 1

Collections

Apple Swift Packages 9

Apple Swift Packages
developer.apple.com

Search or Enter Package URL

swift-algorithms
Commonly used sequence and collection algorithms for Swift

swift-argument-parser
Straightforward, type-safe argument parsing for Swift

swift-atomics
Low-level atomic operations for Swift

swift-collections
Commonly used data structures for Swift

swift-crypto
Implements most of Apple's CryptoKit API for use across multiple platforms.

swift-nio
Supports development of asynchronous event-driven network applications that m...

swift-numerics
Advanced mathematical types and functions for Swift

swift-system

swift-algorithms Swift ☆ 3.71k

Version	Authors	Release Date	License	Repository
0.2.1	natecook1...	Jun 1, 2021	Apache v2.0	github.co

Dependency Rule: Up to Next Major Version 0.2.1 < 1.0.0

Add to Project: Supergame

Description Release History

Swift Algorithms

Swift Algorithms is an open-source package of sequence and collection algorithms, along with their related types.

Read more about the package, and the intent behind it, in the announcement on swift.org.

Contents

Combinations / permutations

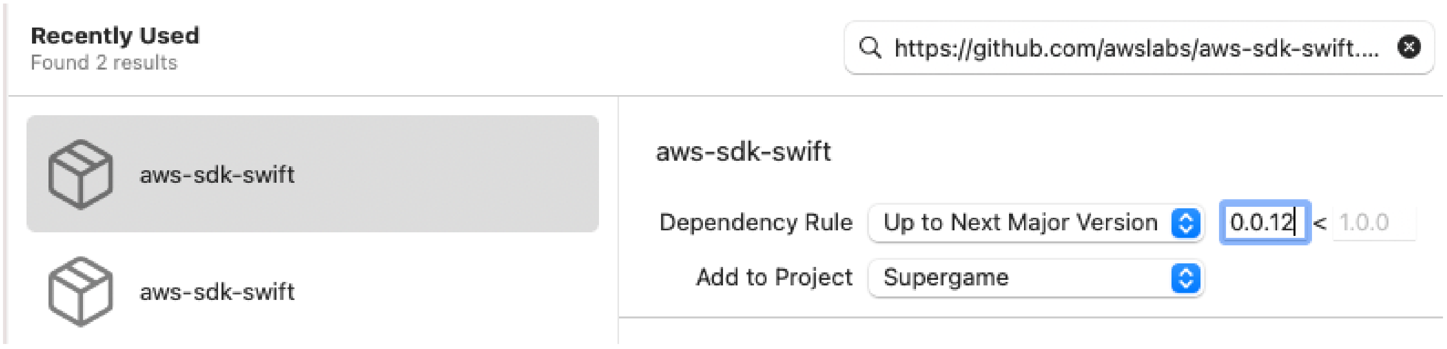
- `combinations(ofCount:)`: Combinations of particular sizes of the elements in a collection.

Add Local... Cancel Add Package

Next, specify the package or packages to add to your project. You can choose from standard Apple-provided packages or enter the URL of a custom package in the search box at the top of the window. Enter the URL of the AWS SDK for Swift as follows: `https://github.com/awslabs/aws-sdk-swift.git` .

After you enter the SDK URL, you can configure version requirements and other options for the SDK package import.

Configure dependency rules for the SDK for Swift package



Recently Used
Found 2 results

https://github.com/awslabs/aws-sdk-swift....

aws-sdk-swift

aws-sdk-swift

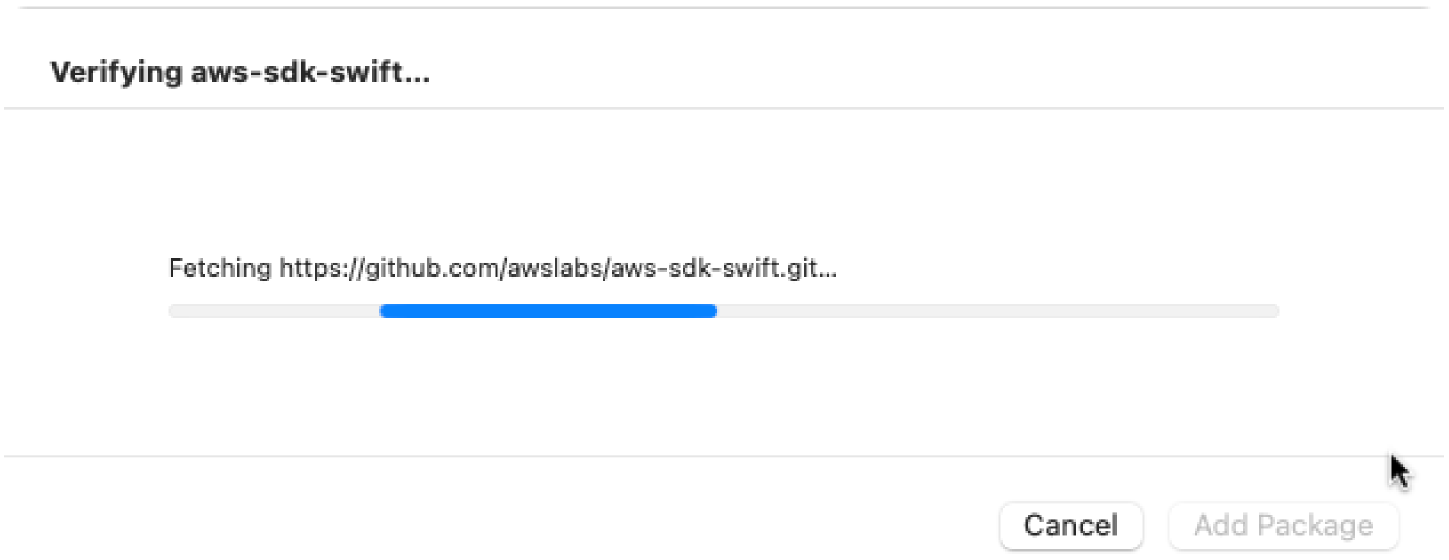
aws-sdk-swift

Dependency Rule: Up to Next Major Version 0.0.12 < 1.0.0

Add to Project: Supergame

Configure the dependency rule. Make sure that **Add to Project** is set to your project — "Supergame" in this case — and choose **Add Package**. You will see a progress bar while the SDK and all its dependencies are processed and retrieved.

Fetching the AWS SDK for Swift package and its product list

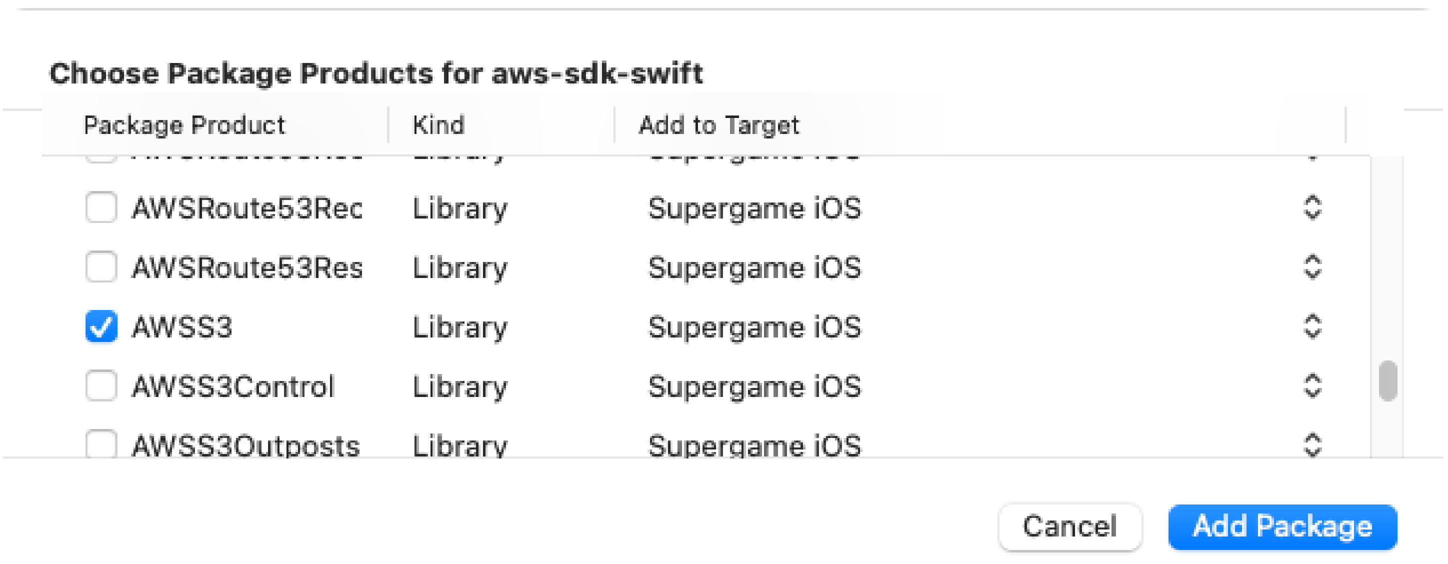

Verifying aws-sdk-swift...

Fetching https://github.com/awslabs/aws-sdk-swift.git...

Next, select specific *products* from the AWS SDK for Swift package to include in your project. Each product is generally one AWS API or service. Each package is listed by package name, starting with `AWS` and followed by the shorthand name of the service or toolkit.

For the Supergame project, select `AWSS3`, `AWSDynamoDB`, and `AWSGameLift`. Assign them to the correct target (iOS in this example), and choose **Add Package**.

Choose package products for specific AWS services and toolkits

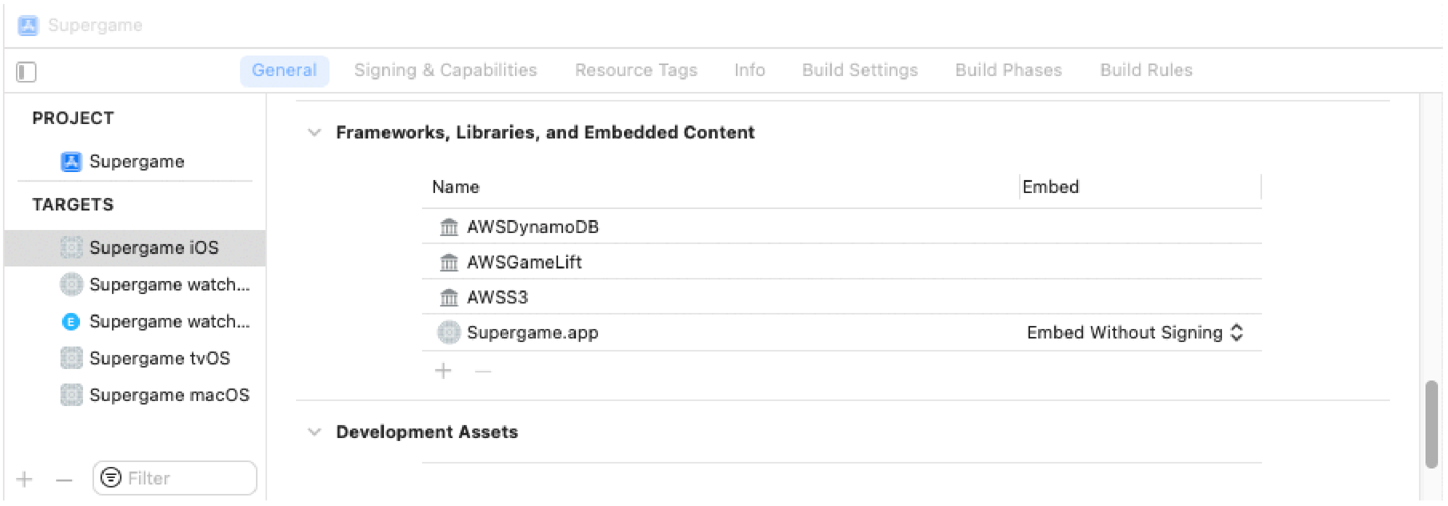


Choose Package Products for aws-sdk-swift

Package Product	Kind	Add to Target
☐ AWSRoute53Rec	Library	Supergame iOS
☐ AWSRoute53Res	Library	Supergame iOS
✓ AWSS3	Library	Supergame iOS
☐ AWSS3Control	Library	Supergame iOS
☐ AWSS3Outposts	Library	Supergame iOS

Your project is now configured to import the AWS SDK for Swift package and to include the desired APIs in the build for that target. To see a list of the AWS libraries, open the target's **General** tab and scroll down to **Frameworks, Libraries, and Embedded Content**.

AWS SDK for Swift libraries in the Xcode target



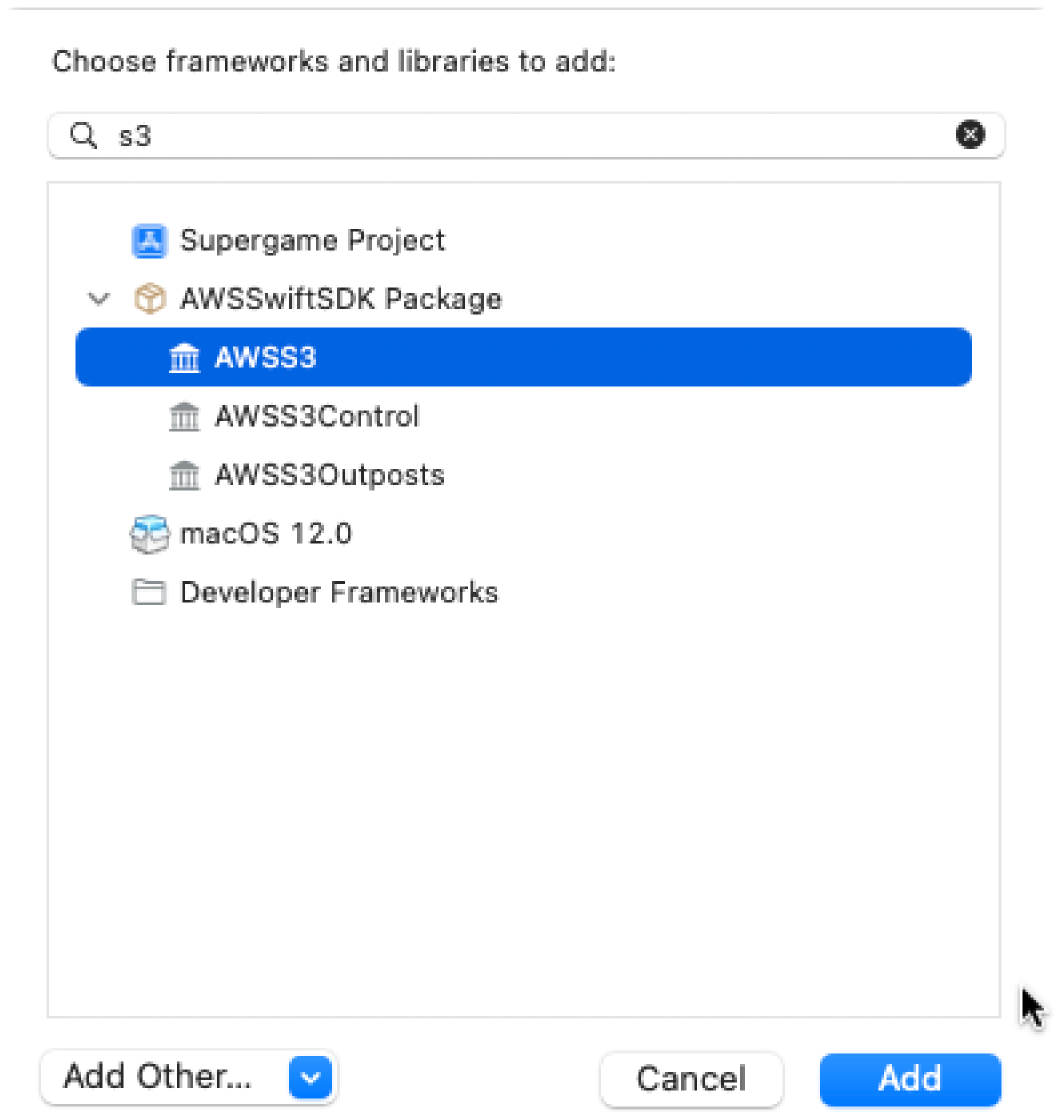
Frameworks, Libraries, and Embedded Content

Name	Embed
AWSDynamoDB	
AWSGameLift	
AWSS3	
Supergame.app	Embed Without Signing

If your project is a multi-platform project, you also need to add the AWS libraries to the other targets in your project. For each platform's target, navigate to the **Frameworks, Libraries, and Embedded Content** section under the **General** tab and choose **+** to open the library picker window.

Then, you can scroll to find and select all of the needed libraries and choose **Add** to add them all at once. Alternatively, you can search for and select each library, then choose **Add** to add them to the target one at a time.

Find and add SDK for Swift libraries using the Xcode library picker window



You're now ready to import the libraries and any needed dependencies into individual Swift source code files and start using the AWS services in your project. Build your project by using the Xcode **Build** option in the **Product** menu.

Build and run an SPM project

To build and run a Swift Package Manager project from a Linux or macOS terminal prompt, use the following commands.

Build a project

```
$ swift build
```

Run a project

```
$ swift run
$ swift run executable-name
$ swift run executable-name arg1, ...
```

If your project builds only one executable file, you can type **swift run** to build and run it. If your project outputs multiple executables, you can specify the file name of the executable you want to run. If you want to pass arguments to the program when you run it, you *must* specify the executable name before listing the arguments.

Get the built product output directory

```
$ swift build --show-bin-path
/home/janice/MyProject/.build/x86_64-unknown-linux-gnu/debug
```

Delete build artifacts

```
$ swift package clean
```

Delete build artifacts and all build caches

```
$ swift package reset
```

Import SDK for Swift libraries into source files

After the libraries are in place, you can use the Swift `import` directive to import the individual libraries into each source file that needs them. To use the functions for a given service, import its library from the AWS SDK for Swift package into your source code file. Also import the `ClientRuntime` library, which contains utility functions and type definitions.

```
import Foundation
import ClientRuntime
import AWSS3
```

The standard Swift library `Foundation` is also imported because it's used by many features of the AWS SDK for Swift.

Additional information

- *Set up*
- *Use the SDK*
- SDK for Swift code examples

Use the SDK for Swift

After completing the steps in *Set up*, you're ready to make requests to AWS services such as Amazon S3, DynamoDB, IAM, Amazon EC2, and more by instantiating service objects and making calls on them using the AWS SDK for Swift. The guides below cover setting up and using AWS services for common use cases.

Prerelease documentation

This is prerelease documentation for an SDK in preview release. It may be incomplete and is subject to change.
In addition, versions of the SDK prior to version 1.0.0 may have flaws, and no guarantee is made about the API's stability. Changes can and will occur that break compatibility during the prerelease stage. **These releases are not intended for use in production code!**

Topics

Customize AWS service client configurations

By default, AWS SDK for Swift uses a basic default configuration for each AWS service. This configuration automatically looks for credentials to use in a predictable, standard way:

1. The environment variables `AWS_ACCESS_KEY_ID`, `AWS_SECRET_ACCESS_KEY_ID`, and `AWS_SESSION_TOKEN`.
2. The default AWS profile, as described in the AWS configuration file (located at `~/.aws/config` on Linux and macOS and at `C:\Users\USERNAME\.aws\config` on Windows), and the credentials found in the file `~/.aws/credentials` on Linux and macOS and in `C:\Users\USERNAME\.aws\credentials` on Windows.
3. Optionally, the configuration is looked for on Amazon Elastic Container Service.

4. Optionally, the configuration can be taken from Amazon EC2 instance metadata.

Each service might have other options available through its configuration class, depending on that service's needs.

Configuration data types

Each AWS service has its own configuration class that you use to specify a given set of options. All of these classes are based on the generic `AWSClientRuntime.AWSClientConfiguration` class, which defines the configuration options available across all services. This includes options such as the Region and credentials, which are always needed in order to access an AWS service.

Within the AWS SDK for Swift, each service defines a `struct` that's used to resolve the `AWSClientConfiguration` type to include options supported by the service's client. The resolved type is given an alias such as `S3Client.S3ClientConfiguration` for convenience, which is defined like this:

```
extension S3Client {
   public typealias S3ClientConfiguration =
 AWSClientConfiguration<ServiceSpecificConfiguration>

   public struct ServiceSpecificConfiguration: AWSServiceSpecificConfiguration {
      /// Service-specific properties are defined here, including:

      public var serviceName: String { "S3" }
      public var clientName: String { "S3Client" }

      /// ... and so on.
   }
}
```

This establishes `S3Client.S3ClientConfiguration` as an alias for the type `AWSClientConfiguration<ServiceSpecificConfiguration>`. As a result, `S3ClientConfiguration` includes its own properties and also everything defined in `AWSClientConfiguration` and the `AWSServiceSpecificConfiguration` protocol it's based on.

Every service configuration class includes the `serviceName` and `clientName` properties. `serviceName` specifies the shorthand name of the service, such as `S3`, `IAM`, or `DynamoDB`.

`clientName` gives the name of the actual service client class, such as `S3Client`, `IAMClient`, or `DynamoDBClient`.

By creating a custom configuration object and using it when creating a service client object, you can specify a configuration source from which credentials and other options are taken. Alternatively, you can directly specify the credentials instead of letting the SDK obtain them automatically.

Configure a client

When only changing common options, you can often specify the custom values for your configuration when instantiating the service's client object. If the client class constructor doesn't support the option you need to change, then create and specify a configuration object with a type corresponding to the client class.

Create a client with only a custom Region

Most services let you directly specify the Region when you call their constructors. For example, to create an Amazon S3 client configured for the Region `af-south-1`, specify the `region` parameter when creating the client, as shown.

```
do {
    let s3 = try S3Client(region: "af-south-1")

    // Use the client.
} catch {
    // Handle the error.
    dump(error, name: "Error accessing S3 service")
}
```

This lets you handle a common client configuration scenario (keeping every option other than the Region with its default value) without going through the full configuration process. That process is covered in the next topic.

Create and use a custom configuration

To customize the configuration of an AWS service, create a configuration object of the appropriate type for the service. Then pass that configuration object into the service client's constructor as the value of its `config` parameter.

For example, to configure an Amazon S3 client, create an object of type `S3Client.S3ClientConfiguration`. Set the properties that you want to change, then pass the configuration object into `S3Client(config:)`.

The following example creates a new Amazon S3 client configured with the following options:

- The AWS Region is set to `us-east-1`.
- The retry mode is set to `RetryStrategyOptions.RateLimitingMode.adaptive`. See Retry behavior in the *AWS SDKs and Tools Reference Guide* for details.
- The maximum number of retries is set to 5.

```
        // Create an Amazon S3 client configuration object that specifies the
        // region as "us-east-1", the adaptive retry mode, and the maximum
        // number of retries as 5.

        let config: S3Client.S3ClientConfiguration

        do {
            config = try await S3Client.S3ClientConfiguration(
                region: "us-east-1",
                retryStrategyOptions: RetryStrategyOptions(
                    maxRetriesBase: 5,
                    rateLimitingMode: .adaptive
                )
            )
        } catch {
            print("Error: Unable to create configuration")
            dump(error)
            exit(1)
        }

        // Create an Amazon S3 client using the configuration created above.

        let client = S3Client(config: config)
```

If an error occurs creating the configuration, an error message is displayed and the details are dumped to the console. The program then exits. In a real world application, a more constructive approach should be taken when handling this error.

Use client services with the SDK for Swift

Each AWS service is exposed through one or more Swift classes. Each class provides a number of functions that you can call to issue requests to AWS services, including Amazon S3, DynamoDB, IAM, and others. Functions that access the network are designed to operate in the background so that your application can continue to run while awaiting the response. The SDK then notifies you when the response arrives.

The process of sending requests to AWS services is as follows:

1. Create a service client object with the desired configuration, such as the specific AWS Region.
2. Create an input parameters object with the values and data needed to make the request. For example, when sending a request to Amazon S3, you need to specify the bucket name and the key of the data that you want to access. For a request method named `SomeOperation`, the input parameters object is created using a function called `SomeOperationInput()`.
3. Call the service object method that sends the desired request, with the parameters object created in the previous step.
4. Use `await` to wait for the response, and handle thrown exceptions to appropriately handle error conditions.
5. Examine the contents of the returned structure for the results you need. Every SDK for Swift function returns a structure with a type whose name is the same as the service action performed by the function, followed by the word `Output`. For example, when calling the Amazon S3 function `S3Client.createBucket(input:)`, the return type is `CreateBucketOutput`.

Create and use AWS client objects

Before you can send requests to an AWS service, you must first instantiate a client object corresponding to the service. These client classes are helpfully named using the service name and the word `Client`. Examples include `S3Client` and `IAMClient`.

After creating the client object, use it to make your requests. When you're done, release the object. If the service connection is open, it is closed for you automatically.

```
do {
    let s3 = try await S3Client()

    // ...
} catch {
    dump(error)
}
```

If an error occurs while trying to instantiate an AWS service — or at any time while using the service — an exception is thrown. Your `catch` block should handle the error appropriately.

Unless you are in a testing environment in which you expect a knowledgeable user to have configured reasonable default options, specify the appropriate service configuration when instantiating the client object. This is described in ???.

Specify service client function parameters

When calling service client methods, you pass input parameters within objects created using factory functions provided for that purpose. For example, before calling the `getObject()` method on the Amazon S3 service class `S3Client`, you need to create the input parameter object using the factory function `GetObjectInput()`.

```
do {
    let s3 = try S3Client()
    let inputObject = GetObjectInput(bucket: "bucketName", key: "keyName")
    let output = try await s3.getObject(input: inputObject)

    // ...
} catch {
    dump(error)
}
```

In this example, `GetObjectInput()` is used to create an input object for the `getObject(input:)` method. The resulting input object specifies that the desired data has the `keyName` key and should be fetched from the Amazon S3 bucket named `bucketName`.

Call SDK functions

Nearly all AWS SDK for Swift functions are asynchronous and can be called using Swift's `async`/`await` model.

To call one of the SDK's asynchronous functions from synchronous code, call the function from a Swift `Task` created and run from your synchronous code.

Call SDK functions asynchronously

The following function fetches and returns the content of a file named `text/motd.txt` using Amazon S3.

```
func getMOTD() async throws -> String? {
    let s3 = try S3Client()
    let motdInput = GetObjectInput(bucket: "supergame-datastore",
                                    key: "text/motd.txt")
    let output = try await s3.getObject(input: motdInput)

    guard let data = output.body?.toBytes().toData() else {
        return nil
    }
    return String(decoding: data, as: UTF8.self)
}
```

The `getMOTD()` function can only be called from another `async` function, and returns a string that contains the text in the `MOTD` file or `nil` if the file is empty. It throws an exception on errors. Thus, you call the `getMOTD()` function.

```
do {
    let motd = try await getMOTD()
    // ...
} catch {
    dump(error)
}
```

Here, the fetched "message of the day" text is available in the variable `motd` immediately following the call to `getMOTD()`. If an error occurs attempting to fetch the text, an appropriate exception is delivered to the `catch` clause. The standard Swift variable `error` describes the problem that occurred.

Call SDK functions from synchronous code

To call AWS SDK for Swift functions from synchronous code, enclose the code that needs to run asynchronously in a `Task`. The `Task` uses `await` for each SDK function call that returns its results asynchronously. You might need to use an atomic flag or other means to know that the operation has finished.

Note

It's important to properly manage asynchronous requests. Be sure that any operation that's dependent on a previous result waits until that result is available before it begins. When used properly, the `async/await` model handles most of this for you.

```
func updateMOTD() {
    Task() {
        var motd: String = ""

        do {
            let s3 = try S3Client()
            let motdInput = GetObjectInput(bucket: "supergame-datastore",
                                           key: "text/motd.txt")
            let output = try await s3.getObject(input: motdInput)

            if let bytes = output.body?.toBytes() {
                motd = String(decoding: bytes.toData(), as: UTF8.self)
            }
        } catch {
            motd = ""
        }

        setMOTD(motd)
    }
}
```

In this example, the code inside the `Task` block runs asynchronously, returning no output value to the caller. It fetches the contents of a text file located at the key `text/motd.txt` and calls a function named `setMOTD()`, with the contents of the file decoded into a UTF-8 string.

SDK function calls that might encounter errors are preceded by the `try` keyword. This indicates that they might result in an exception. A `do/catch` block is used to capture any thrown exceptions and set the `motd` variable to an empty string, which indicates that no message is available.

A call to this `updateMOTD()` function will spawn the task and return almost immediately. While the program continues to run, the asynchronous task code fetches and uses the text from the specified file on Amazon S3. When the task has completed, the `Task` automatically ends.

Configure retry using the SDK for Swift

Calls to AWS services occasionally encounter problems or unexpected situations. Certain types of errors, such as throttling or transient errors, might be successful if the call is retried.

This page describes how to configure automatic retries with the AWS SDK for Swift.

Default retry configuration

By default, every service client is automatically configured with a standard retry strategy. The default configuration tries each action up to three times (the initial attempt plus two retries). The intervening delay between each call is configured with exponential backoff and random jitter to avoid retry storms. This configuration works for the majority of use cases but may be unsuitable in some circumstances, such as high-throughput systems.

The SDK attempts retries only on retryable errors. Examples of retryable errors are socket timeouts, service-side throttling, concurrency or optimistic lock failures, and transient service errors. Missing or invalid parameters, authentication/security errors, and misconfiguration exceptions are not considered retryable.

You can customize the standard retry strategy by setting the maximum number of attempts and the rate limiting strategy to use. To change the retry configuration, create a structure of type `RetryStrategyOptions` with the desired configuration, then assign it to the `retryStrategy` property of the service configuration. For details on how to configure a service, see Customize AWS service client configurations.

Configure retry

Warning

There are other options available in `RetryStrategyOptions` beyond those covered here, such as the `backoffStrategy` (the algorithm used to determine how long to wait after each attempt). These options are currently intended only for future expansion, and should not be used unless advised to do so by an AWS representative.

Maximum number of retries

You can customize the maximum number of attempts by setting the value of `RetryStrategyOptions.maxRetriesBase`. The default value is 2, which allows for a total of three attempts to be made (the initial attempt plus up to two retries).

Rate limiting mode

The rate limiting mode can be set by changing the `RetryStrategyOptions` structure's `rateLimitingMode`. The available values are provided by the `enum RateLimitingMode`.

Standard

The `standard` rate limiting mode is the default. In this mode, requests may be sent immediately, and are not delayed for rate limiting when throttling is detected.

In `standard` mode, requests are only delayed according to the backoff strategy in use.

Adaptive

In the `adaptive` rate limiting mode, initial and retry requests may be delayed by an additional amount when throttling is detected. This is sometimes called "client-side rate limiting" mode, and is available opt-in. You should only use adaptive mode when advised to do so by an AWS representative.

In `adaptive` retry mode, requests are delayed when the server indicates that requests are being throttled.

Example

This example creates an Amazon S3 client configured to retry five times (up to a total of six attempts), using the adaptive rate limiting mode.

```
        let config: S3Client.S3ClientConfiguration

        // Create an Amazon S3 client configuration object that specifies the
        // adaptive retry mode and the base maximum number of retries as 5.

        do {
            config = try await S3Client.S3ClientConfiguration(
                retryStrategyOptions: RetryStrategyOptions(
                    maxRetriesBase: 5,
                    rateLimitingMode: .adaptive
                )
            )
        } catch {
            print("Error: Unable to create configuration")
            dump(error)
            exit(1)
        }

        // Create an Amazon S3 client using the configuration created above.

        let client = S3Client(config: config)
```

Handle SDK for Swift errors

Prerelease documentation

This is prerelease documentation for an SDK in preview release. It may be incomplete and is subject to change.
In addition, versions of the SDK prior to version 1.0.0 may have flaws, and no guarantee is made about the API's stability. Changes can and will occur that break compatibility during the prerelease stage. **These releases are not intended for use in production code!**

Overview

The AWS SDK for Swift uses Swift's standard error handling mechanism to report errors that occur while using AWS services. Errors are reported using Swift's `throw` statement.

To catch the errors that an AWS SDK for Swift function might return, use the Swift do/`catch` statement. Encapsulate the code that calls the SDK inside the do block, then use one or more `catch` blocks to capture and handle the errors. Each `catch` block can capture a specific error, a specific kind of error, or all uncaught errors. This lets an application recover from errors it knows how to handle, notify the user of transient errors or errors that can't be recovered from but are non-fatal, and safely exit the program if the error is fatal.

Note

The architecture of the AWS SDK for Swift is generated using models specified using the Smithy interface definition language (IDL). The Smithy models describe the underlying types and functions used by AWS services. Smithy models also describe each service's API. These models are used to generate the Swift types and classes that comprise the SDK. This is useful to understand both while reading this guide and while writing error handling code.

AWS SDK for Swift error protocols

SDK for Swift errors conform to one or more error protocols. The protocols implemented by the error depend on the type of error that occurred and the context in which it occurred.

The `Error` protocol

Every error thrown by the AWS SDK for Swift conforms to the standard Swift `Error` protocol. As such, every error has a `localizedDescription` property that returns a string containing a useful description of the error.

When the underlying AWS service provides an error message, that string is used as the `localizedDescription`. These are usually in English. Otherwise, the SDK generates an appropriate message, which may or may not be localized.

The `AWSServiceError` protocol

When the AWS service responds with a service error, the error object conforms to the `AWSClientRuntime.AWSServiceError` protocol.

Note

If an `AWSServiceError` occurs while performing a service action over an HTTP connection, the error also implements the `HTTPError` protocol. Currently, all AWS protocols use HTTP, but if this were to change, an appropriate error protocol would be added.

Errors that conform to `AWSServiceError` include these additional properties:

`errorCode`

An `optional` string identifying the error type.

`requestID`

An `optional` string that gives the request ID of the request that resulted in the error.

The `ModeledError` protocol

When an error occurs that matches a defined, modeled error type, the error object conforms to the protocol `ClientRuntime.ModeledError`, in addition to any other appropriate protocols such as `HTTPError`. This includes most of the errors defined by an AWS service.

`ModeledError` adds several useful properties to the error:

`fault`

A value from the `ClientRuntime.ErrorFault` enum. The value is `.client` if the source of the error is the client, or `.server` if the server is the source of the error.

`isRetryable`

A Boolean value indicating whether or not the model indicates that the failed operation can be retried.

`isThrottling`

A Boolean value indicating whether or not the model indicates that the error is due to throttling.

In addition, any properties the API reference (and thus the Smithy model) defines for the error are available as members of the `struct` `ModeledError.properties`.

The `HTTPError` protocol

Errors that occur during an action that uses an HTTP connection conform to the `ClientRuntime.HTTPError` protocol. An error conforming to `HTTPError` contains an HTTP response whose status code is in either the 4xx range or the 5xx range.

`HTTPError` adds one property to the error:

`httpResponse`

An object of type `HttpResponse`, which describes the entire HTTP response from the AWS service. It has properties that include the response's headers, body, and the HTTP status code.

Handling errors

All errors returned by the SDK for Swift implement the standard Swift `Error` protocol. The error's type depends on the service and the error being reported, so it could be any Swift type including but not limited to `enum`, `struct`, or `class`, depending on what kind of error occurred. For example, an error reporting that an Amazon S3 bucket is missing may conform to `Error`, `AWSServiceError`, and `HTTPError`. This lets you know it's a service error that occurred while communicating using the HTTP protocol. In this case, the HTTP status code is 404 (Not Found), because of the missing bucket.

Even if no other information is provided, the error's `localizedDescription` property is always a string describing the error.

When catching errors thrown by the AWS SDK for Swift, follow these guidelines:

- If the error is modeled, the error is a `struct` describing the error. Catch these errors using that `struct`'s name. In many cases, you can find these modeled errors listed in the documentation of an action in the AWS SDK for Swift Reference.
- If the error isn't modeled, but still originates from an AWS service, it will conform to the protocol `AWSServiceError`. Use `catch let error as AWSServiceError`, then look at the error's `errorCode` property to determine what error occurred.
- **Don't catch any concrete types that represent unknown errors**, such as `UnknownAWSHTTPServiceError`. These are reserved for internal use and may be made non-public before the 1.0 release of the SDK.

Service errors

An error thrown because of an AWS service response, whether it could be parsed or not, conforms to the `AWSServiceError` protocol. An error defined by the underlying Smithy model — which is usually defined by the AWS service — also conforms to `ModeledError` and has a concrete type. One example is the Amazon S3 error `CreateBucketOutputError`, which is thrown by the `AWSS3.CreateBucketInput()` initializer.

Any `AWSServiceError` received over an HTTP connection also conforms to `HTTPError`. This is currently all service errors, but that could change in the future if a service adds support for other AWS protocols.

The following code tries to create an object on Amazon S3, with code to handle service errors. It features a `catch` clause that specifically handles the error code `NoSuchBucket`, which indicates that the bucket doesn't exist. This snippet assumes that the given bucket name doesn't exist.

```
        do {
            let client = try S3Client(region: "us-east-1")

            _ = try await client.putObject(input: PutObjectInput(
                body: ByteStream.data(Data(body.utf8)),
                bucket: bucketName,
                key: objectKey
            ))
            print("Done.")
        } catch let error as AWSServiceError {
            let errorCode = error.errorCode ?? "<none>"
            let message = error.message ?? "<no message>"

            switch errorCode {
            case "NoSuchBucket":
                print("   | The bucket \"\(bucketName)\" doesn't exist. This is the 
 expected result.")
                print("   | In a real app, you might ask the user whether to use a 
 different name or")
                print("   | create the bucket here.")
            default:
                print("   | Service error of type \(error.errorCode ?? "<unknown>"): 
 \(message)")
            }
        } catch {
            print("Some other error occurred.")
        }
```

HTTP errors

When the SDK encounters an error while communicating with an AWS service over HTTP, it throws an error that conforms to the protocol `ClientRuntime.HTTPError`. This kind of error represents an HTTP response whose status codes are in the 4xx and 5xx ranges.

Note

Currently, HTTP is the only wire protocol used by AWS. If a future AWS product uses a non-HTTP wire protocol, a corresponding error protocol would be added to the SDK. Errors that occur while using the new wire protocol would conform to that Swift protocol instead of HTTPError.

HTTPError includes an httpResponse property that contains an object of the class HttpResponse. The httpResponse provides information received in the response to the failed HTTP request. This provides access to the response headers, including the HTTP status code.

```
        do {
            let client = try S3Client(region: "us-east-1")

            _ = try await client.getObject(input: GetObjectInput(
                bucket: "not-a-real-bucket",
                key: "not-a-real-key"
            ))
            print("   | Found a matching bucket but shouldn't have!")
        } catch let error as HTTPError {
            print("   | HTTP error; status code:
 \(error.httpResponse.statusCode.rawValue). This is the")
            print("   | expected result.")
        } catch {
            dump(error, name: "   | An unexpected error occurred.")
        }
```

This example creates an Amazon S3 client, then calls its getObject(input:) function to fetch an object using a bucket name and key that don't exist. Two catch blocks are used. The first matches errors of type HTTPError. It retrieves the HTTP status code from the response. The status code can then be used to handle specific scenarios, recover from recoverable errors, or whatever the project requires.

The second catch block is a catch-all that just dumps the error to the console. In a full application, this block would ideally either clean up after the failed access attempt and return the application to a safe state, or perform as clean an application exit as possible.

Handling other errors

To catch any errors not already caught for a given do block, use the catch keyword with no qualifiers. The following snippet simply catches all errors.

```
do {
    let s3 = try await S3Client()

    // ...
} catch {
    // Handle the error here.
}
```

Within the context of the `catch` block, the constant `error` conforms to at least the standard Swift `Error` type. It may also conform to a combination of the other AWS SDK for Swift error protocols.

If you use a catch-all like this in your code, it needs to safely stop whatever task it was trying to perform and clean up after itself. In extreme cases, it may be necessary to safely terminate the application and ideally provide diagnostic output to be relayed to the developer.

While developing a project, it can be helpful to temporarily output error details to the console. This can be useful when debugging, or to help determine which errors that occur may need special handling. The Swift `dump()` function can be used to do this.

```
do {
    let output = try await client.listBuckets(input: ListBucketsInput())

    // ...
} catch {
    dump(error, name: "Getting the bucket list")
}
```

The `dump()` function outputs the entire contents of the `error` to the console. The `name` argument is an `optional` string used as a label for the output, to help identify the source of the error in the program's output.

Testing and debugging

Logging

The AWS SDK for Swift uses Apple's SwiftLog mechanism to log informational and debugging messages to the console. The output from the logging system appears in the console provided by most IDEs, and also in the standard system console.

By default, the logging system only outputs informational and more critical error messages, rather than detailed debugging information. To see debug-level output, you change the logging level to `debug`. To do this, use the `SDKLoggingSystem` object provided by the `ClientRuntime` package. In this guide, you learn how to control not only the global output level, but also the logging level on a service-by-service basis.

Enable debug output

Detailed debugging information is output by the SDK for Swift using the `debug` log level, which isn't visible in the console by default. To see these messages, change the logging system's log level as shown in the following example:

```
import ClientRuntime

SDKLoggingSystem.initialize(logLevel: .debug)
```

Call `SDKLoggingSystem.initialize()` only once in your application, during startup.

Log levels

The log levels supported by the SDK for Swift are identified by the values of the `SDKLogLevel` Swift `enum`. Each log level is inclusive of the messages at and below that level. For example, setting the log level to `warning` also causes log messages to be output for levels `error` and `critical`.

The supported log levels (from least severe to most severe) are:

- `.trace`
- `.debug`
- `.info`
- `.notice` (the default)
- `.warning`
- `.error`
- `.critical`

Set the log level for specific services

You can also manage the log level of specific services, rather than setting a single log level for the entire SDK for Swift. To do this, use the `SDKLoggingSystem` method `add()`. This method connects a given AWS service client's logging handler to the logging system.

For example, to set the logging level for Amazon S3 calls to debug and the logging level for Amazon Cognito Identity to `info`, you would use the following code.

```
import AWSCognitoIdentity
import AWSS3
import ClientRuntime

SDKLoggingSystem.add(logHandlerFactory:
                     CognitoIdentityClientLogHandlerFactory(logLevel: .info))
SDKLoggingSystem.add(logHandlerFactory:
                     S3ClientLogHandlerFactory(logLevel: .debug))
SDKLoggingSystem.initialize()
```

Mock the AWS SDK for Swift

When writing unit tests for your AWS SDK for Swift project, it's useful to be able to mock the SDK. Mocking is a technique for unit testing in which external dependencies — such as the SDK for Swift — are replaced with code that simulates those dependencies in a controlled and predictable way. This limits the chance that external forces might influence the results of the test, and lets testing function without actual access to AWS services.

In addition, well-written mocks are almost always faster than the operations they simulate, letting you test more thoroughly in less time.

The Swift language doesn't provide the read/write reflection needed for direct mocking. Instead, you adapt your code to allow an indirect form of mocking. This section describes how to do so with minimal changes to the main body of your code.

To mock the AWS SDK for Swift implementation of a service class, create a protocol. In the protocol, define each of that class's functions that you need to use. This serves as the abstraction layer that you need to implement mocking. It's up to you whether to use a separate protocol for each AWS service class used in your project. Alternatively, you can use a single protocol that encapsulates every SDK function that you call. This guide's examples usually use classes that encapsulate related application tasks, but this is often the same as using a protocol for each service.

After you define the protocol, you need two classes that conform to the protocol: one class in which each function calls through to the corresponding SDK function, and one that mocks the results as if the SDK function was called. Because these two classes both conform to the same protocol, you can create functions that perform AWS actions by calling functions on an object conforming to the protocol.

Example: Mock an Amazon S3 function

Consider a program that needs to use the `S3Client` function `listBuckets(input:)`. To support mocking, this project needs the following:

- A Swift protocol declaring the Amazon S3 functions used by the project. In this example, the protocol is given the name `S3SessionProtocol` and has one function: `listBuckets(input:)`.
- A class conforming to `S3SessionProtocol` whose implementation of `listBuckets(input:)` calls `S3Client.listBuckets(input:)`. In this example, this class is called `S3Session`.
- A class conforming to `S3SessionProtocol` whose implementation of `listBuckets(input:)` returns mocked results based on the input parameters. This is called `MockS3Session` in this example.
- A class that implements access to Amazon S3. This class should accept an object conforming to the session protocol `S3SessionProtocol` during initialization, then perform all AWS requests by making calls through that object. This makes the code testable: the *application* initializes the class by using an `S3Session` object for AWS access, while *tests* use a `MockS3Session` object. This class is called `BucketManager` in the example.

The rest of this section takes an in-depth look at this implementation of mocking. The complete example is available on GitHub.

Protocol

In this example, the `S3SessionProtocol` protocol declares the one `S3Client` function that it needs:

```
/// The S3SessionProtocol protocol describes the Amazon S3 functions this
/// program uses during an S3 session. It needs to be implemented once to call
/// through to the corresponding SDK for Swift functions, and a second time to
/// instead return mock results.
public protocol S3SessionProtocol {
    func listBuckets(input: ListBucketsInput) async throws
            -> ListBucketsOutput
}
```

This protocol describes the interface by which the pair of classes perform Amazon S3 actions.

Main program implementation

To let the main program make Amazon S3 requests using the session protocol, you need an implementation of the protocol in which each function calls the corresponding SDK function. In this example, you create a class named `S3Session` with an implementation of `listBuckets(input:)` that calls `S3Client.listBuckets(input:)`:

```
public class S3Session: S3SessionProtocol {
    let client: S3Client
    let region: String

    /// Initialize the session to use the specified AWS Region.
    ///
    /// - Parameter region: The AWS Region to use. Default is `us-east-1`.
    init(region: String = "us-east-1") throws {
        self.region = region

        // Create an ``S3Client`` to use for AWS SDK for Swift calls.
        self.client = try S3Client(region: self.region)
    }

    /// Call through to the ``S3Client`` function `listBuckets()`.
    ///
    /// - Parameter input: The input to pass through to the SDK function
    ///   `listBuckets()`.
    ///
    /// - Returns: A ``ListBucketsOutput`` with the returned data.
    ///
    public func listBuckets(input: ListBucketsInput) async throws
            -> ListBucketsOutput {
        return try await self.client.listBuckets(input: input)
    }
}
```

The initializer creates the underlying `S3Client` through which the SDK for Swift is called. The only other function is `listBuckets(input:)`, which returns the result of calling the `S3Client` function of the same name. Calls to AWS services work the same way they do when calling the SDK directly.

Mock implementation

In this example, add support for mocking calls to Amazon S3 by using a second implementation of `S3SessionProtocol` called `MockS3Session`. In this class, the `listBuckets(input:)` function generates and returns mock results:

```
    /// An implementation of the Amazon S3 function `listBuckets()` that
    /// returns the mock data instead of accessing AWS.
    ///
    /// - Parameter input: The input to the `listBuckets()` function.
    ///
    /// - Returns: A `ListBucketsOutput` object containing the list of
    ///   buckets.
    public func listBuckets(input: ListBucketsInput) async throws
            -> ListBucketsOutput {
        let response = ListBucketsOutput(
            buckets: self.mockBuckets,
            owner: nil
        )
        return response
    }
```

This works by creating and returning a `ListBucketsOutput` object, like the actual `S3Client` function does. Unlike the SDK function, this makes no actual AWS service requests. Instead, it fills out the response object with data that simulates actual results. In this case, an array of `S3ClientTypes.Bucket` objects describing a number of mock buckets is returned in the `buckets` property.

Not every property of the returned response object is filled out in this example. The only properties that get values are those that always contain a value and those actually used by the application. Your project might require more detailed results in its mock implementations of functions.

Encapsulate access to AWS services

A convenient way to use this approach in your application design is to create an access manager class that encapsulates all your SDK calls. For example, when using Amazon DynamoDB (DynamoDB) to manage a product database, create a `ProductDatabase` class that has functions to perform needed activities. This might include adding products and searching for products. This Amazon S3 example has a class that handles bucket interactions, called `BucketManager`.

The `BucketManager` class initializer needs to accept an object conforming to `S3SessionProtocol` as an input. This lets the caller specify whether to interact with AWS by using actual SDK for Swift calls or mocking. Then, every other function in the class that uses AWS actions should use that session object to do so. This lets `BucketManager` use actual SDK calls or mocked ones based on whether testing is underway.

With this in mind, the `BucketManager` class can now be implemented. It needs an `init(session:)` initializer and a `listBuckets(input:)` function:

```
public class BucketManager {
    /// The object based on the ``S3SessionProtocol`` protocol through which to
    /// call SDK for swift functions. This may be either ``S3Session`` or
    /// ``MockS3Session``.
    var session: S3SessionProtocol

    /// Initialize the ``BucketManager`` to call Amazon S3 functions using the
    /// specified object that implements ``S3SessionProtocol``.
    ///
    /// - Parameter session: The session object to use when calling Amazon S3.
    init(session: S3SessionProtocol) {
        self.session = session
    }

    /// Return an array listing all of the user's buckets by calling the
    /// ``S3SessionProtocol`` function `listBuckets()`.
    ///
    /// - Returns: An array of bucket name strings.
    ///
    public func getBucketNames() async throws -> [String] {
        let output = try await session.listBuckets(input: ListBucketsInput())

        guard let buckets = output.buckets else {
            return []
        }

        return buckets.map { $0.name ?? "<unknown>" }
    }
}
```

The `BucketManager` class in this example has an initializer that takes an object that conforms to `S3SessionProtocol` as an input. That session is used to access or simulate access to AWS actions instead of calling the SDK directly, as shown by the `getBucketNames()` function.

Use the access manager in the main program

The main program can now specify an `S3Session` when creating a `BucketManager` object, causing it to direct its requests to AWS:

```
        /// An ``S3Session`` object that passes calls through to the SDK for
        /// Swift.
        let session: S3Session
        /// A ``BucketManager`` object that will be initialized to call the
        /// SDK using the session.
        let bucketMgr: BucketManager

        // Create the ``S3Session`` and a ``BucketManager`` that calls the SDK
        // using it.
        do {
            session = try S3Session(region: "us-east-1")
            bucketMgr = BucketManager(session: session)
        } catch {
            print("Unable to initialize access to Amazon S3.")
            return
        }
```

Write tests using the protocol

Whether you write tests using Apple's XCTest framework or another framework, you must design the tests to use the mock implementation of the functions that access AWS services. In this example, tests use a class of type `XCTestCase` to implement a standard Swift test case:

```
final class MockingTests: XCTestCase {
    /// The session to use for Amazon S3 calls. In this case, it's a mock
    /// implementation.
    var session: MockS3Session? = nil
    /// The ``BucketManager`` that uses the session to perform Amazon S3
    /// operations.
    var bucketMgr: BucketManager? = nil

    /// Perform one-time initialization before executing any tests.
    override class func setUp() {
        super.setUp()
        SDKLoggingSystem.initialize(logLevel: .error)
    }
    /// Set up things that need to be done just before each
    /// individual test function is called.
    override func setUp() {
        super.setUp()

        self.session = MockS3Session()
        self.bucketMgr = BucketManager(session: self.session!)
    }

    /// Test that `getBucketNames()` returns the expected results.
    func testGetBucketNames() async throws {
        let returnedNames = try await self.bucketMgr!.getBucketNames()
        XCTAssertTrue(self.session!.checkBucketNames(names: returnedNames),
                "Bucket names don't match")
    }
}
```

This `XCTestCase` example's per-test `setUp()` function creates a new `MockS3Session`. Then it uses the mock session to create a `BucketManager` that will return mock results. The `testGetBucketNames()` test function tests the `getBucketNames()` function in the bucket manager object. This way, the tests operate using known data, without needing to access the network, and without accessing AWS services at all.

SDK for Swift code examples

The code examples in this topic show you how to use the AWS SDK for Swift with AWS.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Cross-service examples are sample applications that work across multiple AWS services.

Examples

Actions and scenarios using SDK for Swift

The following code examples show how to perform actions and implement common scenarios by using the AWS SDK for Swift with AWS services.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Services

Amazon Cognito Identity examples using SDK for Swift

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Swift with Amazon Cognito Identity.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

Actions

`CreateIdentityPool`

The following code example shows how to use `CreateIdentityPool`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

Create a new identity pool.

```
    /// Create a new identity pool and return its ID.
    ///
    /// - Parameters:
    ///     - name: The name to give the new identity pool.
    ///
    /// - Returns: A string containing the newly created pool's ID, or `nil`
    ///   if an error occurred.
    ///
    func createIdentityPool(name: String) async throws -> String? {
        let cognitoInputCall = CreateIdentityPoolInput(developerProviderName:
 "com.exampleco.CognitoIdentityDemo",
                                                       identityPoolName: name)

        let result = try await cognitoIdentityClient.createIdentityPool(input:
 cognitoInputCall)
        guard let poolId = result.identityPoolId else {
            return nil
        }

        return poolId
    }
```

- For more information, see AWS SDK for Swift developer guide.
- For API details, see CreateIdentityPool in *AWS SDK for Swift API reference*.

`DeleteIdentityPool`

The following code example shows how to use `DeleteIdentityPool`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

Delete the specified identity pool.

```
    /// Delete the specified identity pool.
    ///
    /// - Parameters:
    ///   - id: The ID of the identity pool to delete.
    ///
    func deleteIdentityPool(id: String) async throws {
        let input = DeleteIdentityPoolInput(
            identityPoolId: id
        )

        _ = try await cognitoIdentityClient.deleteIdentityPool(input: input)
    }
```

- For more information, see AWS SDK for Swift developer guide.
- For API details, see DeleteIdentityPool in *AWS SDK for Swift API reference*.

`ListIdentityPools`

The following code example shows how to use `ListIdentityPools`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

Find the ID of an identity pool given its name.

```
    /// Return the ID of the identity pool with the specified name.
    ///
    /// - Parameters:
    ///   - name: The name of the identity pool whose ID should be returned.
    ///
    /// - Returns: A string containing the ID of the specified identity pool
    ///   or `nil` on error or if not found.
    ///
    func getIdentityPoolID(name: String) async throws -> String? {
        var token: String? = nil

        // Iterate over the identity pools until a match is found.

        repeat {
            /// `token` is a value returned by `ListIdentityPools()` if the
            /// returned list of identity pools is only a partial list. You
            /// use the `token` to tell Amazon Cognito that you want to
            /// continue where you left off previously. If you specify `nil`
            /// or you don't provide the token, Amazon Cognito will start at
            /// the beginning.

            let listPoolsInput = ListIdentityPoolsInput(maxResults: 25, nextToken: 
token)

            /// Read pages of identity pools from Cognito until one is found
            /// whose name matches the one specified in the `name` parameter.
            /// Return the matching pool's ID. Each time we ask for the next
            /// page of identity pools, we pass in the token given by the
            /// previous page.

            let output = try await cognitoIdentityClient.listIdentityPools(input: 
listPoolsInput)

            if let identityPools = output.identityPools {
                for pool in identityPools {
                    if pool.identityPoolName == name {
                        return pool.identityPoolId!
                    }
                }
            }

            token = output.nextToken
        } while token != nil

        return nil
    }
```

Get the ID of an existing identity pool or create it if it doesn't already exist.

```
    /// Return the ID of the identity pool with the specified name.
    ///
    /// - Parameters:
    ///   - name: The name of the identity pool whose ID should be returned
    ///
    /// - Returns: A string containing the ID of the specified identity pool.
    ///   Returns `nil` if there's an error or if the pool isn't found.
    ///
    public func getOrCreateIdentityPoolID(name: String) async throws -> String? {
        // See if the pool already exists. If it doesn't, create it.

        guard let poolId = try await self.getIdentityPoolID(name: name) else {
            return try await self.createIdentityPool(name: name)
        }

        return poolId
    }
```

- For more information, see AWS SDK for Swift developer guide.
- For API details, see ListIdentityPools in *AWS SDK for Swift API reference*.

DynamoDB examples using SDK for Swift

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Swift with DynamoDB.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- Actions
- Scenarios

Actions

`BatchGetItem`

The following code example shows how to use `BatchGetItem`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    /// Gets an array of `Movie` objects describing all the movies in the
    /// specified list. Any movies that aren't found in the list have no
    /// corresponding entry in the resulting array.
    ///
    /// - Parameters
    ///     - keys: An array of tuples, each of which specifies the title and
    ///       release year of a movie to fetch from the table.
    ///
    /// - Returns:
    ///     - An array of `Movie` objects describing each match found in the
    ///     table.
    ///
    /// - Throws:
    ///     - `MovieError.ClientUninitialized` if the DynamoDB client has not
    ///     been initialized.
    ///     - DynamoDB errors are thrown without change.
    func batchGet(keys: [(title: String, year: Int)]) async throws -> [Movie] {
        guard let client = self.ddbClient else {
            throw MovieError.ClientUninitialized
        }

        var movieList: [Movie] = []
        var keyItems: [[Swift.String:DynamoDBClientTypes.AttributeValue]] = []

        // Convert the list of keys into the form used by DynamoDB.

        for key in keys {
            let item: [Swift.String:DynamoDBClientTypes.AttributeValue] = [
                "title": .s(key.title),
                "year": .n(String(key.year))
            ]
            keyItems.append(item)
        }

        // Create the input record for `batchGetItem()`. The list of requested
        // items is in the `requestItems` property. This array contains one
        // entry for each table from which items are to be fetched. In this
        // example, there's only one table containing the movie data.
        //
        // If we wanted this program to also support searching for matches
        // in a table of book data, we could add a second `requestItem`
        // mapping the name of the book table to the list of items we want to
        // find in it.
        let input = BatchGetItemInput(
            requestItems: [
                self.tableName: .init(
                    consistentRead: true,
                    keys: keyItems
                )
            ]
        )

        // Fetch the matching movies from the table.

        let output = try await client.batchGetItem(input: input)

        // Get the set of responses. If there aren't any, return the empty
        // movie list.

        guard let responses = output.responses else {
            return movieList
        }

        // Get the list of matching items for the table with the name
        // `tableName`.

        guard let responseList = responses[self.tableName] else {
            return movieList
        }

        // Create `Movie` items for each of the matching movies in the table
        // and add them to the `MovieList` array.

        for response in responseList {
            movieList.append(try Movie(withItem: response))
        }

        return movieList
    }
```

- For API details, see BatchGetItem in *AWS SDK for Swift API reference*.

`BatchWriteItem`

The following code example shows how to use `BatchWriteItem`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    /// Populate the movie database from the specified JSON file.
    ///
    /// - Parameter jsonPath: Path to a JSON file containing movie data.
    ///
    func populate(jsonPath: String) async throws {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        // Create a Swift `URL` and use it to load the file into a `Data`
        // object. Then decode the JSON into an array of `Movie` objects.

        let fileUrl = URL(fileURLWithPath: jsonPath)
        let jsonData = try Data(contentsOf: fileUrl)

        var movieList = try JSONDecoder().decode([Movie].self, from: jsonData)

        // Truncate the list to the first 200 entries or so for this example.

        if movieList.count > 200 {
            movieList = Array(movieList[...199])
        }

        // Before sending records to the database, break the movie list into
        // 25-entry chunks, which is the maximum size of a batch item request.

        let count = movieList.count
        let chunks = stride(from: 0, to: count, by: 25).map {
            Array(movieList[$0 ..< Swift.min($0 + 25, count)])
        }

        // For each chunk, create a list of write request records and populate
        // them with `PutRequest` requests, each specifying one movie from the
        // chunk. Once the chunk's items are all in the `PutRequest` list,
        // send them to Amazon DynamoDB using the
        // `DynamoDBClient.batchWriteItem()` function.

        for chunk in chunks {
            var requestList: [DynamoDBClientTypes.WriteRequest] = []

            for movie in chunk {
                let item = try await movie.getAsItem()
                let request = DynamoDBClientTypes.WriteRequest(
                    putRequest: .init(
                        item: item
                    )
                )
                requestList.append(request)
            }

            let input = BatchWriteItemInput(requestItems: [tableName: requestList])
            _ = try await client.batchWriteItem(input: input)
        }
    }
```

- For API details, see BatchWriteItem in *AWS SDK for Swift API reference*.

`CreateTable`

The following code example shows how to use `CreateTable`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    ///
    /// Create a movie table in the Amazon DynamoDB data store.
    ///
    private func createTable() async throws {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = CreateTableInput(
            attributeDefinitions: [
                DynamoDBClientTypes.AttributeDefinition(attributeName: "year", 
 attributeType: .n),
                DynamoDBClientTypes.AttributeDefinition(attributeName: "title", 
attributeType: .s),
            ],
            keySchema: [
                DynamoDBClientTypes.KeySchemaElement(attributeName: "year", 
keyType: .hash),
                DynamoDBClientTypes.KeySchemaElement(attributeName: "title", 
keyType: .range)
            ],
            provisionedThroughput: DynamoDBClientTypes.ProvisionedThroughput(
                readCapacityUnits: 10,
                writeCapacityUnits: 10
            ),
            tableName: self.tableName
        )
        let output = try await client.createTable(input: input)
        if output.tableDescription == nil {
            throw MoviesError.TableNotFound
        }
    }
```

- For API details, see CreateTable in *AWS SDK for Swift API reference*.

DeleteItem

The following code example shows how to use `DeleteItem`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    /// Delete a movie, given its title and release year.
    ///
    /// - Parameters:
    ///   - title: The movie's title.
    ///   - year: The movie's release year.
    ///
    func delete(title: String, year: Int) async throws {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = DeleteItemInput(
            key: [
                "year": .n(String(year)),
                "title": .s(title)
            ],
            tableName: self.tableName
        )
        _ = try await client.deleteItem(input: input)
    }
```

- For API details, see DeleteItem in *AWS SDK for Swift API reference*.

`DeleteTable`

The following code example shows how to use `DeleteTable`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    ///
    /// Deletes the table from Amazon DynamoDB.
    ///
    func deleteTable() async throws {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = DeleteTableInput(
            tableName: self.tableName
        )
        _ = try await client.deleteTable(input: input)
    }
```

- For API details, see DeleteTable in *AWS SDK for Swift API reference*.

`GetItem`

The following code example shows how to use `GetItem`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    /// Return a `Movie` record describing the specified movie from the Amazon
    /// DynamoDB table.
    ///
    /// - Parameters:
    ///   - title: The movie's title (`String`).
    ///   - year: The movie's release year (`Int`).
    ///
    /// - Throws: `MoviesError.ItemNotFound` if the movie isn't in the table.
    ///
    /// - Returns: A `Movie` record with the movie's details.
    func get(title: String, year: Int) async throws -> Movie {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = GetItemInput(
            key: [
                "year": .n(String(year)),
                "title": .s(title)
            ],
            tableName: self.tableName
        )
        let output = try await client.getItem(input: input)
        guard let item = output.item else {
            throw MoviesError.ItemNotFound
        }

        let movie = try Movie(withItem: item)
        return movie
    }
```

- For API details, see GetItem in *AWS SDK for Swift API reference*.

`ListTables`

The following code example shows how to use `ListTables`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
/// Get a list of the DynamoDB tables available in the specified Region.
///
/// - Returns: An array of strings listing all of the tables available
///   in the Region specified when the session was created.
public func getTableList() async throws -> [String] {
    var tableList: [String] = []
    var lastEvaluated: String? = nil

    // Iterate over the list of tables, 25 at a time, until we have the
    // names of every table. Add each group to the `tableList` array.
    // Iteration is complete when `output.lastEvaluatedTableName` is `nil`.

    repeat {
        let input = ListTablesInput(
            exclusiveStartTableName: lastEvaluated,
            limit: 25
        )
        let output = try await self.session.listTables(input: input)
        guard let tableNames = output.tableNames else {
            return tableList
        }
        tableList.append(contentsOf: tableNames)
        lastEvaluated = output.lastEvaluatedTableName
    } while lastEvaluated != nil

    return tableList
}
```

- For API details, see ListTables in *AWS SDK for Swift API reference*.

PutItem

The following code example shows how to use `PutItem`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    /// Add a movie specified as a `Movie` structure to the Amazon DynamoDB
    /// table.
    ///
    /// - Parameter movie: The `Movie` to add to the table.
    ///
    func add(movie: Movie) async throws {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        // Get a DynamoDB item containing the movie data.
        let item = try await movie.getAsItem()

        // Send the `PutItem` request to Amazon DynamoDB.

        let input = PutItemInput(
            item: item,
            tableName: self.tableName
        )
        _ = try await client.putItem(input: input)
    }

    ///
    /// Return an array mapping attribute names to Amazon DynamoDB attribute
    /// values, representing the contents of the `Movie` record as a DynamoDB
    /// item.
    ///
    /// - Returns: The movie item as an array of type
    ///   `[Swift.String:DynamoDBClientTypes.AttributeValue]`.
    ///
    func getAsItem() async throws ->
 [Swift.String:DynamoDBClientTypes.AttributeValue]  {
        // Build the item record, starting with the year and title, which are
        // always present.

        var item: [Swift.String:DynamoDBClientTypes.AttributeValue] = [
            "year": .n(String(self.year)),
            "title": .s(self.title)
        ]

        // Add the `info` field with the rating and/or plot if they're
        // available.

        var details: [Swift.String:DynamoDBClientTypes.AttributeValue] = [:]
        if (self.info.rating != nil || self.info.plot != nil) {
            if self.info.rating != nil {
                details["rating"] = .n(String(self.info.rating!))
            }
            if self.info.plot != nil {
                details["plot"] = .s(self.info.plot!)
            }
        }
        item["info"] = .m(details)

        return item
    }
```

- For API details, see PutItem in *AWS SDK for Swift API reference*.

`Query`

The following code example shows how to use `Query`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](https://github.com/awsdocs/aws-doc-sdk-examples).

```
    /// Get all the movies released in the specified year.
    ///
    /// - Parameter year: The release year of the movies to return.
    ///
    /// - Returns: An array of `Movie` objects describing each matching movie.
    ///
    func getMovies(fromYear year: Int) async throws -> [Movie] {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = QueryInput(
            expressionAttributeNames: [
                "#y": "year"
            ],
            expressionAttributeValues: [
                ":y": .n(String(year))
            ],
            keyConditionExpression: "#y = :y",
            tableName: self.tableName
        )
        let output = try await client.query(input: input)

        guard let items = output.items else {
            throw MoviesError.ItemNotFound
        }

        // Convert the found movies into `Movie` objects and return an array
        // of them.

        var movieList: [Movie] = []
        for item in items {
            let movie = try Movie(withItem: item)
            movieList.append(movie)
        }
        return movieList
    }
```

- For API details, see Query in *AWS SDK for Swift API reference*.

Scan

The following code example shows how to use `Scan`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    /// Return an array of `Movie` objects released in the specified range of
    /// years.
    ///
    /// - Parameters:
    ///   - firstYear: The first year of movies to return.
    ///   - lastYear: The last year of movies to return.
    ///   - startKey: A starting point to resume processing; always use `nil`.
    ///
    /// - Returns: An array of `Movie` objects describing the matching movies.
    ///
    /// > Note: The `startKey` parameter is used by this function when
    ///   recursively calling itself, and should always be `nil` when calling
    ///   directly.
    ///
    func getMovies(firstYear: Int, lastYear: Int,
                   startKey: [Swift.String:DynamoDBClientTypes.AttributeValue]? =
 nil)
                   async throws -> [Movie] {
        var movieList: [Movie] = []
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = ScanInput(
            consistentRead: true,
            exclusiveStartKey: startKey,
            expressionAttributeNames: [
                "#y": "year"            // `year` is a reserved word, so use `#y` 
instead.
            ],
            expressionAttributeValues: [
                ":y1": .n(String(firstYear)),
                ":y2": .n(String(lastYear))
            ],
            filterExpression: "#y BETWEEN :y1 AND :y2",
            tableName: self.tableName
        )

        let output = try await client.scan(input: input)

        guard let items = output.items else {
            return movieList
        }

        // Build an array of `Movie` objects for the returned items.

        for item in items {
            let movie = try Movie(withItem: item)
            movieList.append(movie)
        }

        // Call this function recursively to continue collecting matching
        // movies, if necessary.

        if output.lastEvaluatedKey != nil {
            let movies = try await self.getMovies(firstYear: firstYear, lastYear: 
lastYear,
                                 startKey: output.lastEvaluatedKey)
            movieList += movies
        }
        return movieList
    }
```

- For API details, see Scan in *AWS SDK for Swift API reference*.

UpdateItem

The following code example shows how to use `UpdateItem`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    /// Update the specified movie with new `rating` and `plot` information.
    ///
    /// - Parameters:
    ///   - title: The title of the movie to update.
    ///   - year: The release year of the movie to update.
    ///   - rating: The new rating for the movie.
    ///   - plot: The new plot summary string for the movie.
    ///
    /// - Returns: An array of mappings of attribute names to their new
    ///   listing each item actually changed. Items that didn't need to change
    ///   aren't included in this list. `nil` if no changes were made.
    ///
    func update(title: String, year: Int, rating: Double? = nil, plot: String? =
 nil) async throws
                -> [Swift.String:DynamoDBClientTypes.AttributeValue]? {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }
        // Build the update expression and the list of expression attribute
        // values. Include only the information that's changed.

        var expressionParts: [String] = []
        var attrValues: [Swift.String:DynamoDBClientTypes.AttributeValue] = [:]

        if rating != nil {
            expressionParts.append("info.rating=:r")
            attrValues[":r"] = .n(String(rating!))
        }
        if plot != nil {
            expressionParts.append("info.plot=:p")
            attrValues[":p"] = .s(plot!)
        }
        let expression: String = "set \(expressionParts.joined(separator: ", "))"

        let input = UpdateItemInput(
            // Create substitution tokens for the attribute values, to ensure
            // no conflicts in expression syntax.
            expressionAttributeValues: attrValues,
            // The key identifying the movie to update consists of the release
            // year and title.
            key: [
                "year": .n(String(year)),
                "title": .s(title)
            ],
            returnValues: .updatedNew,
            tableName: self.tableName,
            updateExpression: expression
        )
        let output = try await client.updateItem(input: input)

        guard let attributes: [Swift.String:DynamoDBClientTypes.AttributeValue] =
 output.attributes else {
            throw MoviesError.InvalidAttributes
        }
        return attributes
    }
```

- For API details, see UpdateItem in *AWS SDK for Swift API reference*.

Scenarios

Get started with tables, items, and queries

The following code example shows how to:

- Create a table that can hold movie data.
- Put, get, and update a single movie in the table.
- Write movie data to the table from a sample JSON file.
- Query for movies that were released in a given year.
- Scan for movies that were released in a range of years.
- Delete a movie from the table, then delete the table.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

A Swift class that handles DynamoDB calls to the SDK for Swift.

```
import Foundation
import AWSDynamoDB

/// An enumeration of error codes representing issues that can arise when using
/// the `MovieTable` class.
enum MoviesError: Error {
    /// The specified table wasn't found or couldn't be created.
    case TableNotFound
    /// The specified item wasn't found or couldn't be created.
    case ItemNotFound
    /// The Amazon DynamoDB client is not properly initialized.
    case UninitializedClient
    /// The table status reported by Amazon DynamoDB is not recognized.
    case StatusUnknown
    /// One or more specified attribute values are invalid or missing.
    case InvalidAttributes
}


/// A class representing an Amazon DynamoDB table containing movie
/// information.
public class MovieTable {
    var ddbClient: DynamoDBClient? = nil
    let tableName: String

    /// Create an object representing a movie table in an Amazon DynamoDB
    /// database.
    ///
    /// - Parameters:
    ///   - region: The Amazon Region to create the database in.
    ///   - tableName: The name to assign to the table. If not specified, a
    ///     random table name is generated automatically.
    ///
    /// > Note: The table is not necessarily available when this function
    /// returns. Use `tableExists()` to check for its availability, or
    /// `awaitTableActive()` to wait until the table's status is reported as
    /// ready to use by Amazon DynamoDB.
    ///
    init(region: String = "us-east-2", tableName: String) async throws {
        ddbClient = try DynamoDBClient(region: region)
        self.tableName = tableName

        try await self.createTable()
    }

    ///
    /// Create a movie table in the Amazon DynamoDB data store.
    ///
    private func createTable() async throws {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = CreateTableInput(
            attributeDefinitions: [
                DynamoDBClientTypes.AttributeDefinition(attributeName: "year",
attributeType: .n),
                DynamoDBClientTypes.AttributeDefinition(attributeName: "title",
attributeType: .s),
            ],
            keySchema: [
                DynamoDBClientTypes.KeySchemaElement(attributeName: "year",
keyType: .hash),
                DynamoDBClientTypes.KeySchemaElement(attributeName: "title",
keyType: .range)
            ],
            provisionedThroughput: DynamoDBClientTypes.ProvisionedThroughput(
                readCapacityUnits: 10,
                writeCapacityUnits: 10
            ),
            tableName: self.tableName
        )
        let output = try await client.createTable(input: input)
        if output.tableDescription == nil {
            throw MoviesError.TableNotFound
        }
    }

    /// Check to see if the table exists online yet.
    ///
    /// - Returns: `true` if the table exists, or `false` if not.
    ///
    func tableExists() async throws -> Bool {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = DescribeTableInput(
            tableName: tableName
        )
        let output = try await client.describeTable(input: input)
        guard let description = output.table else {
            throw MoviesError.TableNotFound
        }

        return (description.tableName == self.tableName)
    }

    ///
    /// Waits for the table to exist and for its status to be active.
    ///
    func awaitTableActive() async throws {
        while (try await tableExists() == false) {
            Thread.sleep(forTimeInterval: 0.25)
        }

        while (try await getTableStatus() != .active) {
            Thread.sleep(forTimeInterval: 0.25)
        }
    }

    ///
    /// Deletes the table from Amazon DynamoDB.
    ///
    func deleteTable() async throws {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = DeleteTableInput(
            tableName: self.tableName
        )
        _ = try await client.deleteTable(input: input)
    }

    /// Get the table's status.
    ///
    /// - Returns: The table status, as defined by the
    ///   `DynamoDBClientTypes.TableStatus` enum.
    ///
    func getTableStatus() async throws -> DynamoDBClientTypes.TableStatus {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = DescribeTableInput(
            tableName: self.tableName
        )
        let output = try await client.describeTable(input: input)
        guard let description = output.table else {
            throw MoviesError.TableNotFound
        }
        guard let status = description.tableStatus else {
            throw MoviesError.StatusUnknown
        }
        return status
    }

    /// Populate the movie database from the specified JSON file.
    ///
    /// - Parameter jsonPath: Path to a JSON file containing movie data.
    ///
    func populate(jsonPath: String) async throws {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        // Create a Swift `URL` and use it to load the file into a `Data`
        // object. Then decode the JSON into an array of `Movie` objects.

        let fileUrl = URL(fileURLWithPath: jsonPath)
        let jsonData = try Data(contentsOf: fileUrl)

        var movieList = try JSONDecoder().decode([Movie].self, from: jsonData)

        // Truncate the list to the first 200 entries or so for this example.

        if movieList.count > 200 {
            movieList = Array(movieList[...199])
        }

        // Before sending records to the database, break the movie list into
        // 25-entry chunks, which is the maximum size of a batch item request.

        let count = movieList.count
        let chunks = stride(from: 0, to: count, by: 25).map {
            Array(movieList[$0 ..< Swift.min($0 + 25, count)])
        }

        // For each chunk, create a list of write request records and populate
        // them with `PutRequest` requests, each specifying one movie from the
        // chunk. Once the chunk's items are all in the `PutRequest` list,
        // send them to Amazon DynamoDB using the
        // `DynamoDBClient.batchWriteItem()` function.

        for chunk in chunks {
            var requestList: [DynamoDBClientTypes.WriteRequest] = []
            for movie in chunk {
                let item = try await movie.getAsItem()
                let request = DynamoDBClientTypes.WriteRequest(
                    putRequest: .init(
                        item: item
                    )
                )
                requestList.append(request)
            }

            let input = BatchWriteItemInput(requestItems: [tableName: requestList])
            _ = try await client.batchWriteItem(input: input)
        }
    }

    /// Add a movie specified as a `Movie` structure to the Amazon DynamoDB
    /// table.
    ///
    /// - Parameter movie: The `Movie` to add to the table.
    ///
    func add(movie: Movie) async throws {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        // Get a DynamoDB item containing the movie data.
        let item = try await movie.getAsItem()

        // Send the `PutItem` request to Amazon DynamoDB.

        let input = PutItemInput(
            item: item,
            tableName: self.tableName
        )
        _ = try await client.putItem(input: input)
    }

    /// Given a movie's details, add a movie to the Amazon DynamoDB table.
    ///
    /// - Parameters:
    ///   - title: The movie's title as a `String`.
    ///   - year: The release year of the movie (`Int`).
    ///   - rating: The movie's rating if available (`Double`; default is
    ///     `nil`).
    ///   - plot: A summary of the movie's plot (`String`; default is `nil`,
    ///     indicating no plot summary is available).
    ///
    func add(title: String, year: Int, rating: Double? = nil,
             plot: String? = nil) async throws {
        let movie = Movie(title: title, year: year, rating: rating, plot: plot)
        try await self.add(movie: movie)
    }

    /// Return a `Movie` record describing the specified movie from the Amazon
    /// DynamoDB table.
    ///
    /// - Parameters:
    ///   - title: The movie's title (`String`).
    ///   - year: The movie's release year (`Int`).
    ///
    /// - Throws: `MoviesError.ItemNotFound` if the movie isn't in the table.
    ///
    /// - Returns: A `Movie` record with the movie's details.
    func get(title: String, year: Int) async throws -> Movie {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = GetItemInput(
            key: [
                "year": .n(String(year)),
                "title": .s(title)
            ],
            tableName: self.tableName
        )
        let output = try await client.getItem(input: input)
        guard let item = output.item else {
            throw MoviesError.ItemNotFound
        }

        let movie = try Movie(withItem: item)
        return movie
    }

    /// Get all the movies released in the specified year.
    ///
    /// - Parameter year: The release year of the movies to return.
    ///
    /// - Returns: An array of `Movie` objects describing each matching movie.
    ///
    func getMovies(fromYear year: Int) async throws -> [Movie] {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = QueryInput(
            expressionAttributeNames: [
                "#y": "year"
            ],
            expressionAttributeValues: [
                ":y": .n(String(year))
            ],
            keyConditionExpression: "#y = :y",
            tableName: self.tableName
        )
        let output = try await client.query(input: input)

        guard let items = output.items else {
            throw MoviesError.ItemNotFound
        }

        // Convert the found movies into `Movie` objects and return an array
        // of them.

        var movieList: [Movie] = []
        for item in items {
            let movie = try Movie(withItem: item)
            movieList.append(movie)
        }
        return movieList
    }

    /// Return an array of `Movie` objects released in the specified range of
    /// years.
    ///
    /// - Parameters:
    ///   - firstYear: The first year of movies to return.
    ///   - lastYear: The last year of movies to return.
    ///   - startKey: A starting point to resume processing; always use `nil`.
    ///
    /// - Returns: An array of `Movie` objects describing the matching movies.
    ///
    /// > Note: The `startKey` parameter is used by this function when
    ///   recursively calling itself, and should always be `nil` when calling
    ///   directly.
    ///
    func getMovies(firstYear: Int, lastYear: Int,
                   startKey: [Swift.String:DynamoDBClientTypes.AttributeValue]? =
 nil)
                   async throws -> [Movie] {
        var movieList: [Movie] = []

        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = ScanInput(
            consistentRead: true,
            exclusiveStartKey: startKey,
            expressionAttributeNames: [
                "#y": "year"            // `year` is a reserved word, so use `#y`
 instead.
            ],
            expressionAttributeValues: [
                ":y1": .n(String(firstYear)),
                ":y2": .n(String(lastYear))
            ],
            filterExpression: "#y BETWEEN :y1 AND :y2",
            tableName: self.tableName
        )

        let output = try await client.scan(input: input)

        guard let items = output.items else {
            return movieList
        }

        // Build an array of `Movie` objects for the returned items.

        for item in items {
            let movie = try Movie(withItem: item)
            movieList.append(movie)
        }

        // Call this function recursively to continue collecting matching
        // movies, if necessary.

        if output.lastEvaluatedKey != nil {
            let movies = try await self.getMovies(firstYear: firstYear, lastYear:
 lastYear,
                         startKey: output.lastEvaluatedKey)
            movieList += movies
        }
        return movieList
    }

    /// Update the specified movie with new `rating` and `plot` information.
    ///
    /// - Parameters:
    ///   - title: The title of the movie to update.
    ///   - year: The release year of the movie to update.
    ///   - rating: The new rating for the movie.
    ///   - plot: The new plot summary string for the movie.
    ///
    /// - Returns: An array of mappings of attribute names to their new
    ///   listing each item actually changed. Items that didn't need to change
    ///   aren't included in this list. `nil` if no changes were made.
    ///
    func update(title: String, year: Int, rating: Double? = nil, plot: String? =
 nil) async throws
                -> [Swift.String:DynamoDBClientTypes.AttributeValue]? {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        // Build the update expression and the list of expression attribute
        // values. Include only the information that's changed.

        var expressionParts: [String] = []
        var attrValues: [Swift.String:DynamoDBClientTypes.AttributeValue] = [:]

        if rating != nil {
            expressionParts.append("info.rating=:r")
            attrValues[":r"] = .n(String(rating!))
        }
        if plot != nil {
            expressionParts.append("info.plot=:p")
            attrValues[":p"] = .s(plot!)
        }
        let expression: String = "set \(expressionParts.joined(separator: ", "))"

        let input = UpdateItemInput(
            // Create substitution tokens for the attribute values, to ensure
            // no conflicts in expression syntax.
            expressionAttributeValues: attrValues,
            // The key identifying the movie to update consists of the release
            // year and title.
            key: [
                "year": .n(String(year)),
                "title": .s(title)
            ],
            returnValues: .updatedNew,
            tableName: self.tableName,
            updateExpression: expression
        )
        let output = try await client.updateItem(input: input)

        guard let attributes: [Swift.String:DynamoDBClientTypes.AttributeValue] =
 output.attributes else {
            throw MoviesError.InvalidAttributes
        }
        return attributes
    }

    /// Delete a movie, given its title and release year.
    ///
    /// - Parameters:
    ///   - title: The movie's title.
    ///   - year: The movie's release year.
    ///
    func delete(title: String, year: Int) async throws {
        guard let client = self.ddbClient else {
            throw MoviesError.UninitializedClient
        }

        let input = DeleteItemInput(
            key: [
                "year": .n(String(year)),
                "title": .s(title)
            ],
            tableName: self.tableName
        )
        _ = try await client.deleteItem(input: input)
    }
}
```

The structures used by the MovieTable class to represent movies.

```
import Foundation
import AWSDynamoDB

/// The optional details about a movie.
public struct Details: Codable {
    /// The movie's rating, if available.
    var rating: Double?
    /// The movie's plot, if available.
    var plot: String?
}

/// A structure describing a movie. The `year` and `title` properties are
/// required and are used as the key for Amazon DynamoDB operations. The
/// `info` sub-structure's two properties, `rating` and `plot`, are optional.
public struct Movie: Codable {
    /// The year in which the movie was released.
    var year: Int
    /// The movie's title.
    var title: String
    /// A `Details` object providing the optional movie rating and plot
    /// information.
    var info: Details

    /// Create a `Movie` object representing a movie, given the movie's
    /// details.
    ///
    /// - Parameters:
    ///   - title: The movie's title (`String`).
    ///   - year: The year in which the movie was released (`Int`).
    ///   - rating: The movie's rating (optional `Double`).
    ///   - plot: The movie's plot (optional `String`)
    init(title: String, year: Int, rating: Double? = nil, plot: String? = nil) {
        self.title = title
        self.year = year

        self.info = Details(rating: rating, plot: plot)
    }
    /// Create a `Movie` object representing a movie, given the movie's
    /// details.
    ///
    /// - Parameters:
    ///   - title: The movie's title (`String`).
    ///   - year: The year in which the movie was released (`Int`).
    ///   - info: The optional rating and plot information for the movie in a
    ///     `Details` object.
    init(title: String, year: Int, info: Details?){
        self.title = title
        self.year = year

        if info != nil {
            self.info = info!
        } else {
            self.info = Details(rating: nil, plot: nil)
        }
    }

    ///
    /// Return a new `MovieTable` object, given an array mapping string to Amazon
    /// DynamoDB attribute values.
    ///
    /// - Parameter item: The item information provided to the form used by
    ///   DynamoDB. This is an array of strings mapped to
    ///   `DynamoDBClientTypes.AttributeValue` values.
    init(withItem item: [Swift.String:DynamoDBClientTypes.AttributeValue]) throws  {
        // Read the attributes.

        guard let titleAttr = item["title"],
              let yearAttr = item["year"] else {
            throw MoviesError.ItemNotFound
        }
        let infoAttr = item["info"] ?? nil

        // Extract the values of the title and year attributes.

        if case .s(let titleVal) = titleAttr {
            self.title = titleVal
        } else {
            throw MoviesError.InvalidAttributes
        }
        if case .n(let yearVal) = yearAttr {
            self.year = Int(yearVal)!
        } else {
            throw MoviesError.InvalidAttributes
        }

        // Extract the rating and/or plot from the `info` attribute, if
        // they're present.

        var rating: Double? = nil
        var plot: String? = nil

        if infoAttr != nil, case .m(let infoVal) = infoAttr {
            let ratingAttr = infoVal["rating"] ?? nil
            let plotAttr = infoVal["plot"] ?? nil

            if ratingAttr != nil, case .n(let ratingVal) = ratingAttr {
                rating = Double(ratingVal) ?? nil
            }
            if plotAttr != nil, case .s(let plotVal) = plotAttr {
                plot = plotVal
            }
        }

        self.info = Details(rating: rating, plot: plot)
    }

    ///
    /// Return an array mapping attribute names to Amazon DynamoDB attribute
    /// values, representing the contents of the `Movie` record as a DynamoDB
    /// item.
    ///
    /// - Returns: The movie item as an array of type
    ///   `[Swift.String:DynamoDBClientTypes.AttributeValue]`.
    ///
    func getAsItem() async throws ->
 [Swift.String:DynamoDBClientTypes.AttributeValue]  {
        // Build the item record, starting with the year and title, which are
        // always present.

        var item: [Swift.String:DynamoDBClientTypes.AttributeValue] = [
            "year": .n(String(self.year)),
            "title": .s(self.title)
        ]
        // Add the `info` field with the rating and/or plot if they're
        // available.

        var details: [Swift.String:DynamoDBClientTypes.AttributeValue] = [:]
        if (self.info.rating != nil || self.info.plot != nil) {
            if self.info.rating != nil {
                details["rating"] = .n(String(self.info.rating!))
            }
            if self.info.plot != nil {
                details["plot"] = .s(self.info.plot!)
            }
        }
        item["info"] = .m(details)

        return item
    }
 }
```

A program that uses the MovieTable class to access a DynamoDB database.

```
import Foundation
import ArgumentParser
import AWSDynamoDB
import ClientRuntime

@testable import MovieList

struct ExampleCommand: ParsableCommand {
    @Argument(help: "The path of the sample movie data JSON file.")
    var jsonPath: String = "../../../../resources/sample_files/movies.json"

    @Option(help: "The AWS Region to run AWS API calls in.")
    var awsRegion = "us-east-2"

    @Option(
        help: ArgumentHelp("The level of logging for the Swift SDK to perform."),
        completion: .list([
            "critical",
            "debug",
            "error",
            "info",
            "notice",
            "trace",
            "warning"
        ])
    )
    var logLevel: String = "error"

    /// Configuration details for the command.
    static var configuration = CommandConfiguration(
        commandName: "basics",
        abstract: "A basic scenario demonstrating the usage of Amazon DynamoDB.",
        discussion: """
        An example showing how to use Amazon DynamoDB to perform a series of
        common database activities on a simple movie database.
        """
    )

    /// Called by ``main()`` to asynchronously run the AWS example.
    func runAsync() async throws {
        print("Welcome to the AWS SDK for Swift basic scenario for Amazon
 DynamoDB!")
        SDKLoggingSystem.initialize(logLevel: .error)

        //======================================================================
        // 1. Create the table. The Amazon DynamoDB table is represented by
        //    the `MovieTable` class.
        //======================================================================

        let tableName = "ddb-movies-sample-\(Int.random(in: 1...Int.max))"
        //let tableName = String.uniqueName(withPrefix: "ddb-movies-sample",
 maxDigits: 8)

        print("Creating table \"\(tableName)\"...")

        let movieDatabase = try await MovieTable(region: awsRegion,
                            tableName: tableName)

        print("\nWaiting for table to be ready to use...")
        try await movieDatabase.awaitTableActive()

        //======================================================================
        // 2. Add a movie to the table.
        //======================================================================
        print("\nAdding a movie...")
        try await movieDatabase.add(title: "Avatar: The Way of Water", year: 2022)
        try await movieDatabase.add(title: "Not a Real Movie", year: 2023)

        //=====================================================================
        // 3. Update the plot and rating of the movie using an update
        //    expression.
        //=====================================================================

        print("\nAdding details to the added movie...")
        _ = try await movieDatabase.update(title: "Avatar: The Way of Water", year:
 2022,
                    rating: 9.2, plot: "It's a sequel.")

        //=====================================================================
        // 4. Populate the table from the JSON file.
        //=====================================================================

        print("\nPopulating the movie database from JSON...")
        try await movieDatabase.populate(jsonPath: jsonPath)

        //=====================================================================
        // 5. Get a specific movie by key. In this example, the key is a
        //    combination of `title` and `year`.
        //=====================================================================

        print("\nLooking for a movie in the table...")
        let gotMovie = try await movieDatabase.get(title: "This Is the End", year:
 2013)

        print("Found the movie \"\(gotMovie.title)\", released in
 \(gotMovie.year).")
        print("Rating: \(gotMovie.info.rating ?? 0.0).")
        print("Plot summary: \(gotMovie.info.plot ?? "None.")")

        //=====================================================================
        // 6. Delete a movie.
        //=====================================================================

        print("\nDeleting the added movie...")
        try await movieDatabase.delete(title: "Avatar: The Way of Water", year:
 2022)

        //=====================================================================
        // 7. Use a query with a key condition expression to return all movies
        //    released in a given year.
        //======================================================================

        print("\nGetting movies released in 1994...")
        let movieList = try await movieDatabase.getMovies(fromYear: 1994)
        for movie in movieList {
            print("    \(movie.title)")
        }

        //======================================================================
        // 8. Use `scan()` to return movies released in a range of years.
        //======================================================================

        print("\nGetting movies released between 1993 and 1997...")
        let scannedMovies = try await movieDatabase.getMovies(firstYear: 1993,
 lastYear: 1997)
        for movie in scannedMovies {
            print("    \(movie.title) (\(movie.year))")
        }

        //======================================================================
        // 9. Delete the table.
        //======================================================================

        print("\nDeleting the table...")
        try await movieDatabase.deleteTable()
    }
}

@main
struct Main {
    static func main() async {
        let args = Array(CommandLine.arguments.dropFirst())

        do {
            let command = try ExampleCommand.parse(args)
            try await command.runAsync()
        } catch {
            ExampleCommand.exit(withError: error)
        }
    }
}
```

- For API details, see the following topics in *AWS SDK for Swift API reference*.
  - BatchWriteItem
  - CreateTable
  - DeleteItem
  - DeleteTable
  - DescribeTable
  - GetItem
  - PutItem
  - Query
  - Scan
  - UpdateItem

IAM examples using SDK for Swift

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Swift with IAM.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

Actions

AttachRolePolicy

The following code example shows how to use `AttachRolePolicy`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func attachRolePolicy(role: String, policyArn: String) async throws {
        let input = AttachRolePolicyInput(
            policyArn: policyArn,
            roleName: role
        )
        do {
            _ = try await client.attachRolePolicy(input: input)
        } catch {
            throw error
        }
    }
```

- For API details, see AttachRolePolicy in *AWS SDK for Swift API reference*.

CreateAccessKey

The following code example shows how to use `CreateAccessKey`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func createAccessKey(userName: String) async throws ->
IAMClientTypes.AccessKey {
        let input = CreateAccessKeyInput(
            userName: userName
        )
        do {
            let output = try await iamClient.createAccessKey(input: input)
            guard let accessKey = output.accessKey else {
                throw ServiceHandlerError.keyError
            }
            return accessKey
        } catch {
            throw error
        }
    }
```

- For API details, see CreateAccessKey in *AWS SDK for Swift API reference*.

CreatePolicy

The following code example shows how to use `CreatePolicy`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func createPolicy(name: String, policyDocument: String) async throws ->
IAMClientTypes.Policy {
        let input = CreatePolicyInput(
            policyDocument: policyDocument,
            policyName: name
        )
        do {
            let output = try await iamClient.createPolicy(input: input)
            guard let policy = output.policy else {
                throw ServiceHandlerError.noSuchPolicy
            }
            return policy
        } catch {
            throw error
        }
    }
```

- For API details, see CreatePolicy in *AWS SDK for Swift API reference*.

`CreateRole`

The following code example shows how to use `CreateRole`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func createRole(name: String, policyDocument: String) async throws ->
 String {
        let input = CreateRoleInput(
            assumeRolePolicyDocument: policyDocument,
            roleName: name
        )
        do {
            let output = try await client.createRole(input: input)
            guard let role = output.role else {
                throw ServiceHandlerError.noSuchRole
            }
            guard let id = role.roleId else {
                throw ServiceHandlerError.noSuchRole
            }
            return id
        } catch {
            throw error
        }
    }
```

- For API details, see CreateRole in *AWS SDK for Swift API reference*.

`CreateServiceLinkedRole`

The following code example shows how to use `CreateServiceLinkedRole`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func createServiceLinkedRole(service: String, suffix: String? = nil,
 description: String?)
                        async throws -> IAMClientTypes.Role {
        let input = CreateServiceLinkedRoleInput(
            awsServiceName: service,
            customSuffix: suffix,
            description: description
        )
        do {
            let output = try await client.createServiceLinkedRole(input: input)
            guard let role = output.role else {
                throw ServiceHandlerError.noSuchRole
            }
            return role
        } catch {
            throw error
        }
    }
```

- For API details, see CreateServiceLinkedRole in *AWS SDK for Swift API reference*.

`CreateUser`

The following code example shows how to use `CreateUser`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
public func createUser(name: String) async throws -> String {
    let input = CreateUserInput(
        userName: name
    )
    do {
        let output = try await client.createUser(input: input)
        guard let user = output.user else {
            throw ServiceHandlerError.noSuchUser
        }
        guard let id = user.userId else {
            throw ServiceHandlerError.noSuchUser
        }
        return id
    } catch {
        throw error
    }
}
```

- For API details, see CreateUser in *AWS SDK for Swift API reference*.

`DeleteAccessKey`

The following code example shows how to use `DeleteAccessKey`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func deleteAccessKey(user: IAMClientTypes.User? = nil,
                                key: IAMClientTypes.AccessKey) async throws {
        let userName: String?

        if user != nil {
            userName = user!.userName
        } else {
            userName = nil
        }

        let input = DeleteAccessKeyInput(
            accessKeyId: key.accessKeyId,
            userName: userName
        )
        do {
            _ = try await iamClient.deleteAccessKey(input: input)
        } catch {
            throw error
        }
    }
```

- For API details, see DeleteAccessKey in *AWS SDK for Swift API reference*.

`DeletePolicy`

The following code example shows how to use `DeletePolicy`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
public func deletePolicy(policy: IAMClientTypes.Policy) async throws {
    let input = DeletePolicyInput(
        policyArn: policy.arn
    )
    do {
        _ = try await iamClient.deletePolicy(input: input)
    } catch {
        throw error
    }
}
```

- For API details, see DeletePolicy in *AWS SDK for Swift API reference*.

`DeleteRole`

The following code example shows how to use `DeleteRole`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func deleteRole(role: IAMClientTypes.Role) async throws {
        let input = DeleteRoleInput(
            roleName: role.roleName
        )
        do {
            _ = try await iamClient.deleteRole(input: input)
        } catch {
            throw error
        }
    }
```

- For API details, see DeleteRole in *AWS SDK for Swift API reference*.

DeleteUser

The following code example shows how to use `DeleteUser`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func deleteUser(user: IAMClientTypes.User) async throws {
        let input = DeleteUserInput(
            userName: user.userName
        )
        do {
            _ = try await iamClient.deleteUser(input: input)
        } catch {
            throw error
        }
    }
```

- For API details, see DeleteUser in *AWS SDK for Swift API reference*.

`DeleteUserPolicy`

The following code example shows how to use `DeleteUserPolicy`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    func deleteUserPolicy(user: IAMClientTypes.User, policyName: String) async
 throws {
        let input = DeleteUserPolicyInput(
            policyName: policyName,
            userName: user.userName
        )
        do {
            _ = try await iamClient.deleteUserPolicy(input: input)
        } catch {
            throw error
        }
    }
```

- For API details, see DeleteUserPolicy in *AWS SDK for Swift API reference*.

`DetachRolePolicy`

The following code example shows how to use `DetachRolePolicy`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func detachRolePolicy(policy: IAMClientTypes.Policy, role: 
IAMClientTypes.Role) async throws {
        let input = DetachRolePolicyInput(
            policyArn: policy.arn,
            roleName: role.roleName
        )

        do {
            _ = try await iamClient.detachRolePolicy(input: input)
        } catch {
            throw error
        }
    }
```

- For API details, see DetachRolePolicy in *AWS SDK for Swift API reference*.

GetPolicy

The following code example shows how to use `GetPolicy`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func getPolicy(arn: String) async throws -> IAMClientTypes.Policy {
        let input = GetPolicyInput(
            policyArn: arn
        )
        do {
            let output = try await client.getPolicy(input: input)
            guard let policy = output.policy else {
                throw ServiceHandlerError.noSuchPolicy
            }
            return policy
        } catch {
            throw error
        }
    }
```

- For API details, see GetPolicy in *AWS SDK for Swift API reference*.

GetRole

The following code example shows how to use `GetRole`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func getRole(name: String) async throws -> IAMClientTypes.Role {
        let input = GetRoleInput(
            roleName: name
        )
        do {
            let output = try await client.getRole(input: input)
            guard let role = output.role else {
                throw ServiceHandlerError.noSuchRole
            }
            return role
        } catch {
            throw error
        }
    }
```

- For API details, see GetRole in *AWS SDK for Swift API reference*.

`ListAttachedRolePolicies`

The following code example shows how to use `ListAttachedRolePolicies`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    /// Returns a list of AWS Identity and Access Management (IAM) policies
    /// that are attached to the role.
    ///
    /// - Parameter role: The IAM role to return the policy list for.
    ///
    /// - Returns: An array of `IAMClientTypes.AttachedPolicy` objects
    ///   describing each managed policy that's attached to the role.
    public func listAttachedRolePolicies(role: String) async throws ->
[IAMClientTypes.AttachedPolicy] {
        var policyList: [IAMClientTypes.AttachedPolicy] = []
        var marker: String? = nil
        var isTruncated: Bool

        repeat {
            let input = ListAttachedRolePoliciesInput(
                marker: marker,
                roleName: role
            )
            let output = try await client.listAttachedRolePolicies(input: input)

            guard let attachedPolicies = output.attachedPolicies else {
                return policyList
            }

            for attachedPolicy in attachedPolicies {
                policyList.append(attachedPolicy)
            }
            marker = output.marker
            isTruncated = output.isTruncated
        } while isTruncated == true
        return policyList
    }
```

- For API details, see ListAttachedRolePolicies in *AWS SDK for Swift API reference*.

`ListGroups`

The following code example shows how to use `ListGroups`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func listGroups() async throws -> [String] {
        var groupList: [String] = []
        var marker: String? = nil
        var isTruncated: Bool

        repeat {
            let input = ListGroupsInput(marker: marker)
            let output = try await client.listGroups(input: input)

            guard let groups = output.groups else {
                return groupList
            }

            for group in groups {
                if let name = group.groupName {
                    groupList.append(name)
                }
            }
            marker = output.marker
            isTruncated = output.isTruncated
        } while isTruncated == true
        return groupList
    }
```

- For API details, see ListGroups in *AWS SDK for Swift API reference*.

`ListPolicies`

The following code example shows how to use `ListPolicies`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func listPolicies() async throws -> [MyPolicyRecord] {
        var policyList: [MyPolicyRecord] = []
        var marker: String? = nil
        var isTruncated: Bool

        repeat {
            let input = ListPoliciesInput(marker: marker)
            let output = try await client.listPolicies(input: input)

            guard let policies = output.policies else {
                return policyList
            }

            for policy in policies {
                guard   let name = policy.policyName,
                        let id = policy.policyId,
                        let arn = policy.arn else {
                    throw ServiceHandlerError.noSuchPolicy
                }
                policyList.append(MyPolicyRecord(name: name, id: id, arn: arn))
            }
            marker = output.marker
            isTruncated = output.isTruncated
        } while isTruncated == true
        return policyList
    }
```

- For API details, see ListPolicies in *AWS SDK for Swift API reference*.

`ListRolePolicies`

The following code example shows how to use `ListRolePolicies`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func listRolePolicies(role: String) async throws -> [String] {
        var policyList: [String] = []
        var marker: String? = nil
        var isTruncated: Bool

        repeat {
            let input = ListRolePoliciesInput(
                marker: marker,
                roleName: role
            )
            let output = try await client.listRolePolicies(input: input)

            guard let policies = output.policyNames else {
                return policyList
            }
            for policy in policies {
                policyList.append(policy)
            }
            marker = output.marker
            isTruncated = output.isTruncated
        } while isTruncated == true
        return policyList
    }
```

- For API details, see ListRolePolicies in *AWS SDK for Swift API reference*.

`ListRoles`

The following code example shows how to use `ListRoles`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func listRoles() async throws -> [String] {
        var roleList: [String] = []
        var marker: String? = nil
        var isTruncated: Bool

        repeat {
            let input = ListRolesInput(marker: marker)
            let output = try await client.listRoles(input: input)

            guard let roles = output.roles else {
                return roleList
            }

            for role in roles {
                if let name = role.roleName {
                    roleList.append(name)
                }
            }
            marker = output.marker
            isTruncated = output.isTruncated
        } while isTruncated == true
        return roleList
    }
```

- For API details, see ListRoles in *AWS SDK for Swift API reference*.

`ListUsers`

The following code example shows how to use `ListUsers`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func listUsers() async throws -> [MyUserRecord] {
        var userList: [MyUserRecord] = []
        var marker: String? = nil
        var isTruncated: Bool

        repeat {
            let input = ListUsersInput(marker: marker)
            let output = try await client.listUsers(input: input)

            guard let users = output.users else {
                return userList
            }

            for user in users {
                if let id = user.userId, let name = user.userName {
                    userList.append(MyUserRecord(id: id, name: name))
                }
            }
            marker = output.marker
            isTruncated = output.isTruncated
        } while isTruncated == true
        return userList
    }
```

- For API details, see ListUsers in *AWS SDK for Swift API reference*.

PutUserPolicy

The following code example shows how to use `PutUserPolicy`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    func putUserPolicy(policyDocument: String, policyName: String, user:
 IAMClientTypes.User) async throws {
        let input = PutUserPolicyInput(
            policyDocument: policyDocument,
            policyName: policyName,
            userName: user.userName
        )
        do {
            _ = try await iamClient.putUserPolicy(input: input)
        } catch {
            throw error
        }
    }
```

- For API details, see PutUserPolicy in *AWS SDK for Swift API reference*.

Amazon S3 examples using SDK for Swift

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Swift with Amazon S3.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

Actions

`CopyObject`

The following code example shows how to use `CopyObject`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func copyFile(from sourceBucket: String, name: String, to destBucket:
 String) async throws {
        let srcUrl = ("\(sourceBucket)/
\(name)").addingPercentEncoding(withAllowedCharacters: .urlPathAllowed)

        let input = CopyObjectInput(
            bucket: destBucket,
            copySource: srcUrl,
            key: name
        )
        _ = try await client.copyObject(input: input)
    }
```

- For API details, see CopyObject in *AWS SDK for Swift API reference*.

`CreateBucket`

The following code example shows how to use `CreateBucket`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
public func createBucket(name: String) async throws {
    let config = S3ClientTypes.CreateBucketConfiguration(
        locationConstraint: .usEast2
    )
    let input = CreateBucketInput(
        bucket: name,
        createBucketConfiguration: config
    )
    _ = try await client.createBucket(input: input)
}
```

- For API details, see CreateBucket in *AWS SDK for Swift API reference*.

`DeleteBucket`

The following code example shows how to use `DeleteBucket`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
public func deleteBucket(name: String) async throws {
    let input = DeleteBucketInput(
        bucket: name
    )
    _ = try await client.deleteBucket(input: input)
}
```

- For API details, see DeleteBucket in *AWS SDK for Swift API reference*.

`DeleteObject`

The following code example shows how to use `DeleteObject`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func deleteFile(bucket: String, key: String) async throws {
        let input = DeleteObjectInput(
            bucket: bucket,
            key: key
        )

        do {
            _ = try await client.deleteObject(input: input)
        } catch {
            throw error
        }
    }
```

- For API details, see DeleteObject in *AWS SDK for Swift API reference*.

`DeleteObjects`

The following code example shows how to use `DeleteObjects`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func deleteObjects(bucket: String, keys: [String]) async throws {
        let input = DeleteObjectsInput(
            bucket: bucket,
            delete: S3ClientTypes.Delete(
                objects: keys.map({ S3ClientTypes.ObjectIdentifier(key: $0) }),
                quiet: true
            )
        )

        do {
            let output = try await client.deleteObjects(input: input)

            // As of the last update to this example, any errors are returned
            // in the `output` object's `errors` property. If there are any
            // errors in this array, throw an exception. Once the error
            // handling is finalized in later updates to the AWS SDK for
            // Swift, this example will be updated to handle errors better.

            guard let errors = output.errors else {
                return  // No errors.
            }
            if errors.count != 0 {
                throw ServiceHandlerError.deleteObjectsError
            }
        } catch {
            throw error
        }
    }
```

- For API details, see DeleteObjects in *AWS SDK for Swift API reference*.

`GetObject`

The following code example shows how to use `GetObject`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

Download an object from a bucket to a local file.

```
    public func downloadFile(bucket: String, key: String, to: String) async throws {
        let fileUrl = URL(fileURLWithPath: to).appendingPathComponent(key)

        let input = GetObjectInput(
            bucket: bucket,
            key: key
        )
        let output = try await client.getObject(input: input)

        // Get the data stream object. Return immediately if there isn't one.
        guard let body = output.body,
              let data = try await body.readData() else {
            return
        }
        try data.write(to: fileUrl)
    }
```

Read an object into a Swift Data object.

```
    public func readFile(bucket: String, key: String) async throws -> Data {
        let input = GetObjectInput(
            bucket: bucket,
            key: key
        )
        let output = try await client.getObject(input: input)

        // Get the stream and return its contents in a `Data` object. If
        // there is no stream, return an empty `Data` object instead.
        guard let body = output.body,
              let data = try await body.readData() else {
            return "".data(using: .utf8)!
        }

        return data
    }
```

- For API details, see GetObject in *AWS SDK for Swift API reference*.

`ListBuckets`

The following code example shows how to use `ListBuckets`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    /// Return an array containing information about every available bucket.
    ///
    /// - Returns: An array of ``S3ClientTypes.Bucket`` objects describing
    ///   each bucket.
    public func getAllBuckets() async throws -> [S3ClientTypes.Bucket] {
        let output = try await client.listBuckets(input: ListBucketsInput())

        guard let buckets = output.buckets else {
            return []
        }
        return buckets
    }
```

- For API details, see ListBuckets in *AWS SDK for Swift API reference*.

`ListObjectsV2`

The following code example shows how to use `ListObjectsV2`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func listBucketFiles(bucket: String) async throws -> [String] {
        let input = ListObjectsV2Input(
            bucket: bucket
        )
        let output = try await client.listObjectsV2(input: input)
        var names: [String] = []
        guard let objList = output.contents else {
            return []
        }

        for obj in objList {
            if let objName = obj.key {
                names.append(objName)
            }
        }

        return names
    }
```

- For API details, see ListObjectsV2 in *AWS SDK for Swift API reference*.

`PutObject`

The following code example shows how to use `PutObject`.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

Upload a file from local storage to a bucket.

```
    public func uploadFile(bucket: String, key: String, file: String) async throws {
        let fileUrl = URL(fileURLWithPath: file)
        let fileData = try Data(contentsOf: fileUrl)
        let dataStream = ByteStream.from(data: fileData)
        let input = PutObjectInput(
            body: dataStream,
            bucket: bucket,
            key: key
        )
        _ = try await client.putObject(input: input)
    }
```

Upload the contents of a Swift Data object to a bucket.

```
    public func createFile(bucket: String, key: String, withData data: Data) async
 throws {
        let dataStream = ByteStream.from(data: data)

        let input = PutObjectInput(
            body: dataStream,
            bucket: bucket,
            key: key
        )
        _ = try await client.putObject(input: input)
    }
```

- For API details, see PutObject in *AWS SDK for Swift API reference*.

Scenarios

Get started with buckets and objects

The following code example shows how to:

- Create a bucket and upload a file to it.
- Download an object from a bucket.
- Copy an object to a subfolder in a bucket.
- List the objects in a bucket.
- Delete the bucket objects and the bucket.

SDK for Swift

Note

This is prerelease documentation for an SDK in preview release. It is subject to change.

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

A Swift class that handles calls to the SDK for Swift.

```
import Foundation
import AWSS3
import ClientRuntime
import AWSClientRuntime

/// A class containing all the code that interacts with the AWS SDK for Swift.
public class ServiceHandler {
    let client: S3Client

    /// Initialize and return a new ``ServiceHandler`` object, which is used to
 drive the AWS calls
    /// used for the example.
    ///
    /// - Returns: A new ``ServiceHandler`` object, ready to be called to
    ///            execute AWS operations.
    public init() async {
        do {
            client = try S3Client(region: "us-east-2")
        } catch {
            print("ERROR: ", dump(error, name: "Initializing S3 client"))
            exit(1)
        }
    }

    /// Create a new user given the specified name.
    ///
    /// - Parameters:
```

```
    ///   - name: Name of the bucket to create.
    /// Throws an exception if an error occurs.
    public func createBucket(name: String) async throws {
        let config = S3ClientTypes.CreateBucketConfiguration(
            locationConstraint: .usEast2
        )
        let input = CreateBucketInput(
            bucket: name,
            createBucketConfiguration: config
        )
        _ = try await client.createBucket(input: input)
    }

    /// Delete a bucket.
    /// - Parameter name: Name of the bucket to delete.
    public func deleteBucket(name: String) async throws {
        let input = DeleteBucketInput(
            bucket: name
        )
        _ = try await client.deleteBucket(input: input)
    }

    /// Upload a file from local storage to the bucket.
    /// - Parameters:
    ///   - bucket: Name of the bucket to upload the file to.
    ///   - key: Name of the file to create.
    ///   - file: Path name of the file to upload.
    public func uploadFile(bucket: String, key: String, file: String) async throws {
        let fileUrl = URL(fileURLWithPath: file)
        let fileData = try Data(contentsOf: fileUrl)
        let dataStream = ByteStream.from(data: fileData)

        let input = PutObjectInput(
            body: dataStream,
            bucket: bucket,
            key: key
        )
        _ = try await client.putObject(input: input)
    }

    /// Create a file in the specified bucket with the given name. The new
    /// file's contents are uploaded from a `Data` object.
    ///
    /// - Parameters:
```

```
    ///   - bucket: Name of the bucket to create a file in.
    ///   - key: Name of the file to create.
    ///   - data: A `Data` object to write into the new file.
    public func createFile(bucket: String, key: String, withData data: Data) async
 throws {
        let dataStream = ByteStream.from(data: data)

        let input = PutObjectInput(
            body: dataStream,
            bucket: bucket,
            key: key
        )
        _ = try await client.putObject(input: input)
    }

    /// Download the named file to the given directory on the local device.
    ///
    /// - Parameters:
    ///   - bucket: Name of the bucket that contains the file to be copied.
    ///   - key: The name of the file to copy from the bucket.
    ///   - to: The path of the directory on the local device where you want to
    ///     download the file.
    public func downloadFile(bucket: String, key: String, to: String) async throws {
        let fileUrl = URL(fileURLWithPath: to).appendingPathComponent(key)

        let input = GetObjectInput(
            bucket: bucket,
            key: key
        )
        let output = try await client.getObject(input: input)

        // Get the data stream object. Return immediately if there isn't one.
        guard let body = output.body,
              let data = try await body.readData() else {
            return
        }
        try data.write(to: fileUrl)
    }

    /// Read the specified file from the given S3 bucket into a Swift
    /// `Data` object.
    ///
    /// - Parameters:
    ///   - bucket: Name of the bucket containing the file to read.
    ///   - key: Name of the file within the bucket to read.
    ///
    /// - Returns: A `Data` object containing the complete file data.
    public func readFile(bucket: String, key: String) async throws -> Data {
        let input = GetObjectInput(
            bucket: bucket,
            key: key
        )
        let output = try await client.getObject(input: input)

        // Get the stream and return its contents in a `Data` object. If
        // there is no stream, return an empty `Data` object instead.
        guard let body = output.body,
              let data = try await body.readData() else {
            return "".data(using: .utf8)!
        }

        return data
    }

    /// Copy a file from one bucket to another.
    ///
    /// - Parameters:
    ///   - sourceBucket: Name of the bucket containing the source file.
    ///   - name: Name of the source file.
    ///   - destBucket: Name of the bucket to copy the file into.
    public func copyFile(from sourceBucket: String, name: String, to destBucket:
 String) async throws {
        let srcUrl = ("\(sourceBucket)/
\(name)").addingPercentEncoding(withAllowedCharacters: .urlPathAllowed)

        let input = CopyObjectInput(
            bucket: destBucket,
            copySource: srcUrl,
            key: name
        )
        _ = try await client.copyObject(input: input)
    }

    /// Deletes the specified file from Amazon S3.
    ///
    /// - Parameters:
    ///   - bucket: Name of the bucket containing the file to delete.
    ///   - key: Name of the file to delete.
    ///
    public func deleteFile(bucket: String, key: String) async throws {
        let input = DeleteObjectInput(
            bucket: bucket,
            key: key
        )

        do {
            _ = try await client.deleteObject(input: input)
        } catch {
            throw error
        }
    }

    /// Returns an array of strings, each naming one file in the
    /// specified bucket.
    ///
    /// - Parameter bucket: Name of the bucket to get a file listing for.
    /// - Returns: An array of `String` objects, each giving the name of
    ///            one file contained in the bucket.
    public func listBucketFiles(bucket: String) async throws -> [String] {
        let input = ListObjectsV2Input(
            bucket: bucket
        )
        let output = try await client.listObjectsV2(input: input)
        var names: [String] = []

        guard let objList = output.contents else {
            return []
        }

        for obj in objList {
            if let objName = obj.key {
                names.append(objName)
            }
        }

        return names
    }
}
```

A Swift command-line program to manage the SDK calls.

```
import Foundation
import ServiceHandler
import ArgumentParser

/// The command-line arguments and options available for this
/// example command.
struct ExampleCommand: ParsableCommand {
    @Argument(help: "Name of the S3 bucket to create")
    var bucketName: String

    @Argument(help: "Pathname of the file to upload to the S3 bucket")
    var uploadSource: String

    @Argument(help: "The name (key) to give the file in the S3 bucket")
    var objName: String

    @Argument(help: "S3 bucket to copy the object to")
    var destBucket: String

    @Argument(help: "Directory where you want to download the file from the S3
 bucket")
    var downloadDir: String

    static var configuration = CommandConfiguration(
        commandName: "s3-basics",
        abstract: "Demonstrates a series of basic AWS S3 functions.",
        discussion: """
        Performs the following Amazon S3 commands:

        * `CreateBucket`
        * `PutObject`
        * `GetObject`
        * `CopyObject`
        * `ListObjects`
        * `DeleteObjects`
        * `DeleteBucket`
        """
    )

    /// Called by ``main()`` to do the actual running of the AWS
    /// example.
    func runAsync() async throws {
        let serviceHandler = await ServiceHandler()
        // 1. Create the bucket.
        print("Creating the bucket \(bucketName)...")
        try await serviceHandler.createBucket(name: bucketName)

        // 2. Upload a file to the bucket.
        print("Uploading the file \(uploadSource)...")
        try await serviceHandler.uploadFile(bucket: bucketName, key: objName, file: 
uploadSource)

        // 3. Download the file.
        print("Downloading the file \(objName) to \(downloadDir)...")
        try await serviceHandler.downloadFile(bucket: bucketName, key: objName, to: 
downloadDir)

        // 4. Copy the file to another bucket.
        print("Copying the file to the bucket \(destBucket)...")
        try await serviceHandler.copyFile(from: bucketName, name: objName, to: 
destBucket)

        // 5. List the contents of the bucket.

        print("Getting a list of the files in the bucket \(bucketName)")
        let fileList = try await serviceHandler.listBucketFiles(bucket: bucketName)
        let numFiles = fileList.count
        if numFiles != 0 {
            print("\(numFiles) file\((numFiles > 1) ? "s" : "") in bucket 
\(bucketName):")
            for name in fileList {
                print("  \(name)")
            }
        } else {
            print("No files found in bucket \(bucketName)")
        }

        // 6. Delete the objects from the bucket.

        print("Deleting the file \(objName) from the bucket \(bucketName)...")
        try await serviceHandler.deleteFile(bucket: bucketName, key: objName)
        print("Deleting the file \(objName) from the bucket \(destBucket)...")
        try await serviceHandler.deleteFile(bucket: destBucket, key: objName)

        // 7. Delete the bucket.
        print("Deleting the bucket \(bucketName)...")
        try await serviceHandler.deleteBucket(name: bucketName)

        print("Done.")
    }
}

//
// Main program entry point.
//
@main
struct Main {
    static func main() async {
        let args = Array(CommandLine.arguments.dropFirst())

        do {
            let command = try ExampleCommand.parse(args)
            try await command.runAsync()
        } catch {
            ExampleCommand.exit(withError: error)
        }
    }
}
```

- For API details, see the following topics in *AWS SDK for Swift API reference*.
  - CopyObject
  - CreateBucket
  - DeleteBucket
  - DeleteObjects
  - GetObject
  - ListObjectsV2
  - PutObject

AWS STS examples using SDK for Swift

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Swift with AWS STS.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

Actions

`AssumeRole`

The following code example shows how to use `AssumeRole`.

SDK for Swift

> **Note**
>
> This is prerelease documentation for an SDK in preview release. It is subject to change.

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    public func assumeRole(role: IAMClientTypes.Role, sessionName: String)
                    async throws -> STSClientTypes.Credentials {
        let input = AssumeRoleInput(
            roleArn: role.arn,
            roleSessionName: sessionName
        )
        do {
            let output = try await stsClient.assumeRole(input: input)

            guard let credentials = output.credentials else {
                throw ServiceHandlerError.authError
            }

            return credentials
        } catch {
            throw error
        }
    }
```

- For API details, see [AssumeRole]() in *AWS SDK for Swift API reference*.

Security in AWS SDK for Swift

Cloud security at Amazon Web Services (AWS) is the highest priority. As an AWS customer, you benefit from a data center and network architecture that is built to meet the requirements of the most security-sensitive organizations. Security is a shared responsibility between AWS and you. The Shared Responsibility Model describes this as Security of the Cloud and Security in the Cloud.

Security of the Cloud – AWS is responsible for protecting the infrastructure that runs all of the services offered in the AWS Cloud and providing you with services that you can use securely. Our security responsibility is the highest priority at AWS, and the effectiveness of our security is regularly tested and verified by third-party auditors as part of the AWS Compliance Programs.

Security in the Cloud – Your responsibility is determined by the AWS service you are using, and other factors including the sensitivity of your data, your organization's requirements, and applicable laws and regulations.

This AWS product or service follows the shared responsibility model through the specific Amazon Web Services (AWS) services it supports. For AWS service security information, see the AWS service security documentation page and AWS services that are in scope of AWS compliance efforts by compliance program.

Topics

Data protection in the AWS SDK for Swift

The AWS shared responsibility model applies to data protection in AWS SDK for Swift. 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. You are also responsible for 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 users with AWS IAM Identity Center or 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 require TLS 1.2 and recommend TLS 1.3.
- 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 sensitive 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 text fields such as a **Name** field. This includes when you work with SDK for Swift or other AWS services using the console, API, AWS CLI, or AWS SDKs. Any data that you enter into tags or free-form text 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.

Identity and Access Management

AWS Identity and Access Management (IAM) is an AWS service that helps an administrator securely control access to AWS resources. IAM administrators control who can be *authenticated* (signed in) and *authorized* (have permissions) to use AWS resources. IAM is an AWS service that you can use with no additional charge.

Topics

- Managing access using policies
- How AWS services work with IAM
- Troubleshooting AWS identity and access

Audience

How you use AWS Identity and Access Management (IAM) differs, depending on the work that you do in AWS.

Service user – If you use AWS services to do your job, then your administrator provides you with the credentials and permissions that you need. As you use more AWS features to do your work, you might need additional permissions. Understanding how access is managed can help you request the right permissions from your administrator. If you cannot access a feature in AWS, see Troubleshooting AWS identity and access or the user guide of the AWS service you are using.

Service administrator – If you're in charge of AWS resources at your company, you probably have full access to AWS. It's your job to determine which AWS features and resources your service users should access. You must then submit requests to your IAM administrator to change the permissions of your service users. Review the information on this page to understand the basic concepts of IAM. To learn more about how your company can use IAM with AWS, see the user guide of the AWS service you are using.

IAM administrator – If you're an IAM administrator, you might want to learn details about how you can write policies to manage access to AWS. To view example AWS identity-based policies that you can use in IAM, see the user guide of the AWS service you are using.

Authenticating with identities

Authentication is how you sign in to AWS using your identity credentials. You must be *authenticated* (signed in to AWS) as the AWS account root user, as an IAM user, or by assuming an IAM role.

You can sign in to AWS as a federated identity by using credentials provided through an identity source. AWS IAM Identity Center (IAM Identity Center) users, your company's single sign-on authentication, and your Google or Facebook credentials are examples of federated identities. When you sign in as a federated identity, your administrator previously set up identity federation using IAM roles. When you access AWS by using federation, you are indirectly assuming a role.

Depending on the type of user you are, you can sign in to the AWS Management Console or the AWS access portal. For more information about signing in to AWS, see How to sign in to your AWS account in the *AWS Sign-In User Guide*.

If you access AWS programmatically, AWS provides a software development kit (SDK) and a command line interface (CLI) to cryptographically sign your requests by using your credentials. If you don't use AWS tools, you must sign requests yourself. For more information about using the recommended method to sign requests yourself, see Signing AWS API requests in the *IAM User Guide*.

Regardless of the authentication method that you use, you might be required to provide additional security information. For example, AWS recommends that you use multi-factor authentication (MFA) to increase the security of your account. To learn more, see Multi-factor authentication in the *AWS IAM Identity Center User Guide* and Using multi-factor authentication (MFA) in AWS in the *IAM User Guide*.

AWS account root user

When you create an AWS account, you begin with one 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 don't use the root user for your everyday tasks. Safeguard your root user credentials and use them to perform the tasks that only the root user can perform. For the complete list of tasks that require you to sign in as the root user, see Tasks that require root user credentials in the *IAM User Guide*.

Federated identity

As a best practice, require human users, including users that require administrator access, to use federation with an identity provider to access AWS services by using temporary credentials.

A *federated identity* is a user from your enterprise user directory, a web identity provider, the AWS Directory Service, the Identity Center directory, or any user that accesses AWS services by using credentials provided through an identity source. When federated identities access AWS accounts, they assume roles, and the roles provide temporary credentials.

For centralized access management, we recommend that you use AWS IAM Identity Center. You can create users and groups in IAM Identity Center, or you can connect and synchronize to a set of users and groups in your own identity source for use across all your AWS accounts and applications. For information about IAM Identity Center, see What is IAM Identity Center? in the *AWS IAM Identity Center User Guide*.

IAM users and groups

An *IAM user* is an identity within your AWS account that has specific permissions for a single person or application. Where possible, we recommend relying on temporary credentials instead of creating IAM users who have long-term credentials such as passwords and access keys. However, if you have specific use cases that require long-term credentials with IAM users, we recommend that you rotate access keys. For more information, see Rotate access keys regularly for use cases that require long-term credentials in the *IAM User Guide*.

An *IAM group* is an identity that specifies a collection of IAM users. You can't sign in as a group. You can use groups to specify permissions for multiple users at a time. Groups make permissions easier to manage for large sets of users. For example, you could have a group named *IAMAdmins* and give that group permissions to administer IAM resources.

Users are different from roles. A user is uniquely associated with one person or application, but a role is intended to be assumable by anyone who needs it. Users have permanent long-term credentials, but roles provide temporary credentials. To learn more, see When to create an IAM user (instead of a role) in the *IAM User Guide*.

IAM roles

An *IAM role* is an identity within your AWS account that has specific permissions. It is similar to an IAM user, but is not associated with a specific person. You can temporarily assume an IAM role in the AWS Management Console by switching roles. You can assume a role by calling an AWS CLI or AWS API operation or by using a custom URL. For more information about methods for using roles, see Using IAM roles in the *IAM User Guide*.

IAM roles with temporary credentials are useful in the following situations:

- **Federated user access** – To assign permissions to a federated identity, you create a role and define permissions for the role. When a federated identity authenticates, the identity is associated with the role and is granted the permissions that are defined by the role. For information about roles for federation, see Creating a role for a third-party Identity Provider in the *IAM User Guide*. If you use IAM Identity Center, you configure a permission set. To control what your identities can access after they authenticate, IAM Identity Center correlates the permission set to a role in IAM. For information about permissions sets, see Permission sets in the *AWS IAM Identity Center User Guide*.

- **Temporary IAM user permissions** – An IAM user or role can assume an IAM role to temporarily take on different permissions for a specific task.
- **Cross-account access** – You can use an IAM role to allow someone (a trusted principal) in a different account to access resources in your account. Roles are the primary way to grant cross-account access. However, with some AWS services, you can attach a policy directly to a resource (instead of using a role as a proxy). To learn the difference between roles and resource-based policies for cross-account access, see Cross account resource access in IAM in the *IAM User Guide*.
- **Cross-service access** – Some AWS services use features in other AWS services. For example, when you make a call in a service, it's common for that service to run applications in Amazon EC2 or store objects in Amazon S3. A service might do this using the calling principal's permissions, using a service role, or using a service-linked role.
  - **Forward access sessions (FAS)** – When you use an IAM user or role to perform actions in AWS, you are considered a principal. When you use some services, you might perform an action that then initiates another action in a different service. FAS uses the permissions of the principal calling an AWS service, combined with the requesting AWS service to make requests to downstream services. FAS requests are only made when a service receives a request that requires interactions with other AWS services or resources to complete. In this case, you must have permissions to perform both actions. For policy details when making FAS requests, see Forward access sessions.
  - **Service role** – 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*.
  - **Service-linked role** – A service-linked role is a type of service role that is linked to an AWS service. The service can assume the role to perform an action on your behalf. Service-linked roles appear in your AWS account and are owned by the service. An IAM administrator can view, but not edit the permissions for service-linked roles.
- **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*.

To learn whether to use IAM roles or IAM users, see When to create an IAM role (instead of a user) in the *IAM User Guide*.

Managing access using policies

You control access in AWS by creating policies and attaching them to AWS identities or resources. A policy is an object in AWS that, when associated with an identity or resource, defines their permissions. AWS evaluates these policies when a principal (user, root user, or role session) makes a request. Permissions in the policies determine whether the request is allowed or denied. Most policies are stored in AWS as JSON documents. For more information about the structure and contents of JSON policy documents, see Overview of JSON policies in the *IAM User Guide*.

Administrators can use AWS JSON policies to specify who has access to what. That is, which **principal** can perform **actions** on what **resources**, and under what **conditions**.

By default, users and roles have no permissions. To grant users permission to perform actions on the resources that they need, an IAM administrator can create IAM policies. The administrator can then add the IAM policies to roles, and users can assume the roles.

IAM policies define permissions for an action regardless of the method that you use to perform the operation. For example, suppose that you have a policy that allows the `iam:GetRole` action. A user with that policy can get role information from the AWS Management Console, the AWS CLI, or the AWS API.

Identity-based policies

Identity-based policies are JSON permissions policy documents that you can attach to an identity, such as an IAM user, group of users, or role. These policies control what actions users and roles can perform, on which resources, and under what conditions. To learn how to create an identity-based policy, see Creating IAM policies in the *IAM User Guide*.

Identity-based policies can be further categorized as *inline policies* or *managed policies*. Inline policies are embedded directly into a single user, group, or role. Managed policies are standalone policies that you can attach to multiple users, groups, and roles in your AWS account. Managed policies include AWS managed policies and customer managed policies. To learn how to choose between a managed policy or an inline policy, see Choosing between managed policies and inline policies in the *IAM User Guide*.

Resource-based policies

Resource-based policies are JSON policy documents that you attach to a resource. Examples of resource-based policies are IAM *role trust policies* and Amazon S3 *bucket policies*. In services that support resource-based policies, service administrators can use them to control access to a specific resource. For the resource where the policy is attached, the policy defines what actions a specified principal can perform on that resource and under what conditions. You must specify a principal in a resource-based policy. Principals can include accounts, users, roles, federated users, or AWS services.

Resource-based policies are inline policies that are located in that service. You can't use AWS managed policies from IAM in a resource-based policy.

Access control lists (ACLs)

Access control lists (ACLs) control which principals (account members, users, or roles) have permissions to access a resource. ACLs are similar to resource-based policies, although they do not use the JSON policy document format.

Amazon S3, AWS WAF, and Amazon VPC are examples of services that support ACLs. To learn more about ACLs, see Access control list (ACL) overview in the *Amazon Simple Storage Service Developer Guide*.

Other policy types

AWS supports additional, less-common policy types. These policy types can set the maximum permissions granted to you by the more common policy types.

- **Permissions boundaries** – A permissions boundary is an advanced feature in which you set the maximum permissions that an identity-based policy can grant to an IAM entity (IAM user or role). You can set a permissions boundary for an entity. The resulting permissions are the intersection of an entity's identity-based policies and its permissions boundaries. Resource-based policies that specify the user or role in the `Principal` field are not limited by the permissions boundary. An explicit deny in any of these policies overrides the allow. For more information about permissions boundaries, see Permissions boundaries for IAM entities in the *IAM User Guide*.
- **Service control policies (SCPs)** – SCPs are JSON policies that specify the maximum permissions for an organization or organizational unit (OU) in AWS Organizations. AWS Organizations is a service for grouping and centrally managing multiple AWS accounts that your business owns. If you enable all features in an organization, then you can apply service control policies (SCPs) to

any or all of your accounts. The SCP limits permissions for entities in member accounts, including each AWS account root user. For more information about Organizations and SCPs, see How SCPs work in the *AWS Organizations User Guide*.

- **Session policies** – Session policies are advanced policies that you pass as a parameter when you programmatically create a temporary session for a role or federated user. The resulting session's permissions are the intersection of the user or role's identity-based policies and the session policies. Permissions can also come from a resource-based policy. An explicit deny in any of these policies overrides the allow. For more information, see Session policies in the *IAM User Guide*.

Multiple policy types

When multiple types of policies apply to a request, the resulting permissions are more complicated to understand. To learn how AWS determines whether to allow a request when multiple policy types are involved, see Policy evaluation logic in the *IAM User Guide*.

How AWS services work with IAM

To get a high-level view of how AWS services work with most IAM features, see AWS services that work with IAM in the *IAM User Guide*.

To learn how to use a specific AWS service with IAM, see the security section of the relevant service's User Guide.

Troubleshooting AWS identity and access

Use the following information to help you diagnose and fix common issues that you might encounter when working with AWS and IAM.

Topics

I am not authorized to perform an action in AWS

If you receive an error that you're not authorized to perform an action, your policies must be updated to allow you to perform the action.

The following example error occurs when the `mateojackson` IAM user tries to use the console to view details about a fictional *`my-example-widget`* resource but doesn't have the fictional `awes:`*`GetWidget`* permissions.

```
User: arn:aws:iam::123456789012:user/mateojackson is not authorized to perform:
 awes:GetWidget on resource: my-example-widget
```

In this case, the policy for the `mateojackson` user must be updated to allow access to the *`my-example-widget`* resource by using the `awes:`*`GetWidget`* action.

If you need help, contact your AWS administrator. Your administrator is the person who provided you with your sign-in credentials.

I am not authorized to perform iam:PassRole

If you receive an error that you're not authorized to perform the `iam:PassRole` action, your policies must be updated to allow you to pass a role to AWS.

Some AWS services allow you to pass an existing role to that service instead of creating a new service role or service-linked role. To do this, you must have permissions to pass the role to the service.

The following example error occurs when an IAM user named `marymajor` tries to use the console to perform an action in AWS. However, the action requires the service to have permissions that are granted by a service role. Mary does not have permissions to pass the role to the service.

```
User: arn:aws:iam::123456789012:user/marymajor is not authorized to perform:
 iam:PassRole
```

In this case, Mary's policies must be updated to allow her to perform the `iam:PassRole` action.

If you need help, contact your AWS administrator. Your administrator is the person who provided you with your sign-in credentials.

I want to allow people outside of my AWS account to access my AWS resources

You can create a role that users in other accounts or people outside of your organization can use to access your resources. You can specify who is trusted to assume the role. For services that support resource-based policies or access control lists (ACLs), you can use those policies to grant people access to your resources.

To learn more, consult the following:

- To learn whether AWS supports these features, see How AWS services work with IAM.
- To learn how to provide access to your resources across AWS accounts that you own, see Providing access to an IAM user in another AWS account that you own in the *IAM User Guide*.
- To learn how to provide access to your resources to third-party AWS accounts, see Providing access to AWS accounts owned by third parties in the *IAM User Guide*.
- To learn how to provide access through identity federation, see Providing access to externally authenticated users (identity federation) in the *IAM User Guide*.
- To learn the difference between using roles and resource-based policies for cross-account access, see Cross account resource access in IAM in the *IAM User Guide*.

Compliance Validation for this AWS Product or Service

To learn whether an AWS service is within the scope of specific compliance programs, see AWS services in Scope by Compliance Program and choose the compliance program that you are interested in. 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 AWS services 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 baseline environments on AWS that are security and compliance focused.
- Architecting for HIPAA Security and Compliance on Amazon Web Services – This whitepaper describes how companies can use AWS to create HIPAA-eligible applications.

> **Note**
>
> Not all AWS services are HIPAA eligible. For more information, see the HIPAA Eligible Services Reference.

- AWS Compliance Resources – This collection of workbooks and guides might apply to your industry and location.
- AWS Customer Compliance Guides – Understand the shared responsibility model through the lens of compliance. The guides summarize the best practices for securing AWS services and map the guidance to security controls across multiple frameworks (including National Institute of Standards and Technology (NIST), Payment Card Industry Security Standards Council (PCI), and International Organization for Standardization (ISO)).
- 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. Security Hub uses security controls to evaluate your AWS resources and to check your compliance against security industry standards and best practices. For a list of supported services and controls, see Security Hub controls reference.
- Amazon GuardDuty – This AWS service detects potential threats to your AWS accounts, workloads, containers, and data by monitoring your environment for suspicious and malicious activities. GuardDuty can help you address various compliance requirements, like PCI DSS, by meeting intrusion detection requirements mandated by certain compliance frameworks.
- AWS Audit Manager – This AWS service helps you continuously audit your AWS usage to simplify how you manage risk and compliance with regulations and industry standards.

This AWS product or service follows the shared responsibility model through the specific Amazon Web Services (AWS) services it supports. For AWS service security information, see the AWS service security documentation page and AWS services that are in scope of AWS compliance efforts by compliance program.

Resilience for this AWS Product or Service

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.

This AWS product or service follows the shared responsibility model through the specific Amazon Web Services (AWS) services it supports. For AWS service security information, see the AWS service security documentation page and AWS services that are in scope of AWS compliance efforts by compliance program.

Infrastructure Security for this AWS Product or Service

This AWS product or service uses managed services, and therefore is protected by the AWS global network security. For information about AWS security services and how AWS protects infrastructure, see AWS Cloud Security. To design your AWS environment using the best practices for infrastructure security, see Infrastructure Protection in *Security Pillar AWS Well-Architected Framework*.

You use AWS published API calls to access this AWS Product or Service through the network. Clients must support the following:

- Transport Layer Security (TLS). We require TLS 1.2 and recommend TLS 1.3.
- Cipher suites with perfect forward secrecy (PFS) such as DHE (Ephemeral Diffie-Hellman) or ECDHE (Elliptic Curve Ephemeral Diffie-Hellman). Most modern systems such as Java 7 and later support these modes.

Additionally, requests must be signed by using an access key ID and a secret access key that is associated with an IAM principal. Or you can use the AWS Security Token Service (AWS STS) to generate temporary security credentials to sign requests.

This AWS product or service follows the shared responsibility model through the specific Amazon Web Services (AWS) services it supports. For AWS service security information, see the AWS service security documentation page and AWS services that are in scope of AWS compliance efforts by compliance program.

Document history for the AWS SDK for Swift Developer Guide

Updates about significant changes or changes of interest to the AWS SDK for Swift Developer Guide.

Change	Description	Date
Update package file informati on	Added information missing about how to set up the `Package.swift` file.	February 19, 2024
Maintenance and updates	Updated and added links to the SDK reference now that it's in place in its final home. Additionally, synchroni zed content with latest SDK changes.	February 1, 2024
Updated tool version requirements	Updated the minimum version requirements to Swift 5.7 and Xcode 14.	October 12, 2023
Rewrote section on configuri ng clients	The section named "Client configuration" has been replaced with a mostly rewritten section named "Customize client configura tions". This brings obsolete content up-to-date and provides a working example.	October 10, 2023
Content corrections	Replaced some placeholder text with the correct content and fixed a broken link.	September 12, 2023

Content additions	Renamed the chapter on logging to "Testing and debugging," and added new content covering how to mock the SDK for Swift in tests.	August 28, 2023
Added the section on using waiters	Added the new section on using waiters.	August 9, 2023
Updated setup process to use AWS IAM Identity Center	Updated guide to align with the IAM best practices . For more information, see Security best practices in IAM. This update also features general improvements and updates to bring the documentation closer to being in sync with version 0.20.0 of the SDK.	July 11, 2023
New code examples for Amazon S3 and IAM	Added new examples for Amazon S3 and IAM, cleaned up and removed obsolete information, and fixed reported content errors.	November 4, 2022
Documentation update	Minor corrections and organizational improveme nts to the AWS SDK for Swift Developer Guide.	August 19, 2022
AWS SDK for Swift Developer Preview release	AWS SDK for Swift Developer Preview draft documentation.	December 2, 2021