AWS Serverless Application Model

Developer Guide

AWS Serverless Application Model: Developer Guide

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What is the AWS Serverless Application Model (AWS SAM)?

The AWS Serverless Application Model (AWS SAM) is an open-source framework that you can use to build serverless applications on AWS.

A **serverless application** is a combination of Lambda functions, event sources, and other resources that work together to perform tasks. Note that a serverless application is more than just a Lambda function—it can include additional resources such as APIs, databases, and event source mappings.

You can use AWS SAM to define your serverless applications. AWS SAM consists of the following components:

- **AWS SAM template specification**. You use this specification to define your serverless application. It provides you with a simple and clean syntax to describe the functions, APIs, permissions, configurations, and events that make up a serverless application. You use an AWS SAM template file to operate on a single, deployable, versioned entity that's your serverless application. For the full AWS SAM template specification, see AWS Serverless Application Model (AWS SAM) specification (p. 27).

- **AWS SAM command line interface (AWS SAM CLI)**. You use this tool to build serverless applications that are defined by AWS SAM templates. The CLI provides commands that enable you to verify that AWS SAM template files are written according to the specification, invoke Lambda functions locally, step-through debug Lambda functions, package and deploy serverless applications to the AWS Cloud, and so on. For details about how to use the AWS SAM CLI, including the full AWS SAM CLI Command Reference, see AWS SAM CLI command reference (p. 251).

This guide shows you how to use AWS SAM to define, test, and deploy a simple serverless application. It also provides an example application (p. 16) that you can download, test locally, and deploy to the AWS Cloud. You can use this example application as a starting point for developing your own serverless applications.

Benefits of using AWS SAM

Because AWS SAM integrates with other AWS services, creating serverless applications with AWS SAM provides the following benefits:

- **Single-deployment configuration**. AWS SAM makes it easy to organize related components and resources, and operate on a single stack. You can use AWS SAM to share configuration (such as memory and timeouts) between resources, and deploy all related resources together as a single, versioned entity.

- **Extension of AWS CloudFormation**. Because AWS SAM is an extension of AWS CloudFormation, you get the reliable deployment capabilities of AWS CloudFormation. You can define resources by using AWS CloudFormation in your AWS SAM template. Also, you can use the full suite of resources, intrinsic functions, and other template features that are available in AWS CloudFormation.

- **Built-in best practices**. You can use AWS SAM to define and deploy your infrastructure as config. This makes it possible for you to use and enforce best practices such as code reviews. Also, with a few lines of configuration, you can enable safe deployments through CodeDeploy, and can enable tracing by using AWS X-Ray.

- **Local debugging and testing**. The AWS SAM CLI lets you locally build, test, and debug serverless applications that are defined by AWS SAM templates. The CLI provides a Lambda-like execution environment locally. It helps you catch issues upfront by providing parity with the actual Lambda execution environment. To step through and debug your code to understand what the code is doing, you can use AWS SAM with AWS toolkits like the AWS Toolkit for JetBrains, AWS Toolkit for PyCharm, AWS Toolkit for IntelliJ, and AWS Toolkit for Visual Studio Code. This tightens the feedback loop by making it possible for you to find and troubleshoot issues that you might run into in the cloud.

- **Deep integration with development tools**. You can use AWS SAM with a suite of AWS tools for building serverless applications. You can discover new applications in the AWS Serverless Application Repository. For authoring, testing, and debugging AWS SAM–based serverless applications, you can use the AWS Cloud9 IDE. To build a deployment pipeline for your serverless applications, you can use CodeBuild, CodeDeploy, and CodePipeline. You can also use AWS CodeStar to get started with a project structure, code repository, and a CI/CD pipeline that's automatically configured for you. To deploy your serverless application, you can use the Jenkins plugin. You can use the Stackery.io toolkit to build production-ready applications.

Next step

Getting started with AWS SAM (p. 3)

Getting started with AWS SAM

To get started with AWS SAM, use the AWS SAM CLI to create a serverless application that you can package and deploy in the AWS Cloud. You can run the application both in the AWS Cloud or locally on your development host.

To install the AWS SAM CLI, including everything that needs to be installed or configured to use the AWS SAM CLI, see Installing the AWS SAM CLI (p. 3). After the AWS SAM CLI is installed, you can run through the following tutorial.

Topics

- Installing the AWS SAM CLI (p. 3)
- Setting up AWS credentials (p. 15)
- Tutorial: Deploying a Hello World application (p. 16)

Installing the AWS SAM CLI

AWS SAM provides you with a command line tool, the AWS SAM CLI, that makes it easy for you to create and manage serverless applications. You need to install and configure a few things in order to use the AWS SAM CLI.

To install the AWS SAM CLI, see the following instructions for your development host:

Topics

- Installing the AWS SAM CLI on Linux (p. 3)
- Installing the AWS SAM CLI on Windows (p. 10)
- Installing the AWS SAM CLI on macOS (p. 12)

Installing the AWS SAM CLI on Linux

The AWS SAM command line interface (CLI) is supported on 64-bit versions of recent distributions of CentOS, Fedora, Ubuntu, and Amazon Linux 2. To install the AWS SAM CLI, you must extract or "unzip" the downloaded package. If your operating system doesn't have the built-in **unzip** command, use an equivalent.

To install and configure the prerequisites for using the AWS SAM CLI on your Linux host, follow these steps:

1. Create an AWS account.
2. Configure AWS Identity and Access Management (IAM) permissions and AWS credentials.
3. Install Docker. **Note:** Docker is a prerequisite only for testing your application locally or using the `--use-container` option.
4. Install the AWS SAM CLI.

Step 1: Create an AWS account

If you don't already have an AWS account, see aws.amazon.com and choose **Create an AWS Account**. For detailed instructions, see How do I create and activate a new AWS account?

Step 2: Configure IAM permissions and AWS credentials

The IAM user that you use with AWS SAM must have sufficient permissions to make necessary AWS service calls and manage AWS resources. The simplest way to ensure that a user has sufficient permissions is to grant administrator privileges to them. For more information, see Creating your first IAM admin user and group in the *IAM User Guide*.

> **Note**
> If you don't want to grant administrator privileges to users who use the AWS Command Line Interface (AWS CLI), you can grant restricted sets of permissions to them. For more information, see Permissions (p. 330).

In addition, to enable the AWS SAM CLI to make AWS service calls, you must set up AWS credentials. For more information, see Setting up AWS credentials (p. 15).

Step 3: Install Docker (optional)

> **Note**
> Docker is a prerequisite only for testing your application locally and for building deployment packages using the **--use-container** option. If you don't plan to use these features initially, you can skip this section or install Docker at a later time.

Docker is an application that runs containers on your Linux machines. AWS SAM provides a local environment that's similar to AWS Lambda to use as a Docker container. You can use this container to build, test, and debug your serverless applications.

To run serverless projects and functions locally with the AWS SAM CLI, you must have Docker installed and working. The AWS SAM CLI uses the `DOCKER_HOST` environment variable to contact the Docker daemon. The following steps describe how to install, configure, and verify a Docker installation to work with the AWS SAM CLI.

Docker is available on many different operating systems, including most modern Linux distributions, for example, CentOS, Debian, and Ubuntu. For information about installing Docker on your particular operating system, see Get Docker on the Docker Docs website.

If you're using Amazon Linux 2, follow these steps to install Docker:

1. Update the installed packages and package cache on your instance.

   ```
   sudo yum update -y
   ```

2. Install the most recent Docker Community Edition package.

   ```
   sudo amazon-linux-extras install docker
   ```

3. Start the Docker service.

   ```
   sudo service docker start
   ```

4. Add the `ec2-user` to the `docker` group so that you can run Docker commands without using **sudo**.

   ```
   sudo usermod -a -G docker ec2-user
   ```

5. Pick up the new `docker` group permissions by logging out and logging back in again. To do this, close your current SSH terminal window and reconnect to your instance in a new one. Your new SSH session should have the appropriate `docker` group permissions.
6. Verify that the `ec2-user` can run Docker commands without using **sudo**.

```
docker ps
```

You should see the following output, confirming that Docker is installed and running:

```
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS
             PORTS               NAMES
```

Note
On Linux, to build and run Lambda functions with a different instruction set architecture than your host machine, you must take additional steps to configure Docker. For example, to run `arm64` functions on an `x86_64` machine, you can run the following command to configure the Docker daemon: `docker run --rm --privileged multiarch/qemu-user-static --reset -p yes`.

If you run into issues installing Docker, see the Troubleshooting (p. 7) section later in this guide. Or, see the Troubleshooting section of **Post-installation steps for Linux** on the Docker Docs website.

Step 4: Install the AWS SAM CLI

To install the AWS SAM CLI, on follow these steps:

x86_64

1. Download the AWS SAM CLI zip file to a directory of your choice.
2. Verify the integrity and authenticity of the downloaded installer files by generating a hash value using the following command:

   ```
   sha256sum aws-sam-cli-linux-x86_64.zip
   ```

   The output should look like the following example:

   ```
   <64-character SHA256 hash value> aws-sam-cli-linux-x86_64.zip
   ```

   Compare the 64-character SHA256 hash value with the one for your desired AWS SAM CLI version in the AWS SAM CLI release notes on GitHub.
3. Unzip the installation files into the `sam-installation/` subdirectory.

   ```
   unzip aws-sam-cli-linux-x86_64.zip -d sam-installation
   ```

4. Install the AWS SAM CLI.

   ```
   sudo ./sam-installation/install
   ```

5. Verify the installation.

   ```
   sam --version
   ```

   On successful installation, you should see output like the following:

   ```
   SAM CLI, version 1.18.0
   ```

ARM

1. Use `pip` to install the AWS SAM CLI.

   ```
   pip install aws-sam-cli
   ```

2. Verify the installation.

   ```
   sam --version
   ```

   On successful installation, you should see output like the following:

   ```
    SAM CLI, version 1.18.0
   ```

You're now ready to start development.

Upgrading

To upgrade the AWS SAM CLI, perform the same steps as in the **Install the AWS SAM CLI** section earlier in this topic, but add the **--update** option to the install command, as follows:

```
sudo ./sam-installation/install --update
```

Uninstalling

To uninstall the AWS SAM CLI, you must delete the symlink and installation directory by running the following commands:

1. Locate the symlink and install paths.

   - Find the symlink using the **which** command:

     ```
     which sam
     ```

     The output shows the path where the AWS SAM binaries are located, for example:

     ```
      /usr/local/bin/sam
     ```

   - Find the directory that the symlink points to using the **ls** command:

     ```
     ls -l /usr/local/bin/sam
     ```

     In the following example, the installation directory is `/usr/local/aws-sam-cli`.

     ```
      lrwxrwxrwx 1 ec2-user ec2-user 49 Oct 22 09:49 /usr/local/bin/sam -> /usr/local/aws-
     sam-cli/current/bin/sam
     ```

2. Delete the symlink.

   ```
   sudo rm /usr/local/bin/sam
   ```

3. Delete the installation directory.

```
sudo rm -rf /usr/local/aws-sam-cli
```

Nightly build

A nightly build of the AWS SAM CLI is available for you to install. Once installed, you can use the nightly build using the `sam-nightly` command. You can install and use both the production and nightly build versions of the AWS SAM CLI at the same time.

The nightly build contains a pre-release version of AWS SAM CLI code that may be less stable than the production version. Note that the nightly build does not contain pre-release version of the build image, so building a serverless application with the `--use-container` option uses the latest production version of the build image.

The nightly build is available with this download link: AWS SAM CLI nightly build. To install the nightly build version of the AWS SAM CLI, perform the same steps as in the Step 4: Install the AWS SAM CLI (p. 5) section earlier in this topic, but use the nightly build download link instead. You can find the hash values for the nightly build installer files in the AWS SAM CLI release notes for nightly builds on GitHub.

To verify you have installed the nightly build version, run the `sam-nightly --version` command. The output of this command is in the form `1.X.Y.dev<YYYYMMDDHHmm>`, for example:

```
SAM CLI, version 1.20.0.dev202103151200
```

Troubleshooting

Docker error: "Cannot connect to the Docker daemon. Is the docker daemon running on this host?"

In some cases, to provide permissions for the `ec2-user` to access the Docker daemon, you might have to reboot your instance. If you receive this error, try rebooting your instance.

Shell error: "command not found"

If you receive this error, your shell can't locate the AWS SAM CLI executable in the path. Verify the location of the directory where you installed the AWS SAM CLI executable, and then verify that the directory is on your path.

AWS SAM CLI error: "/lib64/libc.so.6: version `GLIBC_2.14' not found (required by /usr/local/aws-sam-cli/dist/libz.so.1)"

If you receive this error, you're using an unsupported version of Linux, and the built-in glibc version is out of date. Try either of the following:

- Upgrade your Linux host to the 64-bit version of a recent distribution of CentOS, Fedora, Ubuntu, or Amazon Linux 2.
- Follow the instructions for Installing the AWS SAM CLI on Linux using Homebrew (p. 8).

Next steps

You're now ready to begin building your own serverless applications using AWS SAM. To start with a sample serverless application, choose one of the following links:

- Tutorial: Deploying a Hello World application (p. 16) – Step-by-step instructions to download, build, and deploy a simple serverless application.
- AWS SAM example applications in GitHub – Sample applications in the AWS SAM GitHub repository that you can further experiment with.

Installing the AWS SAM CLI on Linux using Homebrew

To install the AWS SAM CLI on Linux, you can use the Homebrew package manager. For more information about Homebrew, see Homebrew on Linux on the Homebrew Documentation website.

> **Note**
> Installing Homebrew changes your environment's default Python version to the one that Homebrew installs.

To install Homebrew, you must first install Git. Git is available on many different operating systems, including most modern Linux distributions. For instructions about installing Git on your particular operating system, see Installing Git on the Git website.

Install Homebrew

After successfully installing Git, to install Homebrew, run the following command:

```
/bin/bash -c "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/
install.sh)"
```

Next, add Homebrew to your PATH by running the following commands. These commands work on all major flavors of Linux by adding either `~/.profile` on Debian and Ubuntu, or `~/.bash_profile` on CentOS, Fedora, and Red Hat.

```
test -d ~/.linuxbrew && eval $(~/.linuxbrew/bin/brew shellenv)
test -d /home/linuxbrew/.linuxbrew && eval $(/home/linuxbrew/.linuxbrew/bin/brew shellenv)
test -r ~/.bash_profile && echo "eval \$($(brew --prefix)/bin/brew shellenv)"
 >>~/.bash_profile
echo "eval \$($(brew --prefix)/bin/brew shellenv)" >>~/.profile
```

Verify that Homebrew is installed.

```
brew --version
```

On successful installation of Homebrew, you should see output like the following:

```

 Homebrew 2.1.6
 Homebrew/homebrew-core (git revision ef21; last commit 2019-06-19)

```

Install the AWS SAM CLI using Homebrew

To install the AWS SAM CLI using Homebrew, run the following commands:

```
brew tap aws/tap
brew install aws-sam-cli
```

Verify the installation.

```
sam --version
```

On successful installation of the AWS SAM CLI, you should see output like the following:

```
SAM CLI, version 1.15.0
```

Upgrading the AWS SAM CLI using Homebrew

To upgrade the AWS SAM CLI using Homebrew, replace **install** with **upgrade** as follows:

```
brew upgrade aws-sam-cli
```

Nightly build using Homebrew

A nightly build of the AWS SAM CLI is available for you to install. Once installed, you can use the nightly build using the `sam-nightly` command. You can install and use both the production and nightly build versions of the AWS SAM CLI at the same time.

The nightly build contains a pre-release version of AWS SAM CLI code that may be less stable than the production version. Note that the nightly build does not contain pre-release version of the build image, so building a serverless application with the `--use-container` option uses the latest production version of the build image.

To install the nightly build version of the AWS SAM CLI, run the following commands:

```
brew tap aws/tap
brew install aws-sam-cli-nightly
```

To verify you have installed the nightly build version, run the `sam-nightly --version` command. The output of this command is in the form `1.X.Y.dev<YYYYMMDDHHmm>`, for example:

```
SAM CLI, version 1.20.0.dev202103151200
```

Troubleshooting

Installing Homebrew message: "Enter your password to install to /home/linuxbrew/.linuxbrew"

During the **Install Homebrew** step, by default you're prompted to provide a password. However, you might not want to set up a password for the current user, for example, when you're setting up a non-interactive environment like CI/CD systems.

If you don't want to set up a password for the current user, you can install Homebrew in non-interactive mode by setting the environment variable `CI=1`. For example:

```
CI=1 /bin/bash -c "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/
install.sh)"
```

Installing AWS SAM CLI error: "The following formulae cannot be installed from bottles and must be built from source. pkg-config, gdbm, openssl@1.1, ncurses, xz and python@3.8"

If you see this error while installing the AWS SAM CLI, you don't have the `gcc` module installed. Install the `gcc` module for your Linux distribution.

```
# for Amazon Linux, Amazon Linux 2, CentOS and Red Hat:
sudo yum install gcc
# for Debian and Ubuntu:
sudo apt-get update
sudo apt-get install gcc
```

After installing the `gcc` module, run the commands in the **Install the AWS SAM CLI using Homebrew** section again.

Shell error: "command not found"

If you receive this error, your shell can't locate the AWS SAM CLI executable in the PATH. Verify the location of the directory where you installed the AWS SAM CLI executable, and then verify that the directory is on your PATH.

For example, if you used the instructions in this topic to both install Homebrew and use Homebrew to install the AWS SAM CLI, then the AWS SAM CLI executable is installed to the following location:

```
/home/linuxbrew/.linuxbrew/bin/sam
```

Installing the AWS SAM CLI on Windows

Follow these steps to install and configure the prerequisites for using the AWS SAM command line interface (CLI) on your Windows host:

1. Create an AWS Identity and Access Management (AWS) account.
2. Configure IAM permissions and AWS credentials.
3. Install Docker. **Note:** Docker is a prerequisite only for testing your application locally or using the `--use-container` option.
4. Install the AWS SAM CLI.

Step 1: Create an AWS account

If you don't already have an AWS account, see aws.amazon.com and choose **Create an AWS Account**. For detailed instructions, see Create and Activate an AWS Account.

Step 2: Configure IAM permissions and AWS credentials

The IAM user that you use with AWS SAM must have sufficient permissions to make necessary AWS service calls and manage AWS resources. The simplest way to ensure that a user has sufficient permissions is to grant administrator privileges to them. For more information, see Creating your first IAM admin user and group in the *IAM User Guide*.

> **Note**
> If you don't want to grant administrator privileges to users who use the AWS Command Line Interface (AWS CLI), you can grant restricted sets of permissions to them. For more information, see Permissions (p. 330).

In addition, to enable the AWS SAM CLI to make AWS service calls, you must set up AWS credentials. For more information, see Setting up AWS credentials (p. 15).

Step 3: Install Docker (optional)

> **Note**
> Docker is a prerequisite only for testing your application locally and for building deployment packages using the `--use-container` option. If you don't plan to use these features initially, you can skip this section or install Docker at a later time.

Docker is an application that runs containers on your Linux machines. AWS SAM provides a local environment that's similar to AWS Lambda to use as a Docker container. You can use this container to build, test, and debug your serverless applications.

To run serverless projects and functions locally with the AWS SAM CLI, you must have Docker installed and working. The AWS SAM CLI uses the `DOCKER_HOST` environment variable to contact the Docker daemon. The following steps describe how to install, configure, and verify a Docker installation to work with the AWS SAM CLI.

1. Install Docker.

   Docker Desktop supports the most recent Windows operating system. For legacy versions of Windows, the Docker Toolbox is available. Choose your version of Windows for the correct Docker installation steps:

   - To install Docker for Windows 10, see Install Docker Desktop for Windows.
   - To install Docker for older versions of Windows, see Install Docker Toolbox on Windows.
2. Configure your shared drives.

   The AWS SAM CLI requires that the project directory, or any parent directory, is listed in a shared drive. In some cases you must share your drive in order for Docker to function properly.

   - If you're using Windows 10 in Hyper-V mode, see Docker File Sharing.
   - To share drives on older versions of Windows, see Add Shared Directories.
3. Verify the installation.

   After Docker is installed, verify that it's working. Also confirm that you can run Docker commands from the command line (for example, `docker ps`). You don't need to install, fetch, or pull any containers—the AWS SAM CLI does this automatically as required.

If you run into issues installing Docker, see the Logs and troubleshooting section of the *Docker installation guide* for additional troubleshooting tips.

Step 4: Install the AWS SAM CLI

Windows Installer (MSI) files are the package installer files for the Windows operating system.

Follow these steps to install the AWS SAM CLI using the MSI file.

1. Install the AWS SAM CLI 64-bit.

   Note
   If you operate on 32-bit system, see Installing AWS SAM CLI on 32-bit Windows (p. 333).
2. Verify the installation.

   After completing the installation, verify it by opening a new command prompt or PowerShell prompt. You should be able to invoke `sam` from the command line.

   ```
   sam --version
   ```

   You should see output like the following after successful installation of the AWS SAM CLI:

   ```
   SAM CLI, version 1.15.0
   ```
3. Install Git.

To download sample applications using the `sam init` command, you must also install Git. For instructions, see Installing Git.

You're now ready to start development.

Uninstalling

To uninstall the AWS SAM CLI using Windows Settings, follow these steps:

1. From the Start menu, search for "Add or remove programs".
2. Select the entry named **AWS SAM Command Line Interface** and choose **Uninstall** to launch the uninstaller.
3. Confirm that you want to uninstall the AWS SAM CLI.

Nightly build

A nightly build of the AWS SAM CLI is available for you to install. Once installed, you can use the nightly build using the `sam-nightly` command. You can install and use both the production and nightly build versions of the AWS SAM CLI at the same time.

The nightly build contains a pre-release version of AWS SAM CLI code that may be less stable than the production version. Note that the nightly build does not contain pre-release version of the build image, so building a serverless application with the `--use-container` option uses the latest production version of the build image.

The nightly build is available with this download link: AWS SAM CLI nightly build. To install the nightly build version of the AWS SAM CLI, perform the same steps as in the Step 4: Install the AWS SAM CLI (p. 11) section earlier in this topic, but use the nightly build download link instead.

To verify you have installed the nightly build version, run the `sam-nightly --version` command. The output of this command is in the form `1.X.Y.dev<YYYYMMDDHHmm>`, for example:

```
SAM CLI, version 1.20.0.dev202103151200
```

Next steps

You're now ready to begin building your own serverless applications using AWS SAM! If you want to start with sample serverless applications, choose one of the following links:

- Tutorial: Deploying a Hello World application (p. 16) – Step-by-step instructions to download, build, and deploy a simple serverless application.
- AWS SAM example applications in GitHub – Sample applications in the AWS SAM GitHub repository that you can further experiment with.

Installing the AWS SAM CLI on macOS

Follow these steps to install and configure the prerequisites for using the AWS SAM command line interface (CLI) on your macOS host:

1. Create an AWS account.
2. Configure AWS Identity and Access Management (IAM) permissions and AWS credentials.

3. Install Docker. **Note:** Docker is a prerequisite only for testing your application locally or using the `--use-container` option
4. Install Homebrew.
5. Install the AWS SAM CLI.

Step 1: Create an AWS account

If you don't already have an AWS account, see aws.amazon.com and choose **Create an AWS Account**. For detailed instructions, see How do I create and activate a new AWS account?

Step 2: Configure IAM permissions and AWS credentials

The IAM user that you use with AWS SAM must have sufficient permissions to make necessary AWS service calls and manage AWS resources. The simplest way to ensure that a user has sufficient permissions is to grant administrator privileges to them. For more information, see Creating your first IAM admin user and group in the *IAM User Guide*.

> **Note**
> If you don't want to grant administrator privileges to users who use the AWS Command Line Interface (AWS CLI), you can grant restricted sets of permissions to them. For more information, see Permissions (p. 330).

In addition, to enable the AWS SAM CLI to make AWS service calls, you must set up AWS credentials. For more information, see Setting up AWS credentials (p. 15).

Step 3: Install Docker (optional)

> **Note**
> Docker is a prerequisite only for testing your application locally and for building deployment packages using the `--use-container` option. If you don't plan to use these features initially, you can skip this section or install Docker at a later time.

Docker is an application that runs containers on your macOS machines. AWS SAM provides a local environment that's similar to AWS Lambda to use as a Docker container. You can use this container to build, test, and debug your serverless applications.

To run serverless projects and functions locally with the AWS SAM CLI, you must have Docker installed and working. The AWS SAM CLI uses the `DOCKER_HOST` environment variable to contact the Docker daemon. The following steps describe how to install, configure, and verify a Docker installation to work with the AWS SAM CLI.

1. Install Docker

   The AWS SAM CLI supports Docker running on macOS Sierra 10.12 or above. To install Docker see Install Docker Desktop for Mac.
2. Configure your shared drives

   The AWS SAM CLI requires that the project directory, or any parent directory, is listed in a shared drive. To share drives on macOS, see File sharing.
3. Verify the installation

   After Docker is installed, verify that it's working. Also confirm that you can run Docker commands from the command line (for example, `docker ps`). You don't need to install, fetch, or pull any containers—the AWS SAM CLI does this automatically as required.

If you run into issues installing Docker, see the Logs and troubleshooting section of the *Docker installation guide* for additional troubleshooting tips.

Step 4: Install Homebrew

The recommended approach for installing the AWS SAM CLI on macOS is to use the Homebrew package manager. For more information about Homebrew, see Homebrew Documentation.

To install Homebrew, you must first install Git. For more information about Git, see Git Documentation. Git is available on many different operating systems, including macOS. For instructions about installing Git on your particular operating system, see Installing Git.

Once you have successfully installed Git, run the following to install Homebrew, making sure to follow the prompts:

```
/bin/bash -c "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/
install.sh)"
```

Verify that Homebrew is installed:

```
brew --version
```

You should see output like the following on successful installation of Homebrew:

```

 Homebrew 2.5.7
 Homebrew/homebrew-core (git revision 1be3ad; last commit 2020-10-29)
 Homebrew/homebrew-cask (git revision a0cf3; last commit 2020-10-29)

```

Step 5: Install the AWS SAM CLI

Follow these steps to install the AWS SAM CLI using Homebrew:

```
brew tap aws/tap
brew install aws-sam-cli
```

Verify the installation:

```
sam --version
```

You should see output like the following after successful installation of the AWS SAM CLI:

```

 SAM CLI, version 1.15.0
```

You're now ready to start development.

Upgrading

To upgrade the AWS SAM CLI, using Homebrew, run the following command:

```
brew upgrade aws-sam-cli
```

Uninstalling

To uninstall the AWS SAM CLI, using Homebrew, run the following command:

```
brew uninstall aws-sam-cli
```

Nightly build

A nightly build of the AWS SAM CLI is available for you to install. Once installed, you can use the nightly build using the `sam-nightly` command. You can install and use both the production and nightly build versions of the AWS SAM CLI at the same time.

The nightly build contains a pre-release version of AWS SAM CLI code that may be less stable than the production version. Note that the nightly build does not contain pre-release version of the build image, so building a serverless application with the `--use-container` option uses the latest production version of the build image.

To install the nightly build version of the AWS SAM CLI, run the following commands:

```
brew tap aws/tap
brew install aws-sam-cli-nightly
```

To verify you have installed the nightly build version, run the `sam-nightly --version` command. The output of this command is in the form `1.X.Y.dev<YYYYMMDDHHmm>`, for example:

```
SAM CLI, version 1.20.0.dev202103151200
```

Next steps

You're now ready to begin building your own serverless applications using AWS SAM! If you want to start with sample serverless applications, choose one of the following links:

- Tutorial: Deploying a Hello World application (p. 16) – Step-by-step instructions to download, build, and deploy a simple serverless application.
- AWS SAM example applications in GitHub – Sample applications in the AWS SAM GitHub repository that you can further experiment with.

Setting up AWS credentials

The AWS SAM command line interface (CLI) requires you to set AWS credentials so that it can make calls to AWS services on your behalf. For example, the AWS SAM CLI makes calls to Amazon S3 and AWS CloudFormation.

You might have already set AWS credentials to work with AWS tools, like one of the AWS SDKs or the AWS CLI. If you haven't, this topic shows you the recommended approaches for setting AWS credentials.

To set AWS credentials, you must have the *access key ID* and your *secret access key* for the IAM user you want to configure. For information about access key IDs and secret access keys, see Managing Access Keys for IAM Users in the *IAM User Guide*.

Next, determine whether you have the AWS CLI installed. Then follow the instructions in one of the following sections:

Using the AWS CLI

If you have the AWS CLI installed, use the `aws configure` command and follow the prompts:

```
$ aws configure
AWS Access Key ID [None]: your_access_key_id
AWS Secret Access Key [None]: your_secret_access_key
Default region name [None]:
Default output format [None]:
```

For information about the `aws configure` command, see Quickly Configuring the AWS CLI in the *AWS Command Line Interface User Guide*.

Not using the AWS CLI

If you don't have the AWS CLI installed, you can either create a credentials file or set environment variables:

- **Credentials file** – You can set credentials in the AWS credentials file on your local system. This file must be located in one of the following locations:
  - `~/.aws/credentials` on Linux or macOS
  - `C:\Users\USERNAME\.aws\credentials` on Windows

  This file should contain lines in the following format:

  ```
  [default]
  aws_access_key_id = your_access_key_id
  aws_secret_access_key = your_secret_access_key
  ```

- **Environment variables** – You can set the `AWS_ACCESS_KEY_ID` and `AWS_SECRET_ACCESS_KEY` environment variables.

  To set these variables on Linux or macOS, use the **export** command:

  ```
  export AWS_ACCESS_KEY_ID=your_access_key_id
  export AWS_SECRET_ACCESS_KEY=your_secret_access_key
  ```

  To set these variables on Windows, use the **set** command:

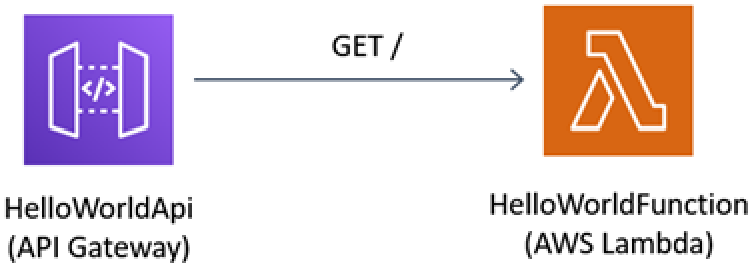
  ```
  set AWS_ACCESS_KEY_ID=your_access_key_id
  set AWS_SECRET_ACCESS_KEY=your_secret_access_key
  ```

Tutorial: Deploying a Hello World application

In this guide, you download, build, and deploy a sample Hello World application using AWS SAM. You then test the application in the AWS Cloud, and optionally test it locally on your development host.

This application implements a basic API backend. It consists of an Amazon API Gateway endpoint and an AWS Lambda function. When you send a GET request to the API Gateway endpoint, the Lambda function is invoked. This function returns a `hello world` message.

The following diagram shows the components of this application:



When you initialize your sample application, you have the option to choose a Lambda deployment package type, either `Zip` or `Image`. For more information about package types, see Lambda deployment packages in the *AWS Lambda Developer Guide*.

The following is a preview of commands that you run to create your Hello World application. For more information about each of these commands, see the sections later in this tutorial.

```
#Step 1 - Download a sample application
sam init

#Step 2 - Build your application
cd sam-app
sam build

#Step 3 - Deploy your application
sam deploy --guided
```

Prerequisites

This guide assumes that you've completed the steps for your operating system in Installing the AWS SAM CLI (p. 3), including:

1. Creating an AWS account.
2. Configuring AWS Identity and Access Management (IAM) permissions.
3. Installing Docker. **Note:** Docker is a prerequisite only for testing your application locally.
4. Installing Homebrew. **Note:** Homebrew is a prerequisite only for Linux and macOS.
5. Installing the AWS SAM command line interface (CLI). **Note:** Make sure that you have version 1.13.0 or later. Check the version by running the `sam --version` command.

Step 1: Download a sample AWS SAM application

Command to run:

```
sam init
```

Follow the on-screen prompts. For this tutorial, we recommend that you choose `AWS Quick Start Templates`, the `Zip` package type, the runtime of your choice, and the `Hello World Example`.

Example output:

```
-----------------------
Generating application:
-----------------------
Name: sam-app
Runtime: python3.7
Dependency Manager: pip
Application Template: hello-world
Output Directory: .

Next steps can be found in the README file at ./sam-app/README.md
```

What AWS SAM is doing:

This command creates a directory with the name that you provided as the project name. The contents of the project directory are similar to the following:

```
sam-app/
  ### README.md
  ### events/
  #   ### event.json
  ### hello_world/
  #   ### __init__.py
  #   ### app.py            #Contains your AWS Lambda handler logic.
  #   ### requirements.txt  #Contains any Python dependencies the application requires,
used for sam build
  ### template.yaml         #Contains the AWS SAM template defining your application's AWS
resources.
  ### tests/
      ### unit/
          ### __init__.py
          ### test_handler.py
```

> **Note**
> These project directory contents are created when you choose one of the Python runtimes and the `Hello World Example`.

There are three especially important files:

- `template.yaml`: Contains the AWS SAM template that defines your application's AWS resources.
- `hello_world/app.py`: Contains your actual Lambda handler logic.
- `hello_world/requirements.txt`: Contains any Python dependencies that the application requires, and is used for `sam build`.

Step 2: Build your application

Command to run:

First, change into the project directory, where the `template.yaml` file for the sample application is located. (By default, this directory is `sam-app`.) Then run this command:

```
sam build
```

Example output:

```

Build Succeeded

Built Artifacts  : .aws-sam/build
Built Template   : .aws-sam/build/template.yaml

Commands you can use next
=========================
[*] Invoke Function: sam local invoke
[*] Deploy: sam deploy --guided
```

What AWS SAM is doing:

The AWS SAM CLI comes with abstractions for a number of Lambda runtimes to build your dependencies, and copies the source code into staging folders so that everything is ready to be packaged and deployed. The `sam build` command builds any dependencies that your application has, and copies your application source code to folders under `.aws-sam/build` to be zipped and uploaded to Lambda.

You can see the following top-level tree under `.aws-sam`:

```

.aws-sam/
  ### build/
      ### HelloWorldFunction/
      ### template.yaml
```

`HelloWorldFunction` is a directory that contains your `app.py` file, as well as third-party dependencies that your application uses.

Step 3: Deploy your application to the AWS Cloud

Command to run:

```
sam deploy --guided
```

Follow the on-screen prompts. To accept the default options provided in the interactive experience, respond with `Enter`.

> **Note**
> For the prompt `HelloWorldFunction may not have authorization defined, Is this okay? [y/N]`, AWS SAM is informing you that the sample application configures an API Gateway API without authorization. When you deploy the sample application, AWS SAM creates a publicly available URL.
> You can acknowledge this notification by answering "Y" to the prompt. For information about configuring authorization, see Controlling access to API Gateway APIs (p. 193).

Example output:

```
   Deploying with following values
   ===============================
   Stack name                 : sam-app
   Region                     : us-east-1
   Confirm changeset          : False
   Deployment s3 bucket       : sam-bucket
   Capabilities               : ["CAPABILITY_IAM"]
   Parameter overrides        : {}

Initiating deployment
=====================

Waiting for changeset to be created..

CloudFormation stack changeset
------------------------------------------------------------------------------------------------------
Operation                                         LogicalResourceId
         ResourceType
------------------------------------------------------------------------------------------------------
+ Add
HelloWorldFunctionHelloWorldPermissionProd        AWS::Lambda::Permission
+ Add                                             ServerlessRestApiDeployment47fc2d5f9d
         AWS::ApiGateway::Deployment
+ Add                                             ServerlessRestApiProdStage
         AWS::ApiGateway::Stage
+ Add                                             ServerlessRestApi
         AWS::ApiGateway::RestApi
* Modify                                          HelloWorldFunctionRole
         AWS::IAM::Role
* Modify                                          HelloWorldFunction
         AWS::Lambda::Function
------------------------------------------------------------------------------------------------------

2019-11-21 14:33:24 - Waiting for stack create/update to complete

CloudFormation events from changeset
------------------------------------------------------------------------------------------------------
ResourceStatus                       ResourceType
LogicalResourceId                    ResourceStatusReason
------------------------------------------------------------------------------------------------------
UPDATE_IN_PROGRESS                   AWS::IAM::Role
HelloWorldFunctionRole               -
UPDATE_COMPLETE                      AWS::IAM::Role
HelloWorldFunctionRole               -
UPDATE_IN_PROGRESS                   AWS::Lambda::Function
HelloWorldFunction                   -
UPDATE_COMPLETE                      AWS::Lambda::Function
HelloWorldFunction                   -
CREATE_IN_PROGRESS                   AWS::ApiGateway::RestApi
ServerlessRestApi                    -
CREATE_COMPLETE                      AWS::ApiGateway::RestApi
ServerlessRestApi                    -
CREATE_IN_PROGRESS                   AWS::ApiGateway::RestApi
ServerlessRestApi                    Resource creation Initiated
CREATE_IN_PROGRESS                   AWS::ApiGateway::Deployment
ServerlessRestApiDeployment47fc2d5   Resource creation Initiated
                                                                         f9d
CREATE_IN_PROGRESS                   AWS::Lambda::Permission
HelloWorldFunctionHelloWorldPermis   Resource creation Initiated
                                                                         sionProd
CREATE_IN_PROGRESS                   AWS::Lambda::Permission
HelloWorldFunctionHelloWorldPermis   -
                                                                         sionProd
CREATE_IN_PROGRESS                   AWS::ApiGateway::Deployment
ServerlessRestApiDeployment47fc2d5   -
                                                                         f9d
```

```
CREATE_COMPLETE                      AWS::ApiGateway::Deployment
 ServerlessRestApiDeployment47fc2d5   -
                                                                          f9d

 CREATE_IN_PROGRESS                   AWS::ApiGateway::Stage
 ServerlessRestApiProdStage           -
 CREATE_IN_PROGRESS                   AWS::ApiGateway::Stage
 ServerlessRestApiProdStage           Resource creation Initiated
 CREATE_COMPLETE                      AWS::ApiGateway::Stage
 ServerlessRestApiProdStage           -
 CREATE_COMPLETE                      AWS::Lambda::Permission
 HelloWorldFunctionHelloWorldPermis   -
                                                                          sionProd
 UPDATE_COMPLETE_CLEANUP_IN_PROGRES   AWS::CloudFormation::Stack           sam-app
                     -

 S
 UPDATE_COMPLETE                      AWS::CloudFormation::Stack           sam-app
                     -
 ------------------------------------------------------------------------------------------------------

 Stack sam-app outputs:
 ------------------------------------------------------------------------------------------------------
 OutputKey-Description                                                     OutputValue
 ------------------------------------------------------------------------------------------------------
 HelloWorldFunctionIamRole - Implicit IAM Role created for Hello World
 arn:aws:iam::123456789012:role/sam-app-
 function
 HelloWorldFunctionRole-104VTJ0TST7M0
 HelloWorldApi - API Gateway endpoint URL for Prod stage for Hello World
 https://0ks2zue0zh.execute-api.us-east-1.amazonaws.com/Prod/hello/
 function
 HelloWorldFunction - Hello World Lambda Function ARN
 arn:aws:lambda:us-east-1:123456789012:function:sam-app-

 HelloWorldFunction-1TY92MJX0BXU5
 ------------------------------------------------------------------------------------------------------

 Successfully created/updated stack - sam-app in us-east-1
```

What AWS SAM is doing:

This command deploys your application to the AWS Cloud. It takes the deployment artifacts that you build with the `sam build` command, packages and uploads them to an Amazon Simple Storage Service (Amazon S3) bucket that the AWS SAM CLI creates, and deploys the application using AWS CloudFormation. In the output of the `sam deploy` command, you can see the changes being made to your AWS CloudFormation stack.

If your application created an HTTP endpoint, the outputs that `sam deploy` generates also show you the endpoint URL for your test application. You can use `curl` to send a request to your application using that endpoint URL. For example:

```
curl https://<restapiid>.execute-api.us-east-1.amazonaws.com/Prod/hello/
```

After successfully deploying your application, you see output like the following:

```

 {"message": "hello world"}

```

If you see `{"message": "hello world"}` after executing the `curl` command, you've successfully deployed your serverless application to AWS, and you're calling your live Lambda function. Otherwise, see the Troubleshooting (p. 24) section later in this tutorial.

Step 4: (Optional) Test your application locally

When you're developing your application, you might find it useful to test locally. The AWS SAM CLI provides the `sam local` command to run your application using Docker containers that simulate the execution environment of Lambda. There are two options to do this:

- Host your API locally
- Invoke your Lambda function directly

This step describes both options.

Host your API locally

Command to run:

```
sam local start-api
```

Example output:

```

 2019-07-12 15:27:58 Mounting HelloWorldFunction at http://127.0.0.1:3000/hello [GET]
 2019-07-12 15:27:58 You can now browse to the above endpoints to invoke your functions.
 You do not need to restart/reload SAM CLI while working on your functions, changes will be
 reflected instantly/automatically. You only need to restart SAM CLI if you update your AWS
 SAM template
 2019-07-12 15:27:58  * Running on http://127.0.0.1:3000/ (Press CTRL+C to quit)

 Fetching lambci/lambda:python3.7 Docker container
 image................................................................................................
 2019-07-12 15:28:56 Mounting /<working-development-path>/sam-app/.aws-sam/build/
HelloWorldFunction as /var/task:ro,delegated inside runtime container
 START RequestId: 52fdfc07-2182-154f-163f-5f0f9a621d72 Version: $LATEST
 END RequestId: 52fdfc07-2182-154f-163f-5f0f9a621d72
 REPORT RequestId: 52fdfc07-2182-154f-163f-5f0f9a621d72  Duration: 4.42 ms       Billed
 Duration: 100 ms Memory Size: 128 MB     Max Memory Used: 22 MB
 2019-07-12 15:28:58 No Content-Type given. Defaulting to 'application/json'.
 2019-07-12 15:28:58 127.0.0.1 - - [12/Jul/2019 15:28:58] "GET /hello HTTP/1.1" 200 -

```

It can take a while for the Docker image to load. After it's loaded, you can use `curl` to send a request to your application that's running on your local host:

```
curl http://127.0.0.1:3000/hello
```

Example output:

```

 2019-07-12 15:29:57 Invoking app.lambda_handler (python3.7)
 2019-07-12 15:29:57 Found credentials in shared credentials file: ~/.aws/credentials

 Fetching lambci/lambda:python3.7 Docker container image......
 2019-07-12 15:29:58 Mounting /<working-development-path>/sam-app/.aws-sam/build/
HelloWorldFunction as /var/task:ro,delegated inside runtime container
 START RequestId: 52fdfc07-2182-154f-163f-5f0f9a621d72 Version: $LATEST
 END RequestId: 52fdfc07-2182-154f-163f-5f0f9a621d72
 REPORT RequestId: 52fdfc07-2182-154f-163f-5f0f9a621d72  Duration: 7.92 ms       Billed
 Duration: 100 ms Memory Size: 128 MB     Max Memory Used: 22 MB
 {"statusCode":200,"body":"{\"message\": \"hello world\"}"}
```

What AWS SAM is doing:

The `start-api` command starts up a local endpoint that replicates your REST API endpoint. It downloads an execution container that you can run your function in locally. The end result is the same output that you saw when you called your function in the AWS Cloud.

Invoke your Lambda function directly

Command to run:

```
sam local invoke "HelloWorldFunction" -e events/event.json
```

Example output:

```
 2019-07-01 14:08:42 Found credentials in shared credentials file: ~/.aws/credentials
 2019-07-01 14:08:42 Invoking app.lambda_handler (python3.7)

 Fetching lambci/lambda:python3.7 Docker container
 image...........................................................................................
 2019-07-01 14:09:39 Mounting /<working-development-path>/sam-app/.aws-sam/build/
HelloWorldFunction as /var/task:ro,delegated inside runtime container
 START RequestId: 52fdfc07-2182-154f-163f-5f0f9a621d72 Version: $LATEST
 END RequestId: 52fdfc07-2182-154f-163f-5f0f9a621d72
 REPORT RequestId: 52fdfc07-2182-154f-163f-5f0f9a621d72    Duration: 3.51 ms    Billed
 Duration: 100 ms    Memory Size: 128 MB    Max Memory Used: 22 MB
 {"statusCode":200,"body":"{\"message\": \"hello world\"}"}
```

What AWS SAM is doing:

The `invoke` command directly invokes your Lambda functions, and can pass input event payloads that you provide. With this command, you pass the event payload in the file `event.json` that the sample application provides.

Your initialized application comes with a default `aws-proxy` event for API Gateway. A number of values are pre-populated for you. In this case, the `HelloWorldFunction` doesn't care about the particular values, so a stubbed request is OK. You can specify a number of values to substitute in to the request to simulate what you would expect from an actual request. The following is an example of generating your own input event and comparing the output with the default `event.json` object:

```
sam local generate-event apigateway aws-proxy --body "" --path "hello" --method GET > api-
event.json
diff api-event.json events/event.json
```

Example output:

```
 <   "body": "",
 ---
 >   "body": "{\"message\": \"hello world\"}",
 4,6c4,6
 <   "path": "/hello",
 <   "httpMethod": "GET",
 <   "isBase64Encoded": true,
 ---
 >   "path": "/path/to/resource",
 >   "httpMethod": "POST",
 >   "isBase64Encoded": false,
 11c11
 <     "proxy": "/hello"
 ---
 >     "proxy": "/path/to/resource"
 56c56
 <     "path": "/prod/hello",
 ---
 >     "path": "/prod/path/to/resource",
 58c58
 <     "httpMethod": "GET",
 ---
 >     "httpMethod": "POST",
```

Troubleshooting

AWS SAM CLI error: "Security Constraints Not Satisfied"

When running **sam deploy --guided**, you're prompted with the question `HelloWorldFunction may not have authorization defined, Is this okay? [y/N]`. If you respond to this prompt with **`N`** (the default response), you see the following error:

```
Error: Security Constraints Not Satisfied
```

The prompt is informing you that the application you're about to deploy might have an Amazon API Gateway API configured without authorization. By responding **`N`** to this prompt, you're saying that this is not OK.

To fix this, you have the following options:

- Configure your application with authorization. For information about configuring authorization, see Controlling access to API Gateway APIs (p. 193).
- Respond to this question with **`Y`** to indicate that you're OK with deploying an application that has an API Gateway API configured without authorization.

AWS SAM CLI error: "no such option: --app-template"

When executing `sam init`, you see the following error:

```
Error: no such option: --app-template
```

This means that you are using an older version of the AWS SAM CLI that does not support the `--app-template` parameter. To fix this, you can either update your version of AWS SAM CLI to 0.33.0 or later, or omit the `--app-template` parameter from the `sam init` command.

AWS SAM CLI error: "no such option: --guided"

When executing `sam deploy`, you see the following error:

```
Error: no such option: --guided
```

This means that you are using an older version of the AWS SAM CLI that does not support the `--guided` parameter. To fix this, you can either update your version of AWS SAM CLI to 0.33.0 or later, or omit the `--guided` parameter from the `sam deploy` command.

AWS SAM CLI error: "Failed to create managed resources: Unable to locate credentials"

When executing `sam deploy`, you see the following error:

```
Error: Failed to create managed resources: Unable to locate credentials
```

This means that you have not set up AWS credentials to enable the AWS SAM CLI to make AWS service calls. To fix this, you must set up AWS credentials. For more information, see Setting up AWS credentials (p. 15).

AWS SAM CLI error: "Running AWS SAM projects locally requires Docker. Have you got it installed?"

When executing `sam local start-api`, you see the following error:

```
Error: Running AWS SAM projects locally requires Docker. Have you got it installed?
```

This means that you do not have Docker properly installed. Docker is required to test your application locally. To fix this, follow the instructions for installing Docker for your development host. Go to Installing the AWS SAM CLI (p. 3), choose the appropriate platform, and then follow the instructions in the section titled **Install Docker**.

Curl error: "Missing Authentication Token"

When trying to invoke the API Gateway endpoint, you see the following error:

```
 {"message":"Missing Authentication Token"}
```

This means that you've attempted to send a request to the correct domain, but the URI isn't recognizable. To fix this, verify the full URL, and update the `curl` command with the correct URL.

Curl error: "curl: (6) Could not resolve: ..."

When trying to invoke the API Gateway endpoint, you see the following error:

```
 curl: (6) Could not resolve: endpointdomain (Domain name not found)
```

This means that you've attempted to send a request to an invalid domain. This can happen if your serverless application failed to deploy successfully, or if you have a typo in your `curl` command. Verify that the application deployed successfully by using the AWS CloudFormation console or the AWS CLI, and verify that your `curl` command is correct.

Clean up

If you no longer need the AWS resources that you created by running this tutorial, you can remove them by deleting the AWS CloudFormation stack that you deployed.

To delete the AWS CloudFormation stack using the AWS Management Console, follow these steps:

1. Sign in to the AWS Management Console and open the AWS CloudFormation console at https://console.aws.amazon.com/cloudformation.
2. In the left navigation pane, choose **Stacks**.
3. In the list of stacks, choose **sam-app** (or the name of the stack that you created).
4. Choose **Delete**.

When done, the status of the stack changes to **DELETE_COMPLETE**.

Alternatively, you can delete the AWS CloudFormation stack by running the following AWS CLI command:

```
aws cloudformation delete-stack --stack-name sam-app --region region
```

Verify the deleted stack

For both methods of deleting the AWS CloudFormation stack, you can verify that it was deleted by going to the AWS CloudFormation console. In the left navigation pane, choose **Stacks**, and then in the dropdown list next to the search box, choose **Deleted**. You should see your stack's name in the list of deleted stacks.

Conclusion

In this tutorial, you've done the following:

1. Created, built, and deployed a serverless application to AWS using AWS SAM.
2. Tested your application locally using the AWS SAM CLI and Docker.
3. Deleted the AWS resources that you no longer need.

Next steps

You're now ready to start building your own applications using the AWS SAM CLI.

To help you get started, you can download any of the example applications from the AWS Serverless Application Repository Examples repository on GitHub.

AWS Serverless Application Model (AWS SAM) specification

You use the AWS SAM specification to define your serverless application. This section provides details for the AWS SAM template sections, resources types, resource properties, data types, resource attributes, intrinsic functions, and API Gateway extensions that you can use in AWS SAM templates.

AWS SAM templates are an extension of AWS CloudFormation templates, with some additional components that make them easier to work with. For the full reference for AWS CloudFormation templates, see AWS CloudFormation Template Reference in the *AWS CloudFormation User Guide*.

Topics

- AWS SAM template anatomy (p. 27)
- AWS SAM resource and property reference (p. 33)
- Resource attributes (p. 176)
- Intrinsic functions (p. 177)
- Generated AWS CloudFormation resources (p. 177)
- API Gateway extensions (p. 187)

AWS SAM template anatomy

An AWS SAM template file closely follows the format of an AWS CloudFormation template file, which is described in Template anatomy in the *AWS CloudFormation User Guide*. The primary differences between AWS SAM template files and AWS CloudFormation template files are the following:

- **Transform declaration.** The declaration `Transform: AWS::Serverless-2016-10-31` is required for AWS SAM template files. This declaration identifies an AWS CloudFormation template file as an AWS SAM template file. For more information about transforms, see Transform in the *AWS CloudFormation User Guide*.
- **Globals section.** The `Globals` section is unique to AWS SAM. It defines properties that are common to all your serverless functions and APIs. All the `AWS::Serverless::Function`, `AWS::Serverless::Api`, and `AWS::Serverless::SimpleTable` resources inherit the properties that are defined in the `Globals` section. For more information about this section, see Globals section of the AWS SAM template (p. 29).
- **Resources section.** In AWS SAM templates the `Resources` section can contain a combination of AWS CloudFormation resources and AWS SAM resources. For more information about AWS CloudFormation resources, see AWS resource and property types reference in the *AWS CloudFormation User Guide*. For more information about AWS SAM resources, see AWS SAM resource and property reference (p. 33).
- **Parameters section.** Objects that are declared in the `Parameters` section cause the `sam deploy --guided` command to present additional prompts to the user. For examples of declared objects and the corresponding prompts, see sam deploy (p. 258) in the AWS SAM CLI command reference.

All other sections of an AWS SAM template file correspond to the AWS CloudFormation template file section of the same name.

YAML

The following example shows a YAML-formatted template fragment.

```
Transform: AWS::Serverless-2016-10-31

Globals:
  set of globals

Description:
  String

Metadata:
  template metadata

Parameters:
  set of parameters

Mappings:
  set of mappings

Conditions:
  set of conditions

Resources:
  set of resources

Outputs:
  set of outputs
```

Template sections

AWS SAM templates can include several major sections. Only the `Transform` and `Resources` sections are required.

You can include template sections in any order. However, as you build your template, it can be helpful to use the logical order that's shown in the following list. This is because the values in one section might refer to values from a previous section.

Transform (required)

For AWS SAM templates, you must include this section with a value of `AWS::Serverless-2016-10-31`.

Additional transforms are optional. For more information about transforms, see Transform in the *AWS CloudFormation User Guide*.

Globals (optional) (p. 29)

Properties that are common to all your serverless functions, APIs, and simple tables. All the `AWS::Serverless::Function`, `AWS::Serverless::Api`, and `AWS::Serverless::SimpleTable` resources inherit the properties that are defined in the `Globals` section.

This section is unique to AWS SAM. There isn't a corresponding section in AWS CloudFormation templates.

Description (optional)

A text string that describes the template.

This section corresponds directly with the `Description` section of AWS CloudFormation templates.

Metadata (optional)

Objects that provide additional information about the template.

This section corresponds directly with the `Metadata` section of AWS CloudFormation templates.

Parameters (optional)

Values to pass to your template at runtime (when you create or update a stack). You can refer to parameters from the `Resources` and `Outputs` sections of the template.

Values that are passed in using the `--parameter-overrides` parameter of the `sam deploy` command—and entries in the configuration file—take precendence over entries in the AWS SAM template file. For more information about the `sam deploy` command, see sam deploy (p. 258) in the AWS SAM CLI command reference. For more information about the configuration file, see AWS SAM CLI configuration file (p. 280).

Mappings (optional)

A mapping of keys and associated values that you can use to specify conditional parameter values, similar to a lookup table. You can match a key to a corresponding value by using the `Fn::FindInMap` intrinsic function in the `Resources` and `Outputs` sections.

This section corresponds directly with the `Mappings` section of AWS CloudFormation templates.

Conditions (optional)

Conditions that control whether certain resources are created or whether certain resource properties are assigned a value during stack creation or update. For example, you could conditionally create a resource that depends on whether the stack is for a production or test environment.

This section corresponds directly with the `Conditions` section of AWS CloudFormation templates.

Resources (required)

The stack resources and their properties, such as an Amazon Elastic Compute Cloud (Amazon EC2) instance or an Amazon Simple Storage Service (Amazon S3) bucket. You can refer to resources in the `Resources` and `Outputs` sections of the template.

This section is similar to the `Resources` section of AWS CloudFormation templates. In AWS SAM templates, this section can contain AWS SAM resources in addition to AWS CloudFormation resources.

Outputs (optional)

The values that are returned whenever you view your stack's properties. For example, you can declare an output for an S3 bucket name, and then call the `aws cloudformation describe-stacks` AWS Command Line Interface (AWS CLI) command to view the name.

This section corresponds directly with the `Outputs` section of AWS CloudFormation templates.

Next steps

To download and deploy a sample serverless application that contains an AWS SAM template file, see Getting started with AWS SAM (p. 3) and follow the instructions in Tutorial: Deploying a Hello World application (p. 16).

Globals section of the AWS SAM template

Sometimes resources that you declare in an AWS SAM template have common configurations. For example, you might have an application with multiple `AWS::Serverless::Function` resources that have identical `Runtime`, `Memory`, `VPCConfig`, `Environment`, and `Cors` configurations. Instead of duplicating this information in every resource, you can declare them once in the `Globals` section and let your resources inherit them.

The Globals section is supported by the AWS::Serverless::Function, AWS::Serverless::Api, AWS::Serverless::HttpApi, and AWS::Serverless::SimpleTable resources.

Example:

```
Globals:
  Function:
    Runtime: nodejs12.x
    Timeout: 180
    Handler: index.handler
    Environment:
      Variables:
        TABLE_NAME: data-table

Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function
    Properties:
      Environment:
        Variables:
          MESSAGE: "Hello From SAM"

  ThumbnailFunction:
    Type: AWS::Serverless::Function
    Properties:
      Events:
        Thumbnail:
          Type: Api
          Properties:
            Path: /thumbnail
            Method: POST
```

In this example, both HelloWorldFunction and ThumbnailFunction use "nodejs12.x" for Runtime, "180" seconds for Timeout, and "index.handler" for Handler. HelloWorldFunction adds the MESSAGE environment variable, in addition to the inherited TABLE_NAME. ThumbnailFunction inherits all the Globals properties and adds an API event source.

Supported resources and properties

AWS SAM supports the following resources and properties.

```
Globals:
  Function:
    Handler:
    Runtime:
    CodeUri:
    DeadLetterQueue:
    Description:
    MemorySize:
    Timeout:
    VpcConfig:
    Environment:
    Tags:
    Tracing:
    KmsKeyArn:
    Layers:
    AutoPublishAlias:
    DeploymentPreference:
    PermissionsBoundary:
    ReservedConcurrentExecutions:
    ProvisionedConcurrencyConfig:
    AssumeRolePolicyDocument:
    EventInvokeConfig:
```

```
    Architectures:

  Api:
    Auth:
    Name:
    DefinitionUri:
    CacheClusterEnabled:
    CacheClusterSize:
    Variables:
    EndpointConfiguration:
    MethodSettings:
    BinaryMediaTypes:
    MinimumCompressionSize:
    Cors:
    GatewayResponses:
    AccessLogSetting:
    CanarySetting:
    TracingEnabled:
    OpenApiVersion:
    Domain:

  HttpApi:
    Auth:
    AccessLogSettings:
    StageVariables:
    Tags:

  SimpleTable:
    SSESpecification:
```

Note

Any resources and properties that are not included in the previous list are not supported. Some reasons for not supporting them include: 1) They open potential security issues, or 2) They make the template hard to understand.

Implicit APIs

AWS SAM creates *implicit APIs* when you declare an API in the `Events` section. You can use `Globals` to override all properties of implicit APIs.

Overridable properties

Resources can override the properties that you declare in the `Globals` section. For example, you can add new variables to an environment variable map, or you can override globally declared variables. But the resource cannot remove a property that's specified in the `Globals` section.

More generally, the `Globals` section declares properties that all your resources share. Some resources can provide new values for globally declared properties, but they can't remove them. If some resources use a property but others don't, then you must not declare them in the `Globals` section.

The following sections describe how overriding works for different data types.

Primitive data types are replaced

Primitive data types include strings, numbers, Booleans, and so on.

The value specified in the `Resources` section replaces the value in the `Globals` section.

Example:

```
Globals:
  Function:
    Runtime: nodejs12.x

Resources:
  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      Runtime: python3.6
```

The `Runtime` for `MyFunction` is set to `python3.6`.

Maps are merged

Maps are also known as dictionaries or collections of key-value pairs.

Map entries in the `Resources` section are merged with global map entries. If there are duplicates, the `Resource` section entry overrides the `Globals` section entry.

Example:

```
Globals:
  Function:
    Environment:
      Variables:
        STAGE: Production
        TABLE_NAME: global-table

Resources:
  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      Environment:
        Variables:
          TABLE_NAME: resource-table
          NEW_VAR: hello
```

The environment variables of `MyFunction` are set to the following:

```
{
  "STAGE": "Production",
  "TABLE_NAME": "resource-table",
  "NEW_VAR": "hello"
}
```

Lists are additive

Lists are also known as arrays.

List entries in the `Globals` section are prepended to the list in the `Resources` section.

Example:

```
Globals:
  Function:
    VpcConfig:
      SecurityGroupIds:
        - sg-123
        - sg-456

Resources:
  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      VpcConfig:
        SecurityGroupIds:
          - sg-first
```

The `SecurityGroupIds` for `MyFunction`'s `VpcConfig` are set to the following:

```
[ "sg-123", "sg-456", "sg-first" ]
```

AWS SAM resource and property reference

This section contains reference information for the AWS SAM resource and property types.

Topics

- AWS::Serverless::Api (p. 33)
- AWS::Serverless::Application (p. 65)
- AWS::Serverless::Function (p. 68)
- AWS::Serverless::HttpApi (p. 130)
- AWS::Serverless::LayerVersion (p. 150)
- AWS::Serverless::SimpleTable (p. 153)
- AWS::Serverless::StateMachine (p. 156)

AWS::Serverless::Api

Creates a collection of Amazon API Gateway resources and methods that can be invoked through HTTPS endpoints.

An AWS::Serverless::Api (p. 33) resource need not be explicitly added to a AWS Serverless Application Definition template. A resource of this type is implicitly created from the union of Api events defined on AWS::Serverless::Function (p. 68) resources defined in the template that do not refer to an AWS::Serverless::Api (p. 33) resource.

An AWS::Serverless::Api (p. 33) resource should be used to define and document the API using OpenApi, which provides more ability to configure the underlying Amazon API Gateway resources.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Type: AWS::Serverless::Api
Properties:
  AccessLogSetting: AccessLogSetting
  Auth: ApiAuth (p. 41)
  BinaryMediaTypes: List
  CacheClusterEnabled: Boolean
  CacheClusterSize: String
  CanarySetting: CanarySetting
  Cors: String | CorsConfiguration (p. 58)
  DefinitionBody: String
  DefinitionUri: String | ApiDefinition (p. 57)
  Description: String
  Domain: DomainConfiguration (p. 60)
  EndpointConfiguration: EndpointConfiguration (p. 64)
  GatewayResponses: Map
  MethodSettings: MethodSettings
  MinimumCompressionSize: Integer
  Mode: String
  Models: Map
  Name: String
  OpenApiVersion: String
  StageName: String
  Tags: Map
  TracingEnabled: Boolean
  Variables: Map
```

Properties

`AccessLogSetting`

Configures Access Log Setting for a stage.

Type: AccessLogSetting

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `AccessLogSetting` property of an `AWS::ApiGateway::Stage` resource.

`Auth`

Configure authorization to control access to your API Gateway API.

For more information about configuring access using AWS SAM see Controlling access to API Gateway APIs (p. 193).

Type: ApiAuth (p. 41)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`BinaryMediaTypes`

List of MIME types that your API could return. Use this to enable binary support for APIs. Use ~1 instead of / in the mime types.

Type: List

Required: No

AWS CloudFormation compatibility: This property is similar to the `BinaryMediaTypes` property of an `AWS::ApiGateway::RestApi` resource. The list of BinaryMediaTypes is added to both the AWS CloudFormation resource and the OpenAPI document.

`CacheClusterEnabled`

Indicates whether cache clustering is enabled for the stage.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `CacheClusterEnabled` property of an `AWS::ApiGateway::Stage` resource.

`CacheClusterSize`

The stage's cache cluster size.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `CacheClusterSize` property of an `AWS::ApiGateway::Stage` resource.

`CanarySetting`

Configure a canary setting to a stage of a regular deployment.

Type: CanarySetting

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `CanarySetting` property of an `AWS::ApiGateway::Stage` resource.

`Cors`

Manage Cross-origin resource sharing (CORS) for all your API Gateway APIs. Specify the domain to allow as a string or specify a dictionary with additional Cors configuration. NOTE: CORS requires AWS SAM to modify your OpenAPI definition. So, it works only if inline OpenApi is defined with DefinitionBody.

For more information about CORS, see Enable CORS for an API Gateway REST API Resource in the *API Gateway Developer Guide*.

Type: String | CorsConfiguration (p. 58)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`DefinitionBody`

OpenAPI specification that describes your API. If neither `DefinitionUri` nor `DefinitionBody` are specified, SAM will generate a `DefinitionBody` for you based on your template configuration.

Type: String

Required: No

AWS CloudFormation compatibility: This property is similar to the `Body` property of an `AWS::ApiGateway::RestApi` resource. If certain properties are provided, content may be inserted or modified into the DefinitionBody before being passed to CloudFormation. Properties include `Auth`, `BinaryMediaTypes`, `Cors`, `GatewayResponses`, `Models`, and an `EventSource` of type Api for a corresponding `AWS::Serverless::Function`.

`DefinitionUri`

Amazon S3 Uri, local file path, or location object of the the OpenAPI document defining the API. The Amazon S3 object this property references must be a valid OpenAPI file. If neither `DefinitionUri` nor `DefinitionBody` are specified, SAM will generate a `DefinitionBody` for you based on your template configuration.

If a local file path is provided, the template must go through the workflow that includes the `sam deploy` or `sam package` command, in order for the definition to be transformed properly.

Intrinsic functions are not supported in external OpenApi files referenced by `DefinitionUri`. Use instead the `DefinitionBody` property with the Include Transform to import an OpenApi definition into the template.

Type: String | ApiDefinition (p. 57)

Required: No

AWS CloudFormation compatibility: This property is similar to the `BodyS3Location` property of an `AWS::ApiGateway::RestApi` resource. The nested Amazon S3 properties are named differently.

`Description`

A description of the Api resource.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Description` property of an `AWS::ApiGateway::RestApi` resource.

`Domain`

Configures a custom domain for this API Gateway API.

Type: DomainConfiguration (p. 60)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`EndpointConfiguration`

The endpoint type of a REST API.

Type: EndpointConfiguration (p. 64)

Required: No

AWS CloudFormation compatibility: This property is similar to the `EndpointConfiguration` property of an `AWS::ApiGateway::RestApi` resource. The nested configuration properties are named differently.

`GatewayResponses`

Configures Gateway Responses for an API. Gateway Responses are responses returned by API Gateway, either directly or through the use of Lambda Authorizers. For more information, see the documentation for the Api Gateway OpenApi extension for Gateway Responses.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`MethodSettings`

Configures all settings for API stage including Logging, Metrics, CacheTTL, Throttling.

Type: MethodSettings

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MethodSettings` property of an `AWS::ApiGateway::Stage` resource.

`MinimumCompressionSize`

Allow compression of response bodies based on client's Accept-Encoding header. Compression is triggered when response body size is greater than or equal to your configured threshold. The maximum body size threshold is 10 MB (10,485,760 Bytes). - The following compression types are supported: gzip, deflate, and identity.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MinimumCompressionSize` property of an `AWS::ApiGateway::RestApi` resource.

`Mode`

This property applies only when you use OpenAPI to define your REST API. The `Mode` determines how API Gateway handles resource updates. For more information, see Mode property of the AWS::ApiGateway::RestApi resource type.

Valid values: `overwrite` or `merge`

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Mode` property of an `AWS::ApiGateway::RestApi` resource.

`Models`

The schemas to be used by your API methods. These schemas can be described using JSON or YAML. See the Examples section at the bottom of this page for example models.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Name`

A name for the API Gateway RestApi resource

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Name` property of an `AWS::ApiGateway::RestApi` resource.

`OpenApiVersion`

Version of OpenApi to use. This can either be `2.0` for the Swagger specification, or one of the OpenApi 3.0 versions, like `3.0.1`. For more information about OpenAPI, see the OpenAPI Specification.

Note: Setting this property to any valid value will also remove the stage `Stage` that SAM creates.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`StageName`

The name of the stage, which API Gateway uses as the first path segment in the invoke Uniform Resource Identifier (URI).

To reference the stage resource, use `<api-logical-id>.Stage`. For more information about referencing resources generated when an AWS::Serverless::Api (p. 33) resource is specified, see AWS CloudFormation resources generated when AWS::Serverless::Api is specified (p. 179). For general information about generated AWS CloudFormation resources, see Generated AWS CloudFormation resources (p. 177).

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is similar to the `StageName` property of an `AWS::ApiGateway::Stage` resource. It is required in SAM, but not required in API Gateway

Additional notes: The Implicit API has a stage name of "Prod".

`Tags`

A map (string to string) that specifies the tags to be added to this API Gateway stage. For details about valid keys and values for tags, see Resource tag in the *AWS CloudFormation User Guide*.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is similar to the `Tags` property of an `AWS::ApiGateway::Stage` resource. The Tags property in SAM consists of Key:Value pairs; in CloudFormation it consists of a list of Tag objects.

`TracingEnabled`

Indicates whether active tracing with X-Ray is enabled for the stage. For more information about X-Ray, see Tracing user requests to REST APIs using X-Ray in the *API Gateway Developer Guide*.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `TracingEnabled` property of an `AWS::ApiGateway::Stage` resource.

`Variables`

A map (string to string) that defines the stage variables, where the variable name is the key and the variable value is the value. Variable names are limited to alphanumeric characters. Values must match the following regular expression: `[A-Za-z0-9._~:/?#&=,-]+`.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Variables` property of an `AWS::ApiGateway::Stage` resource.

Return Values

Ref

When the logical ID of this resource is provided to the `Ref` intrinsic function, it returns the ID of the underlying API Gateway API.

For more information about using the `Ref` function, see `Ref` in the *AWS CloudFormation User Guide*.

Fn::GetAtt

`Fn::GetAtt` returns a value for a specified attribute of this type. The following are the available attributes and sample return values.

For more information about using `Fn::GetAtt`, see `Fn::GetAtt` in the *AWS CloudFormation User Guide*.

`RootResourceId`

The root resource ID for a `RestApi` resource, such as `a0bc123d4e`.

Examples

SimpleApiExample

A Hello World AWS SAM template file that contains a Lambda Function with an API endpoint. This is a full AWS SAM template file for a working serverless application.

YAML

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
Description: AWS SAM template with a simple API definition
Resources:
  ApiGatewayApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: prod
  ApiFunction: # Adds a GET api endpoint at "/" to the ApiGatewayApi via an Api event
    Type: AWS::Serverless::Function
    Properties:
      Events:
        ApiEvent:
          Type: Api
          Properties:
            Path: /
            Method: get
            RestApiId:
              Ref: ApiGatewayApi
      Runtime: python3.7
      Handler: index.handler
      InlineCode: |
    def handler(event, context):
      return {'body': 'Hello World!', 'statusCode': 200}
```

ApiCorsExample

An AWS SAM template snippet with an API defined in an external Swagger file along with Lambda integrations and CORS configurations. This is just a portion of an AWS SAM template file showing an AWS::Serverless::Api (p. 33) definition.

YAML

```
Resources:
  ApiGatewayApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      # Allows www.example.com to call these APIs
      # SAM will automatically add AllowMethods with a list of methods for this API
      Cors: "'www.example.com'"
      DefinitionBody: # Pull in an OpenApi definition from S3
        'Fn::Transform':
          Name: 'AWS::Include'
          # Replace "bucket" with your bucket name
          Parameters:
            Location: s3://bucket/swagger.yaml
```

ApiCognitoAuthExample

An AWS SAM template snippet with an API that uses Amazon Cognito to authorize requests against the API. This is just a portion of an AWS SAM template file showing an AWS::Serverless::Api (p. 33) definition.

YAML

```
Resources:
  ApiGatewayApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      Cors: "'*'"
      Auth:
        DefaultAuthorizer: MyCognitoAuthorizer
        Authorizers:
          MyCognitoAuthorizer:
            UserPoolArn:
              Fn::GetAtt: [MyCognitoUserPool, Arn]
```

ApiModelsExample

An AWS SAM template snippet with an API that includes a Models schema. This is just a portion of an AWS SAM template file, showing an AWS::Serverless::Api (p. 33) definition with two model schemas.

YAML

```
Resources:
  ApiGatewayApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      Models:
```

```
      User:
        type: object
        required:
          - username
          - employee_id
        properties:
          username:
            type: string
          employee_id:
            type: integer
          department:
            type: string
      Item:
        type: object
        properties:
          count:
            type: integer
          category:
            type: string
          price:
            type: integer
```

ApiAuth

Configure authorization to control access to your API Gateway API.

For more information and examples for configuring access using AWS SAM see Controlling access to API Gateway APIs (p. 193).

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
AddDefaultAuthorizerToCorsPreflight: Boolean
ApiKeyRequired: Boolean
Authorizers: CognitoAuthorizer (p. 46) | LambdaTokenAuthorizer (p. 51)
| LambdaRequestAuthorizer (p. 48)
DefaultAuthorizer: String
InvokeRole: String
ResourcePolicy: ResourcePolicyStatement (p. 54)
UsagePlan: ApiUsagePlan (p. 44)
```

Properties

`AddDefaultAuthorizerToCorsPreflight`

If the `DefaultAuthorizer` and `Cors` properties are set, then setting `AddDefaultAuthorizerToCorsPreflight` will cause the default authorizer to be added to the `Options` property in the OpenAPI section.

Type: Boolean

Required: No

Default: True

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`ApiKeyRequired`

If set to true then an API key is required for all API events. For more information about API keys see Create and Use Usage Plans with API Keys in the *API Gateway Developer Guide*.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Authorizers`

The authorizer used to control access to your API Gateway API.

For more information, see Controlling access to API Gateway APIs (p. 193).

Type: CognitoAuthorizer (p. 46) | LambdaTokenAuthorizer (p. 51) | LambdaRequestAuthorizer (p. 48)

Required: No

Default: None

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Additional notes: SAM adds the Authorizers to the OpenApi definition of an Api.

`DefaultAuthorizer`

Specify a default authorizer for an API Gateway API, which will be used for authorizing API calls by default.

Note: If the Api EventSource for the function associated with this API is configured to use IAM Permissions, then this property must be set to `AWS_IAM`, otherwise an error will result.

Type: String

Required: No

Default: None

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`InvokeRole`

Sets integration credentials for all resources and methods to this value.

`CALLER_CREDENTIALS` maps to `arn:aws:iam::*:user/*`, which uses the caller credentials to invoke the endpoint.

Valid values: `CALLER_CREDENTIALS`, `NONE`, `IAMRoleArn`

Type: String

Required: No

Default: `CALLER_CREDENTIALS`

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`ResourcePolicy`

Configure Resource Policy for all methods and paths on an API.

Type: ResourcePolicyStatement (p. 54)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Additional notes: This setting can also be defined on individual `AWS::Serverless::Function` using the ApiFunctionAuth (p. 91). This is required for APIs with `EndpointConfiguration: PRIVATE`.

`UsagePlan`

Configures a usage plan associated with this API. For more information about usage plans see Create and Use Usage Plans with API Keys in the *API Gateway Developer Guide*.

This AWS SAM property generates three additional AWS CloudFormation resources when this property is set: an AWS::ApiGateway::UsagePlan, an AWS::ApiGateway::UsagePlanKey, and an AWS::ApiGateway::ApiKey. For information about this scenario, see UsagePlan property is specified (p. 180). For general information about generated AWS CloudFormation resources, see Generated AWS CloudFormation resources (p. 177).

Type: ApiUsagePlan (p. 44)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

CognitoAuth

Cognito Auth Example

YAML

```
Auth:
  Authorizers:
    MyCognitoAuth:
     UserPoolArn:
       Fn::GetAtt:
         - MyUserPool
         - Arn
     AuthType: "COGNITO_USER_POOLS"
  DefaultAuthorizer: MyCognitoAuth
  InvokeRole: CALLER_CREDENTIALS
  AddDefaultAuthorizerToCorsPreflight: false
  ApiKeyRequired: false
  ResourcePolicy:
    CustomStatements: [{
      "Effect": "Allow",
      "Principal": "*",
      "Action": "execute-api:Invoke",
      "Resource": "execute-api:/Prod/GET/pets",
      "Condition": {
          "IpAddress": {
              "aws:SourceIp": "1.2.3.4"
```

```
        }
      }
    }]
    IpRangeBlacklist:
      - "10.20.30.40"
```

ApiUsagePlan

Configures a usage plan for an API Gateway API. For more information about usage plans, see Create and Use Usage Plans with API Keys in the *API Gateway Developer Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  CreateUsagePlan: String
  Description: String
  Quota: QuotaSettings
  Tags: List
  Throttle: ThrottleSettings
  UsagePlanName: String
```

Properties

`CreateUsagePlan`

Determines how this usage plan is configured. Valid values are `PER_API`, `SHARED`, and `NONE`.

`PER_API` creates AWS::ApiGateway::UsagePlan, AWS::ApiGateway::ApiKey, and AWS::ApiGateway::UsagePlanKey resources that are specific to this API. These resources have logical IDs of *<api-logical-id>*`UsagePlan`, *<api-logical-id>*`ApiKey`, and *<api-logical-id>*`UsagePlanKey`, respectively.

`SHARED` creates AWS::ApiGateway::UsagePlan, AWS::ApiGateway::ApiKey, and AWS::ApiGateway::UsagePlanKey resources that are shared across any API that also has `CreateUsagePlan: SHARED` in the same AWS SAM template. These resources have logical IDs of `ServerlessUsagePlan`, `ServerlessApiKey`, and `ServerlessUsagePlanKey`, respectively. If you use this option, we recommend that you add additional configuration for this usage plan on only one API resource to avoid conflicting definitions and an uncertain state.

`NONE` disables the creation or association of a usage plan with this API. This is only necessary if `SHARED` or `PER_API` is specified in the Globals section of the AWS SAM template (p. 29).

Valid values: `PER_API`, `SHARED`, and `NONE`

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Description`

A description of the usage plan.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Description` property of an `AWS::ApiGateway::UsagePlan` resource.

`Quota`

Configures the number of requests that users can make within a given interval.

Type: QuotaSettings

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Quota` property of an `AWS::ApiGateway::UsagePlan` resource.

`Tags`

An array of arbitrary tags (key-value pairs) to associate with the usage plan.

This property uses the CloudFormation Tag Type.

Type: List

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Tags` property of an `AWS::ApiGateway::UsagePlan` resource.

`Throttle`

Configures the overall request rate (average requests per second) and burst capacity.

Type: ThrottleSettings

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Throttle` property of an `AWS::ApiGateway::UsagePlan` resource.

`UsagePlanName`

A name for the usage plan.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `UsagePlanName` property of an `AWS::ApiGateway::UsagePlan` resource.

Examples

UsagePlan

The following is a usage plan example.

YAML

```
Auth:
  UsagePlan:
    CreateUsagePlan: PER_API
    Description: Usage plan for this API
    Quota:
      Limit: 500
      Period: MONTH
    Throttle:
      BurstLimit: 100
      RateLimit: 50
    Tags:
      - Key: TagName
        Value: TagValue
```

CognitoAuthorizer

Define a Amazon Cognito User Pool authorizer.

For more information and examples, see Controlling access to API Gateway APIs (p. 193).

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
AuthorizationScopes: List
Identity: CognitoAuthorizationIdentity (p. 47)
UserPoolArn: String
```

Properties

`AuthorizationScopes`

List of authorization scopes for this authorizer.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Identity`

This property can be used to specify an `IdentitySource` in an incoming request for an authorizer.

Type: CognitoAuthorizationIdentity (p. 47)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`UserPoolArn`

Can refer to a user pool/specify a userpool arn to which you want to add this cognito authorizer

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

CognitoAuth

Cognito Auth Example

YAML

```
Auth:
  Authorizers:
    MyCognitoAuth:
      AuthorizationScopes:
        - scope1
        - scope2
      UserPoolArn:
        Fn::GetAtt:
          - MyCognitoUserPool
          - Arn
      Identity:
        Header: MyAuthorizationHeader
        ValidationExpression: myauthvalidationexpression
```

CognitoAuthorizationIdentity

This property can be used to specify an IdentitySource in an incoming request for an authorizer. For more information about IdentitySource see the ApiGateway Authorizer OpenApi extension.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Header: String
  ReauthorizeEvery: Integer
  ValidationExpression: String
```

Properties

`Header`

Specify the header name for Authorization in the OpenApi definition.

Type: String

Required: No

Default: Authorization

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`ReauthorizeEvery`

The time-to-live (TTL) period, in seconds, that specifies how long API Gateway caches authorizer results. If you specify a value greater than 0, API Gateway caches the authorizer responses. By default, API Gateway sets this property to 300. The maximum value is 3600, or 1 hour.

Type: Integer

Required: No

Default: 300

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`ValidationExpression`

Specify a validation expression for validating the incoming Identity

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

CognitoAuthIdentity

YAML

```
Identity:
  Header: MyCustomAuthHeader
  ValidationExpression: Bearer.*
  ReauthorizeEvery: 30
```

LambdaRequestAuthorizer

Configure a Lambda Authorizer to control access to your API with a Lambda function.

For more information and examples, see Controlling access to API Gateway APIs (p. 193).

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  AuthorizationScopes: List
  FunctionArn: String
  FunctionInvokeRole: String
  FunctionPayloadType: String
  Identity: LambdaRequestAuthorizationIdentity (p. 50)
```

Properties

`AuthorizationScopes`

List of authorization scopes for this authorizer.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`FunctionArn`

Specify the function arn of the Lambda function which provides authorization for the API.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`FunctionInvokeRole`

Adds authorizer credentials to the OpenApi definition of the Lambda authorizer.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`FunctionPayloadType`

This property can be used to define the type of Lambda Authorizer for an API.

Valid values: `TOKEN` or `REQUEST`

Type: String

Required: No

Default: `TOKEN`

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Identity`

This property can be used to specify an `IdentitySource` in an incoming request for an authorizer. This property is only required if the `FunctionPayloadType` property is set to `REQUEST`.

Type: LambdaRequestAuthorizationIdentity (p. 50)

Required: Conditional

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

LambdaRequestAuth

YAML

```
Authorizer:
  MyLambdaRequestAuth:
    FunctionPayloadType: REQUEST
    FunctionArn:
      Fn::GetAtt:
        - MyAuthFunction
        - Arn
    FunctionInvokeRole:
```

```
  Fn::GetAtt:
   - LambdaAuthInvokeRole
   - Arn
 Identity:
  Headers:
   - Authorization1
```

LambdaRequestAuthorizationIdentity

This property can be used to specify an IdentitySource in an incoming request for an authorizer. For more information about IdentitySource see the ApiGateway Authorizer OpenApi extension.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Context: List
Headers: List
QueryStrings: List
ReauthorizeEvery: Integer
StageVariables: List
```

Properties

`Context`

Converts the given context strings to the mapping expressions of format `context.contextString`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Headers`

Converts the headers to comma-separated string of mapping expressions of format `method.request.header.name`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`QueryStrings`

Converts the given query strings to comma-separated string of mapping expressions of format `method.request.querystring.queryString`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`ReauthorizeEvery`

The time-to-live (TTL) period, in seconds, that specifies how long API Gateway caches authorizer results. If you specify a value greater than 0, API Gateway caches the authorizer responses. By default, API Gateway sets this property to 300. The maximum value is 3600, or 1 hour.

Type: Integer

Required: No

Default: 300

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`StageVariables`

Converts the given stage variables to comma-separated string of mapping expressions of format `stageVariables.stageVariable`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

LambdaRequestIdentity

YAML

```
Identity:
  QueryStrings:
    - auth
  Headers:
    - Authorization
  StageVariables:
    - VARIABLE
  Context:
    - authcontext
  ReauthorizeEvery: 100
```

LambdaTokenAuthorizer

Configure a Lambda Authorizer to control access to your API with a Lambda function.

For more information and examples, see Controlling access to API Gateway APIs (p. 193).

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  AuthorizationScopes: List
  FunctionArn: String
  FunctionInvokeRole: String
  FunctionPayloadType: String
  Identity: LambdaTokenAuthorizationIdentity (p. 53)
```

Properties

`AuthorizationScopes`

List of authorization scopes for this authorizer.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`FunctionArn`

Specify the function arn of the Lambda function which provides authorization for the API.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`FunctionInvokeRole`

Adds authorizer credentials to the OpenApi definition of the Lambda authorizer.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`FunctionPayloadType`

This property can be used to define the type of Lambda Authorizer for an Api.

Valid values: `TOKEN` or `REQUEST`

Type: String

Required: No

Default: `TOKEN`

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Identity`

This property can be used to specify an `IdentitySource` in an incoming request for an authorizer. This property is only required if the `FunctionPayloadType` property is set to `REQUEST`.

Type: LambdaTokenAuthorizationIdentity (p. 53)

Required: Conditional

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

LambdaTokenAuth

YAML

```
Authorizers:
  MyLambdaTokenAuth:
    FunctionArn:
      Fn::GetAtt:
        - MyAuthFunction
        - Arn
    Identity:
      Header: MyCustomAuthHeader # OPTIONAL; Default: 'Authorization'
      ValidationExpression: mycustomauthexpression # OPTIONAL
      ReauthorizeEvery: 20 # OPTIONAL; Service Default: 300
```

BasicLambdaTokenAuth

YAML

```
Authorizers:
  MyLambdaTokenAuth:
    FunctionArn:
      Fn::GetAtt:
        - MyAuthFunction
        - Arn
```

LambdaTokenAuthorizationIdentity

This property can be used to specify an IdentitySource in an incoming request for an authorizer. For more information about IdentitySource see the ApiGateway Authorizer OpenApi extension.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  ReauthorizeEvery: Integer
  ValidationExpression: String
```

Properties

`ReauthorizeEvery`

The time-to-live (TTL) period, in seconds, that specifies how long API Gateway caches authorizer results. If you specify a value greater than 0, API Gateway caches the authorizer responses. By default, API Gateway sets this property to 300. The maximum value is 3600, or 1 hour.

Type: Integer

Required: No

Default: 300

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`ValidationExpression`

Specify a validation expression for validating the incoming Identity.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

LambdaTokenIdentity

YAML

```
Identity:
  Header: Auth
  ValidationExpression: Bearer.*
  ReauthorizeEvery: 30
```

ResourcePolicyStatement

Configures a resource policy for all methods and paths of an API. For more information about resource policies, see Controlling access to an API with API Gateway resource policies in the *API Gateway Developer Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  AwsAccountBlacklist: List
  AwsAccountWhitelist: List
  CustomStatements: List
  IntrinsicVpcBlacklist: List
  IntrinsicVpcWhitelist: List
  IntrinsicVpceBlacklist: List
  IntrinsicVpceWhitelist: List
  IpRangeBlacklist: List
  IpRangeWhitelist: List
  SourceVpcBlacklist: List
  SourceVpcWhitelist: List
```

Properties

`AwsAccountBlacklist`

The AWS accounts to block.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AwsAccountWhitelist`

The AWS accounts to allow. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`CustomStatements`

A list of custom resource policy statements to apply to this API. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpcBlacklist`

The list of virtual private clouds (VPCs) to block, where each VPC is specified as a reference such as a dynamic reference or the `Ref` intrinsic function. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpcWhitelist`

The list of VPCs to allow, where each VPC is specified as a reference such as a dynamic reference or the `Ref` intrinsic function.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpceBlacklist`

The list of VPC endpoints to block, where each VPC endpoint is specified as a reference such as a dynamic reference or the `Ref` intrinsic function.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpceWhitelist`

The list of VPC endpoints to allow, where each VPC endpoint is specified as a reference such as a dynamic reference or the `Ref` intrinsic function. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IpRangeBlacklist`

The IP addresses or address ranges to block. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IpRangeWhitelist`

The IP addresses or address ranges to allow.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`SourceVpcBlacklist`

The source VPC or VPC endpoints to block. Source VPC names must start with `"vpc-"` and source VPC endpoint names must start with `"vpce-"`. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`SourceVpcWhitelist`

The source VPC or VPC endpoints to allow. Source VPC names must start with `"vpc-"` and source VPC endpoint names must start with `"vpce-"`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Resource Policy Example

The following example blocks two IP addresses and a source VPC, and allows an AWS account.

YAML

```
Auth:
```

```
ResourcePolicy:
  CustomStatements: [{
                       "Effect": "Allow",
                       "Principal": "*",
                       "Action": "execute-api:Invoke",
                       "Resource": "execute-api:/Prod/GET/pets",
                       "Condition": {
                         "IpAddress": {
                           "aws:SourceIp": "1.2.3.4"
                         }
                       }
                     }]
  IpRangeBlacklist:
    - "10.20.30.40"
    - "1.2.3.4"
  SourceVpcBlacklist:
    - "vpce-1a2b3c4d"
  AwsAccountWhitelist:
    - "111122223333"
  IntrinsicVpcBlacklist:
    - "{{resolve:ssm:SomeVPCReference:1}}"
    - !Ref MyVPC
  IntrinsicVpceWhitelist:
    - "{{resolve:ssm:SomeVPCEReference:1}}"
    - !Ref MyVPCE
```

ApiDefinition

An OpenAPI document defining the API.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Bucket: String
Key: String
Version: String
```

Properties

`Bucket`

The name of the Amazon S3 bucket where the OpenAPI file is stored.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `Bucket` property of the `AWS::ApiGateway::RestApi S3Location` data type.

`Key`

The Amazon S3 key of the OpenAPI file.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `Key` property of the `AWS::ApiGateway::RestApi S3Location` data type.

`Version`

For versioned objects, the version of the OpenAPI file.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Version` property of the `AWS::ApiGateway::RestApi S3Location` data type.

Examples

Definition Uri example

API Definition example

YAML

```
DefinitionUri:
  Bucket: mybucket-name
  Key: mykey-name
  Version: 121212
```

CorsConfiguration

Manage cross-origin resource sharing (CORS) for your API Gateway APIs. Specify the domain to allow as a string or specify a dictionary with additional Cors configuration. NOTE: Cors requires SAM to modify your OpenAPI definition, so it only works with inline OpenApi defined in the `DefinitionBody` property.

For more information about CORS, see Enable CORS for an API Gateway REST API Resource in the *API Gateway Developer Guide*.

Note: If CorsConfiguration is set both in OpenAPI and at the property level, AWS SAM merges them, with the properties taking precedence.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  AllowCredentials: Boolean
  AllowHeaders: String
  AllowMethods: String
  AllowOrigin: String
  MaxAge: String
```

Properties

`AllowCredentials`

Boolean indicating whether request is allowed to contain credentials.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AllowHeaders`

String of headers to allow.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AllowMethods`

String containing the HTTP methods to allow.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AllowOrigin`

String of origin to allow.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`MaxAge`

String containing the number of seconds to cache CORS Preflight request.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

CorsConfiguration

Cors Configuration example. This is just a portion of an AWS SAM template file showing an AWS::Serverless::Api (p. 33) definition with Cors configured.

YAML

```
Resources:
```

```
ApiGatewayApi:
  Type: AWS::Serverless::Api
  Properties:
    StageName: Prod
    Cors:
      AllowMethods: "'POST, GET'"
      AllowHeaders: "'X-Forwarded-For'"
      AllowOrigin: "'www.example.com'"
      MaxAge: "'600'"
      AllowCredentials: true
```

DomainConfiguration

Configures a custom domain for an API.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
BasePath: List
CertificateArn: String
DomainName: String
EndpointConfiguration: String
MutualTlsAuthentication: MutualTlsAuthentication
Route53: Route53Configuration (p. 62)
SecurityPolicy: String
```

Properties

`BasePath`

A list of the basepaths to configure with the Amazon API Gateway domain name.

Type: List

Required: No

Default: /

AWS CloudFormation compatibility: This property is similar to the `BasePath` property of an `AWS::ApiGateway::BasePathMapping` resource. AWS SAM creates multiple `AWS::ApiGateway::BasePathMapping` resources, one per `BasePath` specified in this property.

`CertificateArn`

The Amazon Resource Name (ARN) of an AWS managed certificate this domain name's endpoint. AWS Certificate Manager is the only supported source.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is similar to the `CertificateArn` property of an `AWS::ApiGateway::DomainName` resource. If `EndpointConfiguration` is set to `REGIONAL` (the default value), `CertificateArn` maps to RegionalCertificateArn in `AWS::ApiGateway::DomainName`. If the `EndpointConfiguration` is set to `EDGE`, `CertificateArn` maps to CertificateArn in `AWS::ApiGateway::DomainName`.

Additional notes: For an `EDGE` endpoint, you must create the certificate in the `us-east-1` AWS Region.

`DomainName`

The custom domain name for your API Gateway API. Uppercase letters are not supported.

AWS SAM generates an AWS::ApiGateway::DomainName resource when this property is set. For information about this scenario, see DomainName property is specified (p. 180). For information about generated AWS CloudFormation resources, see Generated AWS CloudFormation resources (p. 177).

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `DomainName` property of an `AWS::ApiGateway::DomainName` resource.

`EndpointConfiguration`

Defines the type of API Gateway endpoint to map to the custom domain. The value of this property determines how the `CertificateArn` property is mapped in AWS CloudFormation.

Valid values: `REGIONAL` or `EDGE`

Type: String

Required: No

Default: `REGIONAL`

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`MutualTlsAuthentication`

The mutual Transport Layer Security (TLS) authentication configuration for a custom domain name.

Type: MutualTlsAuthentication

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MutualTlsAuthentication` property of an `AWS::ApiGateway::DomainName` resource.

`Route53`

Defines an Amazon Route 53 configuration.

Type: Route53Configuration (p. 62)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`SecurityPolicy`

The TLS version plus cipher suite for this domain name.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `SecurityPolicy` property of an `AWS::ApiGateway::DomainName` resource.

Examples

DomainName

DomainName example

YAML

```
Domain:
  DomainName: www.example.com
  CertificateArn: arn-example
  EndpointConfiguration: EDGE
  Route53:
    HostedZoneId: Z1PA6795UKMFR9
  BasePath:
    - /foo
    - /bar
```

Route53Configuration

Configures the Route53 record sets for an API.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  DistributionDomainName: String
  EvaluateTargetHealth: Boolean
  HostedZoneId: String
  HostedZoneName: String
  IpV6: Boolean
```

Properties

`DistributionDomainName`

Configures a custom distribution of the API custom domain name.

Type: String

Required: No

Default: Use the API Gateway distribution.

AWS CloudFormation compatibility: This property is passed directly to the `DNSName` property of an `AWS::Route53::RecordSetGroup AliasTarget` resource.

Additional notes: The domain name of a CloudFront distribution.

`EvaluateTargetHealth`

When EvaluateTargetHealth is true, an alias record inherits the health of the referenced AWS resource, such as an Elastic Load Balancing load balancer or another record in the hosted zone.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `EvaluateTargetHealth` property of an `AWS::Route53::RecordSetGroup AliasTarget` resource.

Additional notes: You can't set EvaluateTargetHealth to true when the alias target is a CloudFront distribution.

`HostedZoneId`

The ID of the hosted zone that you want to create records in.

Specify either `HostedZoneName` or `HostedZoneId`, but not both. If you have multiple hosted zones with the same domain name, you must specify the hosted zone using `HostedZoneId`.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `HostedZoneId` property of an `AWS::Route53::RecordSetGroup RecordSet` resource.

`HostedZoneName`

The name of the hosted zone that you want to create records in.

Specify either `HostedZoneName` or `HostedZoneId`, but not both. If you have multiple hosted zones with the same domain name, you must specify the hosted zone using `HostedZoneId`.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `HostedZoneName` property of an `AWS::Route53::RecordSetGroup RecordSet` resource.

`IpV6`

When this property is set, AWS SAM creates a `AWS::Route53::RecordSet` resource and sets Type to `AAAA` for the provided HostedZone.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Route 53 Configuration Example

This example shows how to configure Route 53.

YAML

```
Domain:
  DomainName: www.example.com
  CertificateArn: arn-example
  EndpointConfiguration: EDGE
  Route53:
    HostedZoneId: Z1PA6795UKMFR9
    EvaluateTargetHealth: true
    DistributionDomainName: xyz
```

EndpointConfiguration

The endpoint type of a REST API.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Type: String
  VPCEndpointIds: List
```

Properties

`Type`

The endpoint type of a REST API.

Valid values: `EDGE` or `REGIONAL` or `PRIVATE`

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Types` property of the `AWS::ApiGateway::RestApi EndpointConfiguration` data type.

`VPCEndpointIds`

A list of VPC endpoint IDs of a REST API against which to create Route53 aliases.

Type: List

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `VpcEndpointIds` property of the `AWS::ApiGateway::RestApi EndpointConfiguration` data type.

Examples

EndpointConfiguration

Endpoint Configuration example

YAML

```
EndpointConfiguration:
  Type: PRIVATE
  VPCEndpointIds:
    - vpce-123a123a
    - vpce-321a321a
```

AWS::Serverless::Application

Embeds a serverless application from the AWS Serverless Application Repository or from an Amazon S3 bucket as a nested application. Nested applications are deployed as nested AWS::CloudFormation::Stack resources, which can contain multiple other resources including other AWS::Serverless::Application (p. 65) resources.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Type: AWS::Serverless::Application
Properties:
  Location: String | ApplicationLocationObject (p. 67)
  NotificationARNs: List
  Parameters: Map
  Tags: Map
  TimeoutInMinutes: Integer
```

Properties

`Location`

Template URL, file path, or location object of a nested application.

If a template URL is provided, it must follow the format specified in the CloudFormation TemplateUrl documentation and contain a valid CloudFormation or SAM template. An ApplicationLocationObject (p. 67) can be used to specify an application that has been published to the AWS Serverless Application Repository.

If a local file path is provided, the template must go through the workflow that includes the `sam deploy` or `sam package` command, in order for the application to be transformed properly.

Type: String | ApplicationLocationObject (p. 67)

Required: Yes

AWS CloudFormation compatibility: This property is similar to the `TemplateURL` property of an `AWS::CloudFormation::Stack` resource. The CloudFormation version does not take an ApplicationLocationObject (p. 67) to retrieve an application from the AWS Serverless Application Repository.

`NotificationARNs`

A list of existing Amazon SNS topics where notifications about stack events are sent.

Type: List

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `NotificationARNs` property of an `AWS::CloudFormation::Stack` resource.

`Parameters`

Application parameter values.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Parameters` property of an `AWS::CloudFormation::Stack` resource.

`Tags`

A map (string to string) that specifies the tags to be added to this application. Keys and values are limited to alphanumeric characters. Keys can be 1 to 127 Unicode characters in length and cannot be prefixed with aws:. Values can be 1 to 255 Unicode characters in length.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is similar to the `Tags` property of an `AWS::CloudFormation::Stack` resource. The Tags property in SAM consists of Key:Value pairs; in CloudFormation it consists of a list of Tag objects. When the stack is created, SAM will automatically add a `lambda:createdBy:SAM` tag to this application. In addition, if this application is from the AWS Serverless Application Repository, then SAM will also automatically the two additional tags `serverlessrepo:applicationId:`*`ApplicationId`* and `serverlessrepo:semanticVersion:`*`SemanticVersion`*.

`TimeoutInMinutes`

The length of time, in minutes, that AWS CloudFormation waits for the nested stack to reach the `CREATE_COMPLETE` state. The default is no timeout. When AWS CloudFormation detects that the nested stack has reached the `CREATE_COMPLETE` state, it marks the nested stack resource as `CREATE_COMPLETE` in the parent stack and resumes creating the parent stack. If the timeout period expires before the nested stack reaches `CREATE_COMPLETE`, AWS CloudFormation marks the nested stack as failed and rolls back both the nested stack and parent stack.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `TimeoutInMinutes` property of an `AWS::CloudFormation::Stack` resource.

Return Values

Ref

When the logical ID of this resource is provided to the `Ref` intrinsic function, it returns the resource name of the underlying `AWS::CloudFormation::Stack` resource.

For more information about using the `Ref` function, see `Ref` in the *AWS CloudFormation User Guide*.

Fn::GetAtt

`Fn::GetAtt` returns a value for a specified attribute of this type. The following are the available attributes and sample return values.

For more information about using `Fn::GetAtt`, see `Fn::GetAtt` in the *AWS CloudFormation User Guide*.

`Outputs.ApplicationOutputName`

The value of the stack output with name *`ApplicationOutputName`*.

Examples

SAR Application

Application that uses a template from the Serverless Application Repository

YAML

```
Type: AWS::Serverless::Application
Properties:
  Location:
    ApplicationId: 'arn:aws:serverlessrepo:us-east-1:012345678901:applications/my-
application'
    SemanticVersion: 1.0.0
  Parameters:
    StringParameter: parameter-value
    IntegerParameter: 2
```

Normal-Application

Application from an S3 url

YAML

```
Type: AWS::Serverless::Application
Properties:
  Location: https://s3.amazonaws.com/demo-bucket/template.yaml
```

ApplicationLocationObject

An application that has been published to the AWS Serverless Application Repository.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  ApplicationId: String
  SemanticVersion: String
```

Properties

`ApplicationId`

The Amazon Resource Name (ARN) of the application.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`SemanticVersion`

The semantic version of the application.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

my-application

Example application location object

YAML

```
Location:
  ApplicationId: 'arn:aws:serverlessrepo:us-east-1:012345678901:applications/my-
application'
  SemanticVersion: 1.0.0
```

AWS::Serverless::Function

Creates an AWS Lambda function, an AWS Identity and Access Management (IAM) execution role, and event source mappings that trigger the function.

The AWS::Serverless::Function (p. 68) resource also supports the `Metadata` resource attribute, so you can instruct AWS SAM to build custom runtimes that your application requires. For more information about building custom runtimes, see Building custom runtimes (p. 211).

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Type: AWS::Serverless::Function
Properties:
  Architectures: List
  AssumeRolePolicyDocument: JSON
  AutoPublishAlias: String
  AutoPublishCodeSha256: String
  CodeSigningConfigArn: String
  CodeUri: String | FunctionCode (p. 129)
  DeadLetterQueue: Map | DeadLetterQueue (p. 78)
  DeploymentPreference: DeploymentPreference (p. 79)
  Description: String
  Environment: Environment
  EventInvokeConfig: EventInvokeConfiguration (p. 82)
  Events: EventSource (p. 87)
  FileSystemConfigs: List
  FunctionName: String
  Handler: String
  ImageConfig: ImageConfig
  ImageUri: String
  InlineCode: String
  KmsKeyArn: String
  Layers: List
  MemorySize: Integer
  PackageType: String
  PermissionsBoundary: String
  Policies: String | List | Map
  ProvisionedConcurrencyConfig: ProvisionedConcurrencyConfig
  ReservedConcurrentExecutions: Integer
  Role: String
  Runtime: String
  Tags: Map
  Timeout: Integer
  Tracing: String
  VersionDescription: String
  VpcConfig: VpcConfig
```

Properties

`Architectures`

The instruction set architecture for the function.

For more information about this property, see Lambda instruction set architectures in the *AWS Lambda Developer Guide*.

Valid values: One of `x86_64` or `arm64`

Type: List

Required: No

Default: `x86_64`

AWS CloudFormation compatibility: This property is passed directly to the `Architectures` property of an `AWS::Lambda::Function` resource.

`AssumeRolePolicyDocument`

Adds an AssumeRolePolicyDocument for the default created `Role` for this function. If this property isn't specified, AWS SAM adds a default assume role for this function.

Type: JSON

Required: No

AWS CloudFormation compatibility: This property is similar to the `AssumeRolePolicyDocument` property of an `AWS::IAM::Role` resource. AWS SAM adds this property to the generated IAM role for this function. If a role's Amazon Resource Name (ARN) is provided for this function, this property does nothing.

`AutoPublishAlias`

The name of the Lambda alias. For more information about Lambda aliases, see Lambda function aliases in the *AWS Lambda Developer Guide*. For examples that use this property, see Deploying serverless applications gradually (p. 326).

AWS SAM generates AWS::Lambda::Version and AWS::Lambda::Alias resources when this property is set. For information about this scenario, see AutoPublishAlias property is specified (p. 181). For general information about generated AWS CloudFormation resources, see Generated AWS CloudFormation resources (p. 177).

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AutoPublishCodeSha256`

The string value that is used, along with the value in `CodeUri`, to determine whether a new Lambda version should be published.

This property addresses a problem that occurs when an AWS SAM template has the following characteristics: the `DeploymentPreference` object is configured for gradual deployments (as described in Deploying serverless applications gradually (p. 326)), the `AutoPublishAlias` property is set and doesn't change between deployments, and the `CodeUri` property is set and doesn't change between deployments.

This scenario can occur when the deployment package stored in an Amazon Simple Storage Service (Amazon S3) location is replaced by a new deployment package that contains updated Lambda function code, but the `CodeUri` property remains unchanged (as opposed to the new deployment package being uploaded to a new Amazon S3 location and the `CodeUri` being changed to the new location).

In this scenario, to trigger the gradual deployment successfully, you must provide a unique value for `AutoPublishCodeSha256`.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`CodeSigningConfigArn`

The ARN of the AWS::Lambda::CodeSigningConfig resource, used to enable code signing for this function. For more information about code signing, see Configuring code signing for AWS SAM applications (p. 203).

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `CodeSigningConfigArn` property of an `AWS::Lambda::Function` resource.

`CodeUri`

The function code's Amazon S3 URI, path to local folder, or FunctionCode (p. 129) object. This property only applies if the `PackageType` property is set to `Zip`, otherwise it is ignored.

Notes:

1. If the `PackageType` property is set to `Zip` (default), then one of `CodeUri` or `InlineCode` is required.

2. If an Amazon S3 URI or FunctionCode (p. 129) object is provided, the Amazon S3 object referenced must be a valid Lambda deployment package.

3. If the path to a local folder is provided, for the code to be transformed properly the template must go through the workflow that includes sam build (p. 252) followed by either sam deploy (p. 258) or sam package (p. 274). By default, relative paths are resolved with respect to the AWS SAM template's location.

Type: String | FunctionCode (p. 129)

Required: Conditional

AWS CloudFormation compatibility: This property is similar to the `Code` property of an `AWS::Lambda::Function` resource. The nested Amazon S3 properties are named differently.

`DeadLetterQueue`

Configures an Amazon Simple Notification Service (Amazon SNS) topic or Amazon Simple Queue Service (Amazon SQS) queue where Lambda sends events that it can't process. For more information about dead-letter queue functionality, see AWS Lambda function dead letter queues in the *AWS Lambda Developer Guide*.

Note: If your Lambda function's event source is an Amazon SQS queue, configure a dead-letter queue for the source queue, not for the Lambda function. The dead-letter queue that you configure for a function is used for the function's asynchronous invocation queue, not for event source queues.

Type: Map | DeadLetterQueue (p. 78)

Required: No

AWS CloudFormation compatibility: This property is similar to the `DeadLetterConfig` property of an `AWS::Lambda::Function` resource. In AWS CloudFormation the type is derived from the `TargetArn`, whereas in AWS SAM you must pass the type along with the `TargetArn`.

`DeploymentPreference`

The settings to enable gradual Lambda deployments.

If a `DeploymentPreference` object is specified, AWS SAM creates an AWS::CodeDeploy::Application called `ServerlessDeploymentApplication` (one per stack), an AWS::CodeDeploy::DeploymentGroup called `<function-logical-id>DeploymentGroup`, and an AWS::IAM::Role called `CodeDeployServiceRole`.

Type: DeploymentPreference (p. 79)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

See also: For more information about this property, see Deploying serverless applications gradually (p. 326).

`Description`

A description of the function.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Description` property of an `AWS::Lambda::Function` resource.

`Environment`

The configuration for the runtime environment.

Type: Environment

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Environment` property of an `AWS::Lambda::Function` resource.

`EventInvokeConfig`

The object that describes event invoke configuration on a Lambda function.

Type: EventInvokeConfiguration (p. 82)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Events`

Specifies the events that trigger this function. Events consist of a type and a set of properties that depend on the type.

Type: EventSource (p. 87)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`FileSystemConfigs`

List of FileSystemConfig objects that specify the connection settings for an Amazon Elastic File System (Amazon EFS) file system.

If your template contains an AWS::EFS::MountTarget resource, you must also specify a `DependsOn` resource attribute to ensure that the mount target is created or updated before the function.

Type: List

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `FileSystemConfigs` property of an `AWS::Lambda::Function` resource.

`FunctionName`

A name for the function. If you don't specify a name, a unique name is generated for you.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `FunctionName` property of an `AWS::Lambda::Function` resource.

`Handler`

The function within your code that is called to begin execution. This property is only required if the `PackageType` property is set to `Zip`.

Type: String

Required: Conditional

AWS CloudFormation compatibility: This property is passed directly to the `Handler` property of an `AWS::Lambda::Function` resource.

`ImageConfig`

The object used to configure Lambda container image settings. For more information, see Using container images with Lambda in the *AWS Lambda Developer Guide*.

Type: ImageConfig

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `ImageConfig` property of an `AWS::Lambda::Function` resource.

`ImageUri`

The URI of the Amazon Elastic Container Registry (Amazon ECR) repository for the Lambda function's container image. This property only applies if the `PackageType` property is set to `Image`, otherwise it is ignored. For more information, see Using container images with Lambda in the *AWS Lambda Developer Guide*.

Note: If the `PackageType` property is set to `Image`, then either `ImageUri` is required, or you must build your application with necessary `Metadata` entries in the AWS SAM template file. For more information, see Building applications (p. 206).

Building your application with necessary `Metadata` entries takes precedence over `ImageUri`, so if you specify both then `ImageUri` is ignored.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `ImageUri` property of the `AWS::Lambda::Function` `Code` data type.

`InlineCode`

The Lambda function code that is written directly in the template. This property only applies if the `PackageType` property is set to `Zip`, otherwise it is ignored.

Note: If the `PackageType` property is set to `Zip` (default), then one of `CodeUri` or `InlineCode` is required.

Type: String

Required: Conditional

AWS CloudFormation compatibility: This property is passed directly to the `ZipFile` property of the `AWS::Lambda::Function` `Code` data type.

`KmsKeyArn`

The ARN of an AWS Key Management Service (AWS KMS) key that Lambda uses to encrypt and decrypt your function's environment variables.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `KmsKeyArn` property of an `AWS::Lambda::Function` resource.

`Layers`

The list of `LayerVersion` ARNs that this function should use. The order specified here is the order in which they will be imported when running the Lambda function.

Type: List

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Layers` property of an `AWS::Lambda::Function` resource.

`MemorySize`

The size of the memory in MB allocated per invocation of the function.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MemorySize` property of an `AWS::Lambda::Function` resource.

`PackageType`

The deployment package type of the Lambda function. For more information, see Lambda deployment packages in the *AWS Lambda Developer Guide*.

Notes:

1. If this property is set to `Zip` (default), then either `CodeUri` or `InlineCode` applies, and `ImageUri` is ignored.

2. If this property is set to `Image`, then only `ImageUri` applies, and both `CodeUri` and `InlineCode` are ignored. The Amazon ECR repository required to store the functionsl container image can be auto created by the AWS SAM CLI. For more information, see sam deploy (p. 258).

Valid values: `Zip` or `Image`

Type: String

Required: No

Default: `Zip`

AWS CloudFormation compatibility: This property is passed directly to the `PackageType` property of an `AWS::Lambda::Function` resource.

`PermissionsBoundary`

The ARN of a permissions boundary to use for this function's execution role. This property works only if the role is generated for you.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `PermissionsBoundary` property of an `AWS::IAM::Role` resource.

`Policies`

One or more policies that this function needs. They will be appended to the default role for this function.

This property accepts a single string or a list of strings, and can be the name of AWS managed policies or AWS SAM policy templates, or inline IAM policy documents formatted in YAML.

For more information about AWS managed policies, see AWS managed policies in the IAM User Guide. For more information about AWS SAM policy templates, see AWS SAM policy templates (p. 283) in the AWS Serverless Application Model Developer Guide. For more information about inline policies, see Inline policies in the IAM User Guide.

Note: If the `Role` property is set, this property is ignored.

Type: String | List | Map

Required: No

AWS CloudFormation compatibility: This property is similar to the `Policies` property of an `AWS::IAM::Role` resource. AWS SAM supports AWS managed policy names and AWS SAM policy templates, in addition to JSON policy documents. AWS CloudFormation accepts only JSON policy documents.

`ProvisionedConcurrencyConfig`

The provisioned concurrency configuration of a function's alias.

Note: `ProvisionedConcurrencyConfig` can be specified only if the `AutoPublishAlias` is set. Otherwise, an error results.

Type: ProvisionedConcurrencyConfig

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `ProvisionedConcurrencyConfig` property of an `AWS::Lambda::Alias` resource.

`ReservedConcurrentExecutions`

The maximum number of concurrent executions that you want to reserve for the function.

For more information about this property, see Lambda Function Scaling in the *AWS Lambda Developer Guide*.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `ReservedConcurrentExecutions` property of an `AWS::Lambda::Function` resource.

`Role`

The ARN of an IAM role to use as this function's execution role.

Type: String

Required: No

AWS CloudFormation compatibility: This property is similar to the `Role` property of an `AWS::Lambda::Function` resource. This is required in AWS CloudFormation but not in AWS SAM. If a role isn't specified, one is created for you with a logical ID of `<function-logical-id>Role`.

`Runtime`

The identifier of the function's runtime. This property is only required if the `PackageType` property is set to `Zip`.

Note: If you specify the `provided` identifier for this property, you can use the `Metadata` resource attribute to instruct AWS SAM to build the custom runtime that this function requires. For more information about building custom runtimes, see Building custom runtimes (p. 211).

Type: String

Required: Conditional

AWS CloudFormation compatibility: This property is passed directly to the `Runtime` property of an `AWS::Lambda::Function` resource.

`Tags`

A map (string to string) that specifies the tags added to this function. For details about valid keys and values for tags, see Tag Key and Value Requirements in the *AWS Lambda Developer Guide*.

When the stack is created, AWS SAM automatically adds a `lambda:createdBy:SAM` tag to this Lambda function, and to the default roles that are generated for this function.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is similar to the `Tags` property of an `AWS::Lambda::Function` resource. The `Tags` property in AWS SAM consists of key-value pairs (whereas in AWS CloudFormation this property consists of a list of `Tag` objects). Also, AWS SAM automatically adds a `lambda:createdBy:SAM` tag to this Lambda function, and to the default roles that are generated for this function.

`Timeout`

The maximum time in seconds that the function can run before it is stopped.

Type: Integer

Required: No

Default: 3

AWS CloudFormation compatibility: This property is passed directly to the `Timeout` property of an `AWS::Lambda::Function` resource.

`Tracing`

The string that specifies the function's X-Ray tracing mode. For more information about X-Ray, see Using AWS Lambda with AWS X-Ray in the *AWS Lambda Developer Guide*.

Valid values: `Active` or `PassThrough`

Type: String

Required: No

AWS CloudFormation compatibility: This property is similar to the `TracingConfig` property of an `AWS::Lambda::Function` resource. If the `Tracing` property is set to `Active` and the `Role` property is not specified, then AWS SAM adds the `arn:aws:iam::aws:policy/AWSXrayWriteOnlyAccess` policy to the Lambda execution role that it creates for you.

`VersionDescription`

Specifies the `Description` field that is added on the new Lambda version resource.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Description` property of an `AWS::Lambda::Version` resource.

`VpcConfig`

The configuration that enables this function to access private resources within your virtual private cloud (VPC).

Type: VpcConfig

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `VpcConfig` property of an `AWS::Lambda::Function` resource.

Return Values

Ref

When the logical ID of this resource is provided to the `Ref` intrinsic function, it returns the resource name of the underlying Lambda function.

For more information about using the `Ref` function, see `Ref` in the *AWS CloudFormation User Guide*.

Fn::GetAtt

`Fn::GetAtt` returns a value for a specified attribute of this type. The following are the available attributes and sample return values.

For more information about using `Fn::GetAtt`, see `Fn::GetAtt` in the *AWS CloudFormation User Guide*.

`Arn`

The ARN of the underlying Lambda function.

Examples

Simple function

The following is a basic example of an AWS::Serverless::Function (p. 68) resource of package type `Zip` (default) and function code in an Amazon S3 bucket.

YAML

```
Type: AWS::Serverless::Function
Properties:
  Handler: index.handler
  Runtime: python3.6
  CodeUri: s3://bucket-name/key-name
```

Function properties example

The following is an example of an AWS::Serverless::Function (p. 68) of package type `Zip` (default) that uses `InlineCode`, `Layers`, `Tracing`, `Policies`, `Amazon EFS`, and an `Api` event source.

YAML

```
Type: AWS::Serverless::Function
DependsOn: MyMountTarget        # This is needed if an AWS::EFS::MountTarget resource is
 declared for EFS
Properties:
  Handler: index.handler
  Runtime: python3.6
  InlineCode: |
    def handler(event, context):
      print("Hello, world!")
  ReservedConcurrentExecutions: 30
  Layers:
    - Ref: MyLayer
  Tracing: Active
  Timeout: 120
  FileSystemConfigs:
    - Arn: !Ref MyEfsFileSystem
      LocalMountPath: /mnt/EFS
  Policies:
    - AWSLambdaExecute
    - Version: '2012-10-17'
      Statement:
        - Effect: Allow
          Action:
            - s3:GetObject
            - s3:GetObjectACL
          Resource: 'arn:aws:s3:::my-bucket/*'
  Events:
    ApiEvent:
      Type: Api
      Properties:
        Path: /path
        Method: get
```

ImageConfig example

The following is an example of an `ImageConfig` for a Lambda function of package type `Image`.

YAML

```
HelloWorldFunction:
  Type: AWS::Serverless::Function
  Properties:
    PackageType: Image
    ImageUri: account-id.dkr.ecr.region.amazonaws.com/ecr-repo-name:image-name
    ImageConfig:
      Command:
        - "app.lambda_handler"
      EntryPoint:
        - "entrypoint1"
      WorkingDirectory: "workDir"
```

DeadLetterQueue

Specifies an SQS queue or SNS topic that AWS Lambda (Lambda) sends events to when it can't process them. For more information about dead letter queue functionality, see AWS Lambda Function Dead Letter Queues.

SAM will automatically add appropriate permission to your Lambda function execution role to give Lambda service access to the resource. sqs:SendMessage will be added for SQS queues and sns:Publish for SNS topics.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  TargetArn: String
  Type: String
```

Properties

`TargetArn`

The Amazon Resource Name (ARN) of an Amazon SQS queue or Amazon SNS topic.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `TargetArn` property of the `AWS::Lambda::Function` `DeadLetterConfig` data type.

`Type`

The type of dead letter queue.

Valid values: `SNS`, `SQS`

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

DeadLetterQueue

Dead Letter Queue example for an SNS topic.

YAML

```
DeadLetterQueue:
  Type: SNS
  TargetArn: arn:aws:sns:us-east-2:123456789012:my-topic
```

DeploymentPreference

Specifies the configurations to enable gradual Lambda deployments. For more information about configuring gradual Lambda deployments, see Deploying serverless applications gradually (p. 326).

Note: You must specify an `AutoPublishAlias` in your AWS::Serverless::Function (p. 68) to use a `DeploymentPreference` object, otherwise an error will result.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Alarms: List
  Enabled: Boolean
  Hooks: Hooks (p. 81)
  Role: String
  TriggerConfigurations: List
  Type: String
```

Properties

`Alarms`

A list of CloudWatch alarms that you want to be triggered by any errors raised by the deployment.

This property accepts the `Fn::If` intrinsic function. See the Examples section at the bottom of this topic for an example template that uses `Fn::If`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Enabled`

Whether this deployment preference is enabled.

Type: Boolean

Required: No

Default: True

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Hooks`

Validation Lambda functions that are run before and after traffic shifting.

Type: Hooks (p. 81)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Role`

An IAM role ARN that CodeDeploy will use for traffic shifting. An IAM role will not be created if this is provided.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`TriggerConfigurations`

A list of trigger configurations you want to associate with the deployment group. Used to notify an SNS topic on lifecycle events.

Type: List

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `TriggerConfigurations` property of an `AWS::CodeDeploy::DeploymentGroup` resource.

`Type`

There are two categories of deployment types at the moment: Linear and Canary. For more information about available deployment types see Deploying serverless applications gradually (p. 326).

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

DeploymentPreference with pre- and post-traffic hooks.

Example deployment preference that contains pre- and post-traffic hooks.

YAML

```
DeploymentPreference:
  Enabled: true
  Type: Canary10Percent10Minutes
  Alarms:
    - Ref: AliasErrorMetricGreaterThanZeroAlarm
    - Ref: LatestVersionErrorMetricGreaterThanZeroAlarm
  Hooks:
    PreTraffic:
      Ref: PreTrafficLambdaFunction
    PostTraffic:
      Ref: PostTrafficLambdaFunction
```

DeploymentPreference with Fn::If intrinsic function

Example deployment preference that uses `Fn::If` for configuring alarms. In this example, `Alarm1` will be configured if `MyCondition` is `true`, and `Alarm2` and `Alarm5` will be configured if `MyCondition` is `false`.

YAML

```
DeploymentPreference:
  Enabled: true
  Type: Canary10Percent10Minutes
  Alarms:
    Fn::If:
      - MyCondition
      - - Alarm1
      - - Alarm2
        - Alarm5
```

Hooks

Validation Lambda functions that are run before and after traffic shifting.

Note: The Lambda functions referenced in this property configure the `CodeDeployLambdaAliasUpdate` object of the resulting AWS::Lambda::Alias resource. For more information, see CodeDeployLambdaAliasUpdate Policy in the *AWS CloudFormation User Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  PostTraffic: String
  PreTraffic: String
```

Properties

`PostTraffic`

Lambda function that is run after traffic shifting.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`PreTraffic`

Lambda function that is run before traffic shifting.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Hooks

Example hook functions

YAML

```
Hooks:
  PreTraffic:
    Ref: PreTrafficLambdaFunction
  PostTraffic:
    Ref: PostTrafficLambdaFunction
```

EventInvokeConfiguration

Configuration options for asynchronous Lambda Alias or Version invocations.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  DestinationConfig: EventInvokeDestinationConfiguration (p. 84)
  MaximumEventAgeInSeconds: Integer
  MaximumRetryAttempts: Integer
```

Properties

`DestinationConfig`

A configuration object that specifies the destination of an event after Lambda processes it.

Type: EventInvokeDestinationConfiguration (p. 84)

Required: No

AWS CloudFormation compatibility: This property is similar to the `DestinationConfig` property of an `AWS::Lambda::EventInvokeConfig` resource. SAM requires an extra parameter, "Type", that does not exist in CloudFormation.

`MaximumEventAgeInSeconds`

The maximum age of a request that Lambda sends to a function for processing.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MaximumEventAgeInSeconds` property of an `AWS::Lambda::EventInvokeConfig` resource.

`MaximumRetryAttempts`

The maximum number of times to retry before the function returns an error.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MaximumRetryAttempts` property of an `AWS::Lambda::EventInvokeConfig` resource.

Examples

MaximumEventAgeInSeconds

MaximumEventAgeInSeconds example

YAML

```
EventInvokeConfig:
  MaximumEventAgeInSeconds: 60
  MaximumRetryAttempts: 2
  DestinationConfig:
    OnSuccess:
      Type: SQS
      Destination: arn:aws:sqs:us-west-2:012345678901:my-queue
    OnFailure:
      Type: Lambda
      Destination: !GetAtt DestinationLambda.Arn
```

EventInvokeDestinationConfiguration

A configuration object that specifies the destination of an event after Lambda processes it.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  OnFailure: OnFailure (p. 84)
  OnSuccess: OnSuccess (p. 86)
```

Properties

`OnFailure`

A destination for events that failed processing.

Type: OnFailure (p. 84)

Required: No

AWS CloudFormation compatibility: This property is similar to the `OnFailure` property of an `AWS::Lambda::EventInvokeConfig` resource. Requires `Type`, an additional SAM-only property.

`OnSuccess`

A destination for events that were processed successfully.

Type: OnSuccess (p. 86)

Required: No

AWS CloudFormation compatibility: This property is similar to the `OnSuccess` property of an `AWS::Lambda::EventInvokeConfig` resource. Requires `Type`, an additional SAM-only property.

Examples

OnSuccess

OnSuccess example

YAML

```
EventInvokeConfig:
  DestinationConfig:
    OnSuccess:
      Type: SQS
      Destination: arn:aws:sqs:us-west-2:012345678901:my-queue
    OnFailure:
      Type: Lambda
      Destination: !GetAtt DestinationLambda.Arn
```

OnFailure

A destination for events that failed processing.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Destination: String
Type: String
```

Properties

`Destination`

The Amazon Resource Name (ARN) of the destination resource.

Type: String

Required: Conditional

AWS CloudFormation compatibility: This property is similar to the `OnFailure` property of an `AWS::Lambda::EventInvokeConfig` resource. SAM will add any necessary permissions to the auto-generated IAM Role associated with this function to access the resource referenced in this property.

Additional notes: If the type is Lambda/EventBridge, Destination is required.

`Type`

Type of the resource referenced in the destination. Supported types are `SQS`, `SNS`, `Lambda`, and `EventBridge`.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Additional notes: If the type is SQS/SNS and the `Destination` property is left blank, then the SQS/SNS resource is auto generated by SAM. To reference the resource, use `<function-logical-id>.DestinationQueue` for SQS or `<function-logical-id>.DestinationTopic` for SNS. If the type is Lambda/EventBridge, `Destination` is required.

Examples

EventInvoke Configuration Example with SQS and Lambda destinations

In this example no Destination is given for the SQS OnSuccess configuration, so SAM implicitly creates a SQS queue and adds any necessary permissions. Also for this example, a Destination for a Lambda resource declared in the template file is specified in the OnFailure configuration, so SAM adds the necessary permissions to this Lambda function to call the destination Lambda function.

YAML

```
EventInvokeConfig:
  DestinationConfig:
    OnSuccess:
      Type: SQS
    OnFailure:
      Type: Lambda
      Destination: !GetAtt DestinationLambda.Arn  # Arn of a Lambda function declared in
 the template file.
```

EventInvoke Configuration Example with SNS destination

In this example a Destination is given for an SNS topic declared in the template file for the OnSuccess configuration.

YAML

```
EventInvokeConfig:
  DestinationConfig:
    OnSuccess:
      Type: SNS
      Destination:
        Ref: DestinationSNS       # Arn of an SNS topic declared in the tempate file
```

OnSuccess

A destination for events that were processed successfully.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Destination: String
  Type: String
```

Properties

`Destination`

The Amazon Resource Name (ARN) of the destination resource.

Type: String

Required: Conditional

AWS CloudFormation compatibility: This property is similar to the `OnSuccess` property of an `AWS::Lambda::EventInvokeConfig` resource. SAM will add any necessary permissions to the auto-generated IAM Role associated with this function to access the resource referenced in this property.

Additional notes: If the type is Lambda/EventBridge, Destination is required.

`Type`

Type of the resource referenced in the destination. Supported types are `SQS`, `SNS`, `Lambda`, and `EventBridge`.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Additional notes: If the type is SQS/SNS and the `Destination` property is left blank, then the SQS/SNS resource is auto generated by SAM. To reference the resource, use *<function-logical-id>*`.DestinationQueue` for SQS or *<function-logical-id>*`.DestinationTopic` for SNS. If the type is Lambda/EventBridge, `Destination` is required.

Examples

EventInvoke Configuration Example with SQS and Lambda destinations

In this example no Destination is given for the SQS OnSuccess configuration, so SAM implicitly creates a SQS queue and adds any necessary permissions. Also for this example, a Destination for a Lambda resource declared in the template file is specified in the OnFailure configuration, so SAM adds the necessary permissions to this Lambda function to call the destination Lambda function.

YAML

```
EventInvokeConfig:
  DestinationConfig:
    OnSuccess:
      Type: SQS
    OnFailure:
      Type: Lambda
      Destination: !GetAtt DestinationLambda.Arn  # Arn of a Lambda function declared in
 the template file.
```

EventInvoke Configuration Example with SNS destination

In this example a Destination is given for an SNS topic declared in the template file for the OnSuccess configuration.

YAML

```
EventInvokeConfig:
  DestinationConfig:
    OnSuccess:
      Type: SNS
      Destination:
        Ref: DestinationSNS       # Arn of an SNS topic declared in the tempate file
```

EventSource

The object describing the source of events which trigger the function. Each event consists of a type and a set of properties that depend on that type. For more information about the properties of each event source, see the topic corresponding to that type.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Properties: S3 (p. 120) | SNS (p. 125) | Kinesis (p. 113) | DynamoDB (p. 101)
 | SQS (p. 128) | Api (p. 89) | Schedule (p. 121) | CloudWatchEvent (p. 97)
 | EventBridgeRule (p. 104) | CloudWatchLogs (p. 99) | IoTRule (p. 112)
 | AlexaSkill (p. 88) | Cognito (p. 100) | HttpApi (p. 109) | MSK (p. 119) | MQ (p. 116)
  Type: String
```

Properties

`Properties`

Object describing properties of this event mapping. The set of properties must conform to the defined Type.

Type: S3 (p. 120) | SNS (p. 125) | Kinesis (p. 113) | DynamoDB (p. 101) | SQS (p. 128) | Api (p. 89) | Schedule (p. 121) | CloudWatchEvent (p. 97) | EventBridgeRule (p. 104) | CloudWatchLogs (p. 99) | IoTRule (p. 112) | AlexaSkill (p. 88) | Cognito (p. 100) | HttpApi (p. 109) | MSK (p. 119) | MQ (p. 116)

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Type`

The event type.

Valid values: `S3`, `SNS`, `Kinesis`, `DynamoDB`, `SQS`, `Api`, `Schedule`, `CloudWatchEvent`, `CloudWatchLogs`, `IoTRule`, `AlexaSkill`, `Cognito`, `EventBridgeRule`, `HttpApi`, `MSK`, `MQ`

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

APIEvent

Example of using an API event

YAML

```
ApiEvent:
  Type: Api
  Properties:
    Method: get
    Path: /group/{user}
    RestApiId:
      Ref: MyApi
```

AlexaSkill

The object describing an `AlexaSkill` event source type.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  SkillId: String
```

Properties

`SkillId`

The Alexa Skill ID for your Alexa Skill. For more information about Skill ID see Configure the trigger for a Lambda function in the Alexa Skills Kit documentation.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

AlexaSkillTrigger

Alexa Skill Event Example

YAML

```
AlexaSkillEvent:
  Type: AlexaSkill
```

Api

The object describing an `Api` event source type. If an AWS::Serverless::Api (p. 33) resource is defined, the path and method values must correspond to an operation in the OpenAPI definition of the API.

If no AWS::Serverless::Api (p. 33) is defined, the function input and output are a representation of the HTTP request and HTTP response.

For example, using the JavaScript API, the status code and body of the response can be controlled by returning an object with the keys statusCode and body.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Auth: ApiFunctionAuth (p. 91)
  Method: String
  Path: String
  RequestModel: RequestModel (p. 96)
  RequestParameters: String | RequestParameter (p. 96)
  RestApiId: String
```

Properties

`Auth`

Auth configuration for this specific Api+Path+Method.

Useful for overriding the API's `DefaultAuthorizer` setting auth config on an individual path when no `DefaultAuthorizer` is specified or overriding the default `ApiKeyRequired` setting.

Type: ApiFunctionAuth (p. 91)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Method`

HTTP method for which this function is invoked.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Path`

Uri path for which this function is invoked. Must start with `/`.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`RequestModel`

Request model to use for this specific Api+Path+Method. This should reference the name of a model specified in the `Models` section of an AWS::Serverless::Api (p. 33) resource.

Type: RequestModel (p. 96)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`RequestParameters`

Request parameters configuration for this specific Api+Path+Method. All parameter names must start with `method.request` and must be limited to `method.request.header`, `method.request.querystring`, or `method.request.path`.

If a parameter is a string and not a Function Request Parameter Object, then `Required` and `Caching` will default to false.

Type: String | RequestParameter (p. 96)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`RestApiId`

Identifier of a RestApi resource, which must contain an operation with the given path and method. Typically, this is set to reference an AWS::Serverless::Api (p. 33) resource defined in this template.

If you don't define this property, AWS SAM creates a default AWS::Serverless::Api (p. 33) resource using a generated `OpenApi` document. That resource contains a union of all paths and methods defined by `Api` events in the same template that do not specify a `RestApiId`.

This cannot reference an AWS::Serverless::Api (p. 33) resource defined in another template.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

ApiEvent

An example of Api Event

YAML

```
Events:
  ApiEvent:
    Type: Api
    Properties:
      Path: /path
      Method: get
      RequestParameters:
        - method.request.header.Authorization
```

ApiFunctionAuth

Configures authorization at the event level, for a specific API, path, and method.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  ApiKeyRequired: Boolean
  AuthorizationScopes: List
  Authorizer: String
  InvokeRole: String
  ResourcePolicy: ResourcePolicyStatement (p. 93)
```

Properties

`ApiKeyRequired`

Requires an API key for this API, path, and method.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AuthorizationScopes`

The authorization scopes to apply to this API, path, and method.

The scopes that you specify will override any scopes applied by the `DefaultAuthorizer` property if you have specified it.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Authorizer`

The `Authorizer` for a specific Function

If you have specified a Global Authorizer on the API and want to make a specific Function public, override by setting `Authorizer` to `NONE`.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`InvokeRole`

Specifies the `InvokeRole` to use for `AWS_IAM` authorization.

Type: String

Required: No

Default: `CALLER_CREDENTIALS`

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Additional notes: `CALLER_CREDENTIALS` maps to `arn:aws:iam::*:user/*`, which uses the caller credentials to invoke the endpoint.

`ResourcePolicy`

Configure Resource Policy for this path on an API.

Type: ResourcePolicyStatement (p. 93)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Function-Auth

The following example specifies authorization at the function level.

YAML

```
Auth:
  ApiKeyRequired: true
  Authorizer: NONE
```

ResourcePolicyStatement

Configures a resource policy for all methods and paths of an API. For more information about resource policies, see Controlling access to an API with API Gateway resource policies in the *API Gateway Developer Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
AwsAccountBlacklist: List
AwsAccountWhitelist: List
CustomStatements: List
IntrinsicVpcBlacklist: List
IntrinsicVpcWhitelist: List
IntrinsicVpceBlacklist: List
IntrinsicVpceWhitelist: List
IpRangeBlacklist: List
IpRangeWhitelist: List
SourceVpcBlacklist: List
SourceVpcWhitelist: List
```

Properties

`AwsAccountBlacklist`

The AWS accounts to block.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AwsAccountWhitelist`

The AWS accounts to allow. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`CustomStatements`

A list of custom resource policy statements to apply to this API. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpcBlacklist`

The list of virtual private clouds (VPCs) to block, where each VPC is specified as a reference such as a dynamic reference or the `Ref` intrinsic function. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpcWhitelist`

The list of VPCs to allow, where each VPC is specified as a reference such as a dynamic reference or the `Ref` intrinsic function.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpceBlacklist`

The list of VPC endpoints to block, where each VPC endpoint is specified as a reference such as a dynamic reference or the `Ref` intrinsic function.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpceWhitelist`

The list of VPC endpoints to allow, where each VPC endpoint is specified as a reference such as a dynamic reference or the `Ref` intrinsic function. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IpRangeBlacklist`

The IP addresses or address ranges to block. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IpRangeWhitelist`

The IP addresses or address ranges to allow.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`SourceVpcBlacklist`

The source VPC or VPC endpoints to block. Source VPC names must start with `"vpc-"` and source VPC endpoint names must start with `"vpce-"`. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`SourceVpcWhitelist`

The source VPC or VPC endpoints to allow. Source VPC names must start with `"vpc-"` and source VPC endpoint names must start with `"vpce-"`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Resource Policy Example

The following example blocks two IP addresses and a source VPC, and allows an AWS account.

YAML

```
Auth:
  ResourcePolicy:
    CustomStatements: [{
                         "Effect": "Allow",
                         "Principal": "*",
                         "Action": "execute-api:Invoke",
                         "Resource": "execute-api:/Prod/GET/pets",
                         "Condition": {
                           "IpAddress": {
                             "aws:SourceIp": "1.2.3.4"
                           }
                         }
                       }]
    IpRangeBlacklist:
      - "10.20.30.40"
      - "1.2.3.4"
    SourceVpcBlacklist:
      - "vpce-1a2b3c4d"
    AwsAccountWhitelist:
      - "111122223333"
    IntrinsicVpcBlacklist:
      - "{{resolve:ssm:SomeVPCReference:1}}"
      - !Ref MyVPC
    IntrinsicVpceWhitelist:
      - "{{resolve:ssm:SomeVPCEReference:1}}"
      - !Ref MyVPCE
```

RequestModel

Configure Request Model for a specific Api+Path+Method.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Model: String
  Required: Boolean
```

Properties

`Model`

Name of a model defined in the Models property of the AWS::Serverless::Api (p. 33).

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Required`

adds a `required` property in the parameters section of OpenApi definition for given API endpoint

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Request Model

Request Model Example

YAML

```
RequestModel:
  Model: User
  Required: true
```

RequestParameter

Configure Request Parameter for a specific Api+Path+Method.

Either `Required` or `Caching` property needs to be specified for request parameter

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Caching: Boolean
  Required: Boolean
```

Properties

`Caching`

Adds `cacheKeyParameters` section to the API Gateway OpenApi definition

Type: Boolean

Required: Conditional

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Required`

This field specifies whether a parameter is required

Type: Boolean

Required: Conditional

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Request Parameter

Example of setting Request Parameters

YAML

```
RequestParameters:
  - method.request.header.Authorization:
      Required: true
      Caching: true
```

CloudWatchEvent

The object describing a `CloudWatchEvent` event source type.

AWS Serverless Application Model (AWS SAM) generates an AWS::Events::Rule resource when this event type is set.

Important Note: EventBridgeRule (p. 104) is the preferred event source type to use, instead of `CloudWatchEvent`. `EventBridgeRule` and `CloudWatchEvent` use the same underlying service, API, and AWS CloudFormation resources. However, AWS SAM will add support for new features only to `EventBridgeRule`.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```yaml
EventBusName: String
Input: String
InputPath: String
Pattern: EventPattern
```

Properties

`EventBusName`

The event bus to associate with this rule. If you omit this property, AWS SAM uses the default event bus.

Type: String

Required: No

Default: Default event bus

AWS CloudFormation compatibility: This property is passed directly to the `EventBusName` property of an `AWS::Events::Rule` resource.

`Input`

Valid JSON text passed to the target. If you use this property, nothing from the event text itself is passed to the target.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Input` property of an `AWS::Events::Rule Target` resource.

`InputPath`

When you don't want to pass the entire matched event to the target, use the `InputPath` property to describe which part of the event to pass.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `InputPath` property of an `AWS::Events::Rule Target` resource.

`Pattern`

Describes which events are routed to the specified target. For more information, see Events and Event Patterns in EventBridge in the *Amazon EventBridge User Guide*.

Type: EventPattern

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `EventPattern` property of an `AWS::Events::Rule` resource.

Examples

CloudWatchEvent

The following is an example of a `CloudWatchEvent` event source type.

YAML

```
CWEvent:
  Type: CloudWatchEvent
  Properties:
    Input: '{"Key": "Value"}'
    Pattern:
      detail:
        state:
          - terminated
```

CloudWatchLogs

The object describing a `CloudWatchLogs` event source type.

This event generates a AWS::Logs::SubscriptionFilter resource and specifies a subscription filter and associates it with the specified log group.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  FilterPattern: String
  LogGroupName: String
```

Properties

`FilterPattern`

The filtering expressions that restrict what gets delivered to the destination AWS resource. For more information about the filter pattern syntax, see Filter and Pattern Syntax.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `FilterPattern` property of an `AWS::Logs::SubscriptionFilter` resource.

`LogGroupName`

The log group to associate with the subscription filter. All log events that are uploaded to this log group are filtered and delivered to the specified AWS resource if the filter pattern matches the log events.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `LogGroupName` property of an `AWS::Logs::SubscriptionFilter` resource.

Examples

Cloudwatchlogs Subscription filter

Cloudwatchlogs Subscription filter Example

YAML

```
CWLog:
  Type: CloudWatchLogs
  Properties:
    LogGroupName:
      Ref: CloudWatchLambdaLogsGroup
    FilterPattern: My pattern
```

Cognito

The object describing a `Cognito` event source type.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Trigger: List
  UserPool: String
```

Properties

`Trigger`

The Lambda trigger configuration information for the new user pool.

Type: List

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `LambdaConfig` property of an `AWS::Cognito::UserPool` resource.

`UserPool`

Reference to UserPool defined in the same template

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Cognito Event

Cognito Event Example

YAML

```
CognitoUserPoolPreSignup:
  Type: Cognito
  Properties:
    UserPool:
      Ref: MyCognitoUserPool
    Trigger: PreSignUp
```

DynamoDB

The object describing a `DynamoDB` event source type. For more information, see Using AWS Lambda with Amazon DynamoDB in the *AWS Lambda Developer Guide*.

AWS SAM generates an AWS::Lambda::EventSourceMapping resource when this event type is set.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  BatchSize: Integer
  BisectBatchOnFunctionError: Boolean
  DestinationConfig: DestinationConfig
  Enabled: Boolean
  FunctionResponseTypes: List
  MaximumBatchingWindowInSeconds: Integer
  MaximumRecordAgeInSeconds: Integer
  MaximumRetryAttempts: Integer
  ParallelizationFactor: Integer
  StartingPosition: String
  Stream: String
  TumblingWindowInSeconds: Integer
```

Properties

`BatchSize`

The maximum number of items to retrieve in a single batch.

Type: Integer

Required: No

Default: 100

AWS CloudFormation compatibility: This property is passed directly to the `BatchSize` property of an `AWS::Lambda::EventSourceMapping` resource.

Minimum: `1`

Maximum: `1000`

`BisectBatchOnFunctionError`

If the function returns an error, split the batch in two and retry.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `BisectBatchOnFunctionError` property of an `AWS::Lambda::EventSourceMapping` resource.

`DestinationConfig`

An Amazon Simple Queue Service (Amazon SQS) queue or Amazon Simple Notification Service (Amazon SNS) topic destination for discarded records.

Type: DestinationConfig

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `DestinationConfig` property of an `AWS::Lambda::EventSourceMapping` resource.

`Enabled`

Disables the event source mapping to pause polling and invocation.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Enabled` property of an `AWS::Lambda::EventSourceMapping` resource.

`FunctionResponseTypes`

A list of the response types currently applied to the event source mapping. For more information, see Reporting batch item failures in the *AWS Lambda Developer Guide*.

Valid values: `ReportBatchItemFailures`

Type: List

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `FunctionResponseTypes` property of an `AWS::Lambda::EventSourceMapping` resource.

`MaximumBatchingWindowInSeconds`

The maximum amount of time to gather records before invoking the function, in seconds.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MaximumBatchingWindowInSeconds` property of an `AWS::Lambda::EventSourceMapping` resource.

`MaximumRecordAgeInSeconds`

The maximum age of a record that Lambda sends to a function for processing.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MaximumRecordAgeInSeconds` property of an `AWS::Lambda::EventSourceMapping` resource.

`MaximumRetryAttempts`

The maximum number of times to retry when the function returns an error.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MaximumRetryAttempts` property of an `AWS::Lambda::EventSourceMapping` resource.

`ParallelizationFactor`

The number of batches to process from each shard concurrently.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `ParallelizationFactor` property of an `AWS::Lambda::EventSourceMapping` resource.

`StartingPosition`

The position in a stream from which to start reading.

Valid values: `TRIM_HORIZON` or `LATEST`

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `StartingPosition` property of an `AWS::Lambda::EventSourceMapping` resource.

`Stream`

The Amazon Resource Name (ARN) of the DynamoDB stream.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `EventSourceArn` property of an `AWS::Lambda::EventSourceMapping` resource.

`TumblingWindowInSeconds`

The duration, in seconds, of a processing window. The valid range is 1 to 900 (15 minutes).

For more information, see Tumbling windows in the *AWS Lambda Developer Guide*.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `TumblingWindowInSeconds` property of an `AWS::Lambda::EventSourceMapping` resource.

Examples

DynamoDB event source for existing DynamoDB table

DynamoDB event source for a DynamoDB table that already exists in an AWS account.

YAML

```
Events:
  DDBEvent:
    Type: DynamoDB
    Properties:
      Stream: arn:aws:dynamodb:us-east-1:123456789012:table/TestTable/
stream/2016-08-11T21:21:33.291
      StartingPosition: TRIM_HORIZON
      BatchSize: 10
      Enabled: false
```

DynamoDB Event for DynamoDB Table Declared in Template

DynamoDB Event for a DynamoDB table that is declared in the same template file.

YAML

```
Events:
  DDBEvent:
    Type: DynamoDB
    Properties:
      Stream:
        !GetAtt MyDynamoDBTable.StreamArn   # This must be the name of a DynamoDB table
 declared in the same template file
      StartingPosition: TRIM_HORIZON
      BatchSize: 10
      Enabled: false
```

EventBridgeRule

The object describing an `EventBridgeRule` event source type, which sets your serverless function as the target of an Amazon EventBridge rule. For more information, see What Is Amazon EventBridge? in the *Amazon EventBridge User Guide*.

AWS SAM generates an AWS::Events::Rule resource when this event type is set.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  DeadLetterConfig: DeadLetterConfig (p. 106)
  EventBusName: String
  Input: String
  InputPath: String
  Pattern: EventPattern
  RetryPolicy: RetryPolicy
  Target: Target (p. 108)
```

Properties

`DeadLetterConfig`

Configure the Amazon Simple Queue Service (Amazon SQS) queue where EventBridge sends events after a failed target invocation. Invocation can fail, for example, when sending an event to a Lambda function that doesn't exist, or when EventBridge has insufficient permissions to invoke the Lambda function. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Note: The AWS::Serverless::Function (p. 68) resource type has a similar data type, `DeadLetterQueue`, which handles failures that occur after successful invocation of the target Lambda function. Examples of these types of failures include Lambda throttling, or errors returned by the Lambda target function. For more information about the function `DeadLetterQueue` property, see AWS Lambda function dead-letter queues in the *AWS Lambda Developer Guide*.

Type: DeadLetterConfig (p. 106)

Required: No

AWS CloudFormation compatibility: This property is similar to the `DeadLetterConfig` property of the `AWS::Events::Rule Target` data type. The AWS SAM version of this property includes additional subproperties, in case you want AWS SAM to create the dead-letter queue for you.

`EventBusName`

The event bus to associate with this rule. If you omit this property, AWS SAM uses the default event bus.

Type: String

Required: No

Default: Default event bus

AWS CloudFormation compatibility: This property is passed directly to the `EventBusName` property of an `AWS::Events::Rule` resource.

`Input`

Valid JSON text passed to the target. If you use this property, nothing from the event text itself is passed to the target.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Input` property of an `AWS::Events::Rule Target` resource.

`InputPath`

When you don't want to pass the entire matched event to the target, use the `InputPath` property to describe which part of the event to pass.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `InputPath` property of an `AWS::Events::Rule Target` resource.

`Pattern`

Describes which events are routed to the specified target. For more information, see Events and Event Patterns in EventBridge in the *Amazon EventBridge User Guide*.

Type: EventPattern

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `EventPattern` property of an `AWS::Events::Rule` resource.

`RetryPolicy`

A `RetryPolicy` object that includes information about the retry policy settings. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Type: RetryPolicy

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `RetryPolicy` property of the `AWS::Events::Rule` `Target` data type.

`Target`

The AWS resource that EventBridge invokes when a rule is triggered. You can use this property to specify the logical ID of the target. If this property is not specified, then AWS SAM generates the logical ID of the target.

Type: Target (p. 108)

Required: No

AWS CloudFormation compatibility: This property is similar to the `Targets` property of an `AWS::Events::Rule` resource. The AWS SAM version of this property only allows you to specify the logical ID of a single target.

Examples

EventBridgeRule

The following is an example of an `EventBridgeRule` event source type.

YAML

```
EBRule:
  Type: EventBridgeRule
  Properties:
    Input: '{"Key": "Value"}'
    Pattern:
      detail:
        state:
          - terminated
    RetryPolicy:
      MaximumRetryAttempts: 5
      MaximumEventAgeInSeconds: 900
    DeadLetterConfig:
      Type: SQS
      QueueLogicalId: EBRuleDLQ
    Target:
      Id: MyTarget
```

DeadLetterConfig

The object used to specify the Amazon Simple Queue Service (Amazon SQS) queue where EventBridge sends events after a failed target invocation. Invocation can fail, for example, when sending an event to a

Lambda function that doesn’t exist, or insufficient permissions to invoke the Lambda function. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Note: The AWS::Serverless::Function (p. 68) resource type has a similar data type, `DeadLetterQueue` which handles failures that occur after successful invocation of the target Lambda function. Examples of this type of failure include Lambda throttling, or errors returned by the Lambda target function. For more information about the function `DeadLetterQueue` property, see AWS Lambda function dead letter queues in the AWS Lambda Developer Guide.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Arn: String
QueueLogicalId: String
Type: String
```

Properties

`Arn`

The Amazon Resource Name (ARN) of the Amazon SQS queue specified as the target for the dead-letter queue.

Note: Specify either the `Type` property or `Arn` property, but not both.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Arn` property of the `AWS::Events::Rule` `DeadLetterConfig` data type.

`QueueLogicalId`

The custom name of the dead letter queue that AWS SAM creates if `Type` is specified.

Note: If the `Type` property is not set, this property is ignored.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Type`

The type of the queue. When this property is set, AWS SAM automatically creates a dead-letter queue and attaches necessary resource-based policy to grant permission to rule resource to send events to the queue.

Note: Specify either the `Type` property or `Arn` property, but not both.

Valid values: `SQS`

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

DeadLetterConfig

DeadLetterConfig

YAML

```
DeadLetterConfig:
  Type: SQS
  QueueLogicalId: MyDLQ
```

Target

Configures the AWS resource that EventBridge invokes when a rule is triggered.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Id: String
```

Properties

`Id`

The logical ID of the target.

The value of `Id` can include alphanumeric characters, periods (`.`), hyphens (-), and underscores (_).

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `Id` property of the `AWS::Events::Rule Target` data type.

Examples

Target

Target

YAML

```
EBRule:
  Type: EventBridgeRule
  Properties:
    Target:
      Id: MyTarget
```

HttpApi

The object describing an event source with type HttpApi.

If an OpenApi definition for the specified path and method exists on the API, SAM will add the Lambda integration and security section (if applicable) for you.

If no OpenApi definition for the specified path and method exists on the API, SAM will create this definition for you.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
ApiId: String
Auth: HttpApiFunctionAuth (p. 111)
Method: String
Path: String
PayloadFormatVersion: String
RouteSettings: RouteSettings
TimeoutInMillis: Integer
```

Properties

`ApiId`

Identifier of an AWS::Serverless::HttpApi (p. 130) resource defined in this template.

If not defined, a default AWS::Serverless::HttpApi (p. 130) resource is created called `ServerlessHttpApi` using a generated OpenApi document containing a union of all paths and methods defined by Api events defined in this template that do not specify an `ApiId`.

This cannot reference an AWS::Serverless::HttpApi (p. 130) resource defined in another template.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Auth`

Auth configuration for this specific Api+Path+Method.

Useful for overriding the API's `DefaultAuthorizer` or setting auth config on an individual path when no `DefaultAuthorizer` is specified.

Type: HttpApiFunctionAuth (p. 111)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Method`

HTTP method for which this function is invoked.

If no `Path` and `Method` are specified, SAM will create a default API path that routes any request that doesn't map to a different endpoint to this Lambda function. Only one of these default paths can exist per API.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Path`

Uri path for which this function is invoked. Must start with `/`.

If no `Path` and `Method` are specified, SAM will create a default API path that routes any request that doesn't map to a different endpoint to this Lambda function. Only one of these default paths can exist per API.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`PayloadFormatVersion`

Specifies the format of the payload sent to an integration.

NOTE: PayloadFormatVersion requires SAM to modify your OpenAPI definition, so it only works with inline OpenApi defined in the `DefinitionBody` property.

Type: String

Required: No

Default: 2.0

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`RouteSettings`

The per-route route settings for this HTTP API. For more information about route settings, see AWS::ApiGatewayV2::Stage RouteSettings in the *API Gateway Developer Guide*.

Note: If RouteSettings are specified in both the HttpApi resource and event source, AWS SAM merges them with the event source properties taking precedence.

Type: RouteSettings

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `RouteSettings` property of an `AWS::ApiGatewayV2::Stage` resource.

`TimeoutInMillis`

Custom timeout between 50 and 29,000 milliseconds.

NOTE: TimeoutInMillis requires SAM to modify your OpenAPI definition, so it only works with inline OpenApi defined in the `DefinitionBody` property.

Type: Integer

Required: No

Default: 5000

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Default HttpApi Event

HttpApi Event that uses the default path. All unmapped paths and methods on this API will route to this endpoint.

YAML

```
Events:
  HttpApiEvent:
    Type: HttpApi
```

HttpApi

HttpApi Event that uses a specific path and method.

YAML

```
Events:
  HttpApiEvent:
    Type: HttpApi
    Properties:
      Path: /
      Method: GET
```

HttpApi Authorization

HttpApi Event that uses an Authorizer.

YAML

```
Events:
  HttpApiEvent:
    Type: HttpApi
    Properties:
      Path: /authenticated
      Method: GET
      Auth:
        Authorizer: OpenIdAuth
        AuthorizationScopes:
          - scope1
          - scope2
```

HttpApiFunctionAuth

Configures authorization at the event level.

Configure Auth for a specific API + Path + Method

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  AuthorizationScopes: List
  Authorizer: String
```

Properties

`AuthorizationScopes`

The authorization scopes to apply to this API, path, and method.

Scopes listed here will override any scopes applied by the `DefaultAuthorizer` if one exists.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Authorizer`

The `Authorizer` for a specific Function

If you have specified a Global Authorizer on the API and want to make a specific Function public, override by setting `Authorizer` to `NONE`.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Function-Auth

Specifing Authorization at Function level

YAML

```
Auth:
  Authorizer: OpenIdAuth
  AuthorizationScopes:
    - scope1
    - scope2
```

IoTRule

The object describing an `IoTRule` event source type.

Creates an AWS::IoT::TopicRule resource to declare an AWS IoT rule. For more information see AWS CloudFormation documentation

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  AwsIotSqlVersion: String
  Sql: String
```

Properties

`AwsIotSqlVersion`

The version of the SQL rules engine to use when evaluating the rule.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `AwsIotSqlVersion` property of an `AWS::IoT::TopicRule TopicRulePayload` resource.

`Sql`

The SQL statement used to query the topic. For more information, see AWS IoT SQL Reference in the *AWS IoT Developer Guide*.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `Sql` property of an `AWS::IoT::TopicRule TopicRulePayload` resource.

Examples

IOT Rule

IOT Rule Example

YAML

```
IoTRule:
  Type: IoTRule
  Properties:
    Sql: SELECT * FROM 'topic/test'
```

Kinesis

The object describing a `Kinesis` event source type. For more information, see Using AWS Lambda with Amazon Kinesis in the *AWS Lambda Developer Guide*.

AWS SAM generates an AWS::Lambda::EventSourceMapping resource when this event type is set.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
BatchSize: Integer
BisectBatchOnFunctionError: Boolean
DestinationConfig: DestinationConfig
Enabled: Boolean
FunctionResponseTypes: List
MaximumBatchingWindowInSeconds: Integer
MaximumRecordAgeInSeconds: Integer
MaximumRetryAttempts: Integer
ParallelizationFactor: Integer
StartingPosition: String
Stream: String
TumblingWindowInSeconds: Integer
```

Properties

`BatchSize`

The maximum number of items to retrieve in a single batch.

Type: Integer

Required: No

Default: 100

AWS CloudFormation compatibility: This property is passed directly to the `BatchSize` property of an `AWS::Lambda::EventSourceMapping` resource.

Minimum: `1`

Maximum: `10000`

`BisectBatchOnFunctionError`

If the function returns an error, split the batch in two and retry.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `BisectBatchOnFunctionError` property of an `AWS::Lambda::EventSourceMapping` resource.

`DestinationConfig`

An Amazon Simple Queue Service (Amazon SQS) queue or Amazon Simple Notification Service (Amazon SNS) topic destination for discarded records.

Type: DestinationConfig

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `DestinationConfig` property of an `AWS::Lambda::EventSourceMapping` resource.

`Enabled`

Disables the event source mapping to pause polling and invocation.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Enabled` property of an `AWS::Lambda::EventSourceMapping` resource.

`FunctionResponseTypes`

A list of the response types currently applied to the event source mapping. For more information, see Reporting batch item failures in the *AWS Lambda Developer Guide*.

Valid values: `ReportBatchItemFailures`

Type: List

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `FunctionResponseTypes` property of an `AWS::Lambda::EventSourceMapping` resource.

`MaximumBatchingWindowInSeconds`

The maximum amount of time to gather records before invoking the function, in seconds.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MaximumBatchingWindowInSeconds` property of an `AWS::Lambda::EventSourceMapping` resource.

`MaximumRecordAgeInSeconds`

The maximum age of a record that Lambda sends to a function for processing.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MaximumRecordAgeInSeconds` property of an `AWS::Lambda::EventSourceMapping` resource.

`MaximumRetryAttempts`

The maximum number of times to retry when the function returns an error.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MaximumRetryAttempts` property of an `AWS::Lambda::EventSourceMapping` resource.

`ParallelizationFactor`

The number of batches to process from each shard concurrently.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `ParallelizationFactor` property of an `AWS::Lambda::EventSourceMapping` resource.

`StartingPosition`

The position in a stream from which to start reading.

Valid values: `TRIM_HORIZON` or `LATEST`

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `StartingPosition` property of an `AWS::Lambda::EventSourceMapping` resource.

`Stream`

The Amazon Resource Name (ARN) of the data stream or a stream consumer.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `EventSourceArn` property of an `AWS::Lambda::EventSourceMapping` resource.

`TumblingWindowInSeconds`

The duration, in seconds, of a processing window. The valid range is 1 to 900 (15 minutes).

For more information, see Tumbling windows in the *AWS Lambda Developer Guide*.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `TumblingWindowInSeconds` property of an `AWS::Lambda::EventSourceMapping` resource.

Examples

Kinesis event source

The following is an example of a Kinesis event source.

YAML

```
Events:
  KinesisEvent:
    Type: Kinesis
    Properties:
      Stream: arn:aws:kinesis:us-east-1:123456789012:stream/my-stream
      StartingPosition: TRIM_HORIZON
      BatchSize: 10
      Enabled: false
```

MQ

The object describing an `MQ` event source type. For more information, see Using Lambda with Amazon MQ in the *AWS Lambda Developer Guide*.

AWS SAM generates an AWS::Lambda::EventSourceMapping resource when this event type is set.

Note: To have an Amazon MQ queue in a virtual private cloud (VPC) but your Lambda function in a public network, your function's execution role must include the following permissions: `ec2:CreateNetworkInterface`, `ec2:DeleteNetworkInterface`, `ec2:DescribeNetworkInterfaces`, `ec2:DescribeSecurityGroups`, `ec2:DescribeSubnets`, `ec2:DescribeVpcs`. For more information, see Execution role permissions in the *AWS Lambda Developer Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
BatchSize: Integer
Broker: String
Enabled: Boolean
Queues: List
SecretsManagerKmsKeyId: String
SourceAccessConfigurations: List
```

Properties

`BatchSize`

The maximum number of items to retrieve in a single batch.

Type: Integer

Required: No

Default: 100

AWS CloudFormation compatibility: This property is passed directly to the `BatchSize` property of an `AWS::Lambda::EventSourceMapping` resource.

Minimum: `1`

Maximum: `10000`

`Broker`

The Amazon Resource Name (ARN) of the Amazon MQ broker.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `EventSourceArn` property of an `AWS::Lambda::EventSourceMapping` resource.

`Enabled`

If true, the event source mapping is active. To pause polling and invocation, set to `false`.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Enabled` property of an `AWS::Lambda::EventSourceMapping` resource.

`Queues`

The name of the Amazon MQ broker destination queue to consume.

Type: List

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `Queues` property of an `AWS::Lambda::EventSourceMapping` resource.

`SecretsManagerKmsKeyId`

The AWS Key Management Service (AWS KMS) key ID of a customer managed key from AWS Secrets Manager. This property is required if you use a customer managed key from Secrets Manager, but your Lambda execution role doesn't include the `kms:Decrypt` permission.

The value of this property is a UUID. For example: `1abc23d4-567f-8ab9-cde0-1fab234c5d67`.

Type: String

Required: Conditional

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`SourceAccessConfigurations`

An array of the authentication protocol or vitual host. Specify this using the SourceAccessConfigurations data type.

Note: For the `MQ` event source type, the only valid configuration types are `BASIC_AUTH` and `VIRTUAL_HOST`.

`BASIC_AUTH` - The Secrets Manager secret that stores your broker credentials. For this type, the credential must be in the following format: `{"username": "your-username", "password": "your-password"}`. Only one object of type `BASIC_AUTH` is allowed.

`VIRTUAL_HOST` - The name of the virtual host in your RabbitMQ broker. Lambda will use this Rabbit MQ's host as the event source. Only one object of type `VIRTUAL_HOST` is allowed.

Type: List

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `SourceAccessConfigurations` property of an `AWS::Lambda::EventSourceMapping` resource.

Examples

Amazon MQ event source

The following is an example of an `MQ` event source type for an Amazon MQ broker.

YAML

```
Events:
  MQEvent:
    Type: MQ
    Properties:
      Broker: arn:aws:mq:us-
east-2:123456789012:broker:MyBroker:b-1234a5b6-78cd-901e-2fgh-3i45j6k178l9
```

```
    Queues: List of queues
    SourceAccessConfigurations:
      - Type: BASIC_AUTH
        URI: arn:aws:secretsmanager:us-east-1:01234567890:secret:MyBrokerSecretName
    BatchSize: 200
    Enabled: true
```

MSK

The object describing an `MSK` event source type. For more information, see Using AWS Lambda with Amazon MSK in the *AWS Lambda Developer Guide*.

AWS SAM generates an AWS::Lambda::EventSourceMapping resource when this event type is set.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
StartingPosition: String
Stream: String
Topics: List
```

Properties

`StartingPosition`

The position in a stream from which to start reading.

Valid values: `TRIM_HORIZON` or `LATEST`

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `StartingPosition` property of an `AWS::Lambda::EventSourceMapping` resource.

`Stream`

The Amazon Resource Name (ARN) of the data stream or a stream consumer.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `EventSourceArn` property of an `AWS::Lambda::EventSourceMapping` resource.

`Topics`

The name of the Kafka topic.

Type: List

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `Topics` property of an `AWS::Lambda::EventSourceMapping` resource.

Examples

Amazon MSK Example for Existing Cluster

The following is an example of an `MSK` event source type for an Amazon MSK cluster that already exists in an AWS account.

YAML

```
Events:
  MSKEvent:
    Type: MSK
    Properties:
      StartingPosition: LATEST
      Stream: arn:aws:kafka:us-east-1:012345678012:cluster/exampleClusterName/
abcdefab-1234-abcd-5678-cdef0123ab01-2
      Topics:
        - MyTopic
```

Amazon MSK Example for Cluster Declared in Same Template

The following is an example of an `MSK` event source type for an Amazon MSK cluster that is declared in the same template file.

YAML

```
Events:
  MSKEvent:
    Type: MSK
    Properties:
      StartingPosition: LATEST
      Stream:
        Ref: MyMskCluster   # This must be the name of an MSK cluster declared in the same
 template file
      Topics:
        - MyTopic
```

S3

The object describing an `S3` event source type.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Bucket: String
  Events: String | List
  Filter: NotificationFilter
```

Properties

`Bucket`

S3 bucket name. This bucket must exist in the same template.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is similar to the `BucketName` property of an `AWS::S3::Bucket` resource. This is a required field in SAM. This field only accepts a reference to the S3 bucket created in this template

`Events`

The Amazon S3 bucket event for which to invoke the Lambda function. See Amazon S3 supported event types for a list of valid values.

Type: String | List

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `Event` property of the `AWS::S3::Bucket LambdaConfiguration` data type.

`Filter`

The filtering rules that determine which Amazon S3 objects invoke the Lambda function. For information about Amazon S3 key name filtering, see Configuring Amazon S3 Event Notifications in the *Amazon Simple Storage Service User Guide*.

Type: NotificationFilter

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Filter` property of the `AWS::S3::Bucket LambdaConfiguration` data type.

Examples

S3-Event

Example of an S3 Event.

YAML

```
Events:
  S3Event:
    Type: S3
    Properties:
      Bucket:
        Ref: ImagesBucket     # This must be the name of an S3 bucket declared in the same
 template file
      Events: s3:ObjectCreated:*
      Filter:
        S3Key:
          Rules:
          - Name: prefix      # or "suffix"
            Value: value      # The value to search for in the S3 object key names
```

Schedule

The object describing a `Schedule` event source type, which sets your serverless function as the target of an EventBridge rule that triggers on a schedule. For more information, see What Is Amazon EventBridge? in the *Amazon EventBridge User Guide*.

AWS Serverless Application Model (AWS SAM) generates an AWS::Events::Rule resource when this event type is set.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
DeadLetterConfig: DeadLetterConfig (p. 124)
Description: String
Enabled: Boolean
Input: String
Name: String
RetryPolicy: RetryPolicy
Schedule: String
```

Properties

`DeadLetterConfig`

Configure the Amazon Simple Queue Service (Amazon SQS) queue where EventBridge sends events after a failed target invocation. Invocation can fail, for example, when sending an event to a Lambda function that doesn't exist, or when EventBridge has insufficient permissions to invoke the Lambda function. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Note: The AWS::Serverless::Function (p. 68) resource type has a similar data type, `DeadLetterQueue`, which handles failures that occur after successful invocation of the target Lambda function. Examples of these types of failures include Lambda throttling, or errors returned by the Lambda target function. For more information about the function `DeadLetterQueue` property, see AWS Lambda function dead-letter queues in the *AWS Lambda Developer Guide*.

Type: DeadLetterConfig (p. 124)

Required: No

AWS CloudFormation compatibility: This property is similar to the `DeadLetterConfig` property of the `AWS::Events::Rule` `Target` data type. The AWS SAM version of this property includes additional subproperties, in case you want AWS SAM to create the dead-letter queue for you.

`Description`

A description of the rule.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Description` property of an `AWS::Events::Rule` resource.

`Enabled`

Indicates whether the rule is enabled.

To disable the rule, set this property to `false`.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is similar to the `State` property of an `AWS::Events::Rule` resource. If this property is set to `true` then AWS SAM passes `ENABLED`, otherwise it passes `DISABLED`.

`Input`

Valid JSON text passed to the target. If you use this property, nothing from the event text itself is passed to the target.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Target` property of an `AWS::Events::Rule Target` resource.

`Name`

The name of the rule. If you don't specify a name, AWS CloudFormation generates a unique physical ID and uses that ID for the rule name.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Name` property of an `AWS::Events::Rule` resource.

`RetryPolicy`

A `RetryPolicy` object that includes information about the retry policy settings. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Type: RetryPolicy

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `RetryPolicy` property of the `AWS::Events::Rule` `Target` data type.

`Schedule`

The scheduling expression that determines when and how often the rule runs. For more information, see Schedule Expressions for Rules.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `ScheduleExpression` property of an `AWS::Events::Rule` resource.

Examples

CloudWatch Schedule Event

CloudWatch Schedule Event Example

YAML

```
CWSchedule:
  Type: Schedule
  Properties:
    Schedule: 'rate(1 minute)'
    Name: TestSchedule
    Description: test schedule
    Enabled: false
```

DeadLetterConfig

The object used to specify the Amazon Simple Queue Service (Amazon SQS) queue where EventBridge sends events after a failed target invocation. Invocation can fail, for example, when sending an event to a Lambda function that doesn’t exist, or insufficient permissions to invoke the Lambda function. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Note: The AWS::Serverless::Function (p. 68) resource type has a similar data type, `DeadLetterQueue` which handles failures that occur after successful invocation of the target Lambda function. Examples of this type of failure include Lambda throttling, or errors returned by the Lambda target function. For more information about the function `DeadLetterQueue` property, see AWS Lambda function dead letter queues in the AWS Lambda Developer Guide.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Arn: String
QueueLogicalId: String
Type: String
```

Properties

`Arn`

The Amazon Resource Name (ARN) of the Amazon SQS queue specified as the target for the dead-letter queue.

Note: Specify either the `Type` property or `Arn` property, but not both.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Arn` property of the `AWS::Events::Rule DeadLetterConfig` data type.

`QueueLogicalId`

The custom name of the dead letter queue that AWS SAM creates if `Type` is specified.

Note: If the `Type` property is not set, this property is ignored.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Type`

The type of the queue. When this property is set, AWS SAM automatically creates a dead-letter queue and attaches necessary resource-based policy to grant permission to rule resource to send events to the queue.

Note: Specify either the `Type` property or `Arn` property, but not both.

Valid values: `SQS`

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

DeadLetterConfig

DeadLetterConfig

YAML

```
DeadLetterConfig:
  Type: SQS
  QueueLogicalId: MyDLQ
```

SNS

The object describing an `SNS` event source type.

SAM generates AWS::SNS::Subscription resource when this event type is set

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  FilterPolicy: SnsFilterPolicy
  Region: String
  SqsSubscription: Boolean | SqsSubscriptionObject (p. 126)
  Topic: String
```

Properties

`FilterPolicy`

The filter policy JSON assigned to the subscription. For more information, see GetSubscriptionAttributes in the Amazon Simple Notification Service API Reference.

Type: SnsFilterPolicy

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `FilterPolicy` property of an `AWS::SNS::Subscription` resource.

`Region`

For cross-region subscriptions, the region in which the topic resides.

If no region is specified, CloudFormation uses the region of the caller as the default.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Region` property of an `AWS::SNS::Subscription` resource.

`SqsSubscription`

Set this property to true, or specify `SqsSubscriptionObject` to enable batching SNS topic notifications in an SQS queue. Setting this property to `true` creates a new SQS queue, whereas specifying a `SqsSubscriptionObject` uses an existing SQS queue.

Type: Boolean | SqsSubscriptionObject (p. 126)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Topic`

The ARN of the topic to subscribe to.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `TopicArn` property of an `AWS::SNS::Subscription` resource.

Examples

SNS Event Source Example

SNS Event Source Example

YAML

```
Events:
  SNSEvent:
    Type: SNS
    Properties:
      Topic: arn:aws:sns:us-east-1:123456789012:my_topic
      SqsSubscription: true
      FilterPolicy:
        store:
          - example_corp
        price_usd:
          - numeric:
              - ">="
              - 100
```

SqsSubscriptionObject

Specify an existing SQS queue option to SNS event

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
BatchSize: String
Enabled: Boolean
QueueArn: String
QueuePolicyLogicalId: String
QueueUrl: String
```

Properties

`BatchSize`

The maximum number of items to retrieve in a single batch for the SQS queue.

Type: String

Required: No

Default: 10

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Enabled`

Disables the SQS event source mapping to pause polling and invocation.

Type: Boolean

Required: No

Default: True

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`QueueArn`

Specify an existing SQS queue arn.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`QueuePolicyLogicalId`

Give a custom logicalId name for the AWS::SQS::QueuePolicy resource.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`QueueUrl`

Specify the queue URL associated with the `QueueArn` property.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Existing SQS for SNS event

Example to add existing SQS queue for subscibing to an SNS topic.

YAML

```
QueuePolicyLogicalId: CustomQueuePolicyLogicalId
QueueArn:
  Fn::GetAtt: MyCustomQueue.Arn
QueueUrl:
  Ref: MyCustomQueue
BatchSize: 5
```

SQS

The object describing an `SQS` event source type. For more information, see Using AWS Lambda with Amazon SQS in the *AWS Lambda Developer Guide*.

SAM generates AWS::Lambda::EventSourceMapping resource when this event type is set

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  BatchSize: Integer
  Enabled: Boolean
  MaximumBatchingWindowInSeconds: Integer
  Queue: String
```

Properties

`BatchSize`

The maximum number of items to retrieve in a single batch.

Type: Integer

Required: No

Default: 10

AWS CloudFormation compatibility: This property is passed directly to the `BatchSize` property of an `AWS::Lambda::EventSourceMapping` resource.

Minimum: `1`

Maximum: `10000`

`Enabled`

Disables the event source mapping to pause polling and invocation.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Enabled` property of an `AWS::Lambda::EventSourceMapping` resource.

`MaximumBatchingWindowInSeconds`

The maximum amount of time, in seconds, to gather records before invoking the function.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MaximumBatchingWindowInSeconds` property of an `AWS::Lambda::EventSourceMapping` resource.

`Queue`

The ARN of the queue.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `EventSourceArn` property of an `AWS::Lambda::EventSourceMapping` resource.

Examples

SQS Event

SQS Event

YAML

```
Events:
  SQSEvent:
    Type: SQS
    Properties:
      Queue: arn:aws:sqs:us-west-2:012345678901:my-queue
      BatchSize: 10
      Enabled: false
```

FunctionCode

The deployment package for a Lambda function.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Bucket: String
  Key: String
  Version: String
```

Properties

`Bucket`

An Amazon S3 bucket in the same AWS Region as your function.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `S3Bucket` property of the `AWS::Lambda::Function` `Code` data type.

`Key`

The Amazon S3 key of the deployment package.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `S3Key` property of the `AWS::Lambda::Function` `Code` data type.

`Version`

For versioned objects, the version of the deployment package object to use.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `S3ObjectVersion` property of the `AWS::Lambda::Function` `Code` data type.

Examples

FunctionCode

Function Code example

YAML

```
FunctionCode:
  Bucket: mybucket-name
  Key: mykey-name
  Version: 121212
```

AWS::Serverless::HttpApi

Creates an Amazon API Gateway HTTP API, which enables you to create RESTful APIs with lower latency and lower costs than REST APIs. For more information, see Working with HTTP APIs in the *API Gateway Developer Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Type: AWS::Serverless::HttpApi
Properties:
  AccessLogSettings: AccessLogSettings
  Auth: HttpApiAuth (p. 137)
  CorsConfiguration: String | HttpApiCorsConfiguration (p. 143)
  DefaultRouteSettings: RouteSettings
  DefinitionBody: String
  DefinitionUri: String | HttpApiDefinition (p. 145)
  Description: String
  DisableExecuteApiEndpoint: Boolean
  Domain: HttpApiDomainConfiguration (p. 146)
  FailOnWarnings: Boolean
  RouteSettings: RouteSettings
  StageName: String
  StageVariables: Json
  Tags: Map
```

Properties

`AccessLogSettings`

The settings for access logging in a stage.

Type: AccessLogSettings

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `AccessLogSettings` property of an `AWS::ApiGatewayV2::Stage` resource.

`Auth`

Configures authorization for controlling access to your API Gateway HTTP API.

For more information, see Controlling access to HTTP APIs with JWT authorizers in the *API Gateway Developer Guide*.

Type: HttpApiAuth (p. 137)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`CorsConfiguration`

Manages cross-origin resource sharing (CORS) for all your API Gateway HTTP APIs. Specify the domain to allow as a string, or specify an `HttpApiCorsConfiguration` object. Note that CORS requires AWS SAM to modify your OpenAPI definition, so CORS works only if the `DefinitionBody` property is specified.

For more information, see Configuring CORS for an HTTP API in the *API Gateway Developer Guide*.

Note: If `CorsConfiguration` is set both in an OpenAPI definition and at the property level, then AWS SAM merges both configuration sources with the properties taking precedence.

Note: If this property is set to `true`, then all origins are allowed.

Type: String | HttpApiCorsConfiguration (p. 143)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`DefaultRouteSettings`

The default route settings for this HTTP API. These settings apply to all routes unless overridden by the `RouteSettings` property for certain routes.

Type: RouteSettings

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `RouteSettings` property of an `AWS::ApiGatewayV2::Stage` resource.

`DefinitionBody`

The OpenAPI definition that describes your HTTP API. If you don't specify a `DefinitionUri` or a `DefinitionBody`, AWS SAM generates a `DefinitionBody` for you based on your template configuration.

Type: String

Required: No

AWS CloudFormation compatibility: This property is similar to the `Body` property of an `AWS::ApiGatewayV2::Api` resource. If certain properties are provided, AWS SAM may insert content into or modify the `DefinitionBody` before it is passed to AWS CloudFormation. Properties include `Auth` and an `EventSource` of type HttpApi for a corresponding `AWS::Serverless::Function` resource.

`DefinitionUri`

The Amazon Simple Storage Service (Amazon S3) URI, local file path, or location object of the the OpenAPI definition that defines the HTTP API. The Amazon S3 object that this property references must be a valid OpenAPI definition file. If you don't specify a `DefinitionUri` or a `DefinitionBody` are specified, AWS SAM generates a `DefinitionBody` for you based on your template configuration.

If you provide a local file path, the template must go through the workflow that includes the `sam deploy` or `sam package` command for the definition to be transformed properly.

Intrinsic functions are not supported in external OpenApi definition files that you reference with `DefinitionUri`. To import an OpenApi definition into the template, use the `DefinitionBody` property with the Include transform.

Type: String | HttpApiDefinition (p. 145)

Required: No

AWS CloudFormation compatibility: This property is similar to the `BodyS3Location` property of an `AWS::ApiGatewayV2::Api` resource. The nested Amazon S3 properties are named differently.

`Description`

A description of the HttpApi resource.

Note: This property requires AWS SAM to modify the HttpApi resource's OpenAPI definition, to set the `description` field. The following two scenarios result in an error: 1) The `DefinitionBody` property is specified with the `description` field set in the OpenAPI definition (since this is a conflict that AWS SAM won't resolve), or 2) The `DefinitionUri` property is specified (since AWS SAM won't modify an OpenAPI definition that it retrieves from Amazon S3).

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`DisableExecuteApiEndpoint`

Specifies whether clients can invoke your HTTP API by using the default `execute-api` endpoint `https://{api_id}.execute-api.{region}.amazonaws.com`. By default, clients can invoke your API with the default endpoint. To require that clients only use a custom domain name to invoke your API, disable the default endpoint.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `DisableExecuteApiEndpoint` property of an `AWS::ApiGatewayV2::Api` resource.

`Domain`

Configures a custom domain for this API Gateway HTTP API.

Type: HttpApiDomainConfiguration (p. 146)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`FailOnWarnings`

Specifies whether to roll back the HTTP API creation (`true`) or not (`false`) when a warning is encountered. The default value is `false`.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `FailOnWarnings` property of an `AWS::ApiGatewayV2::Api` resource.

`RouteSettings`

The route settings, per route, for this HTTP API. For more information, see Working with routes for HTTP APIs in the *API Gateway Developer Guide*.

Type: RouteSettings

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `RouteSettings` property of an `AWS::ApiGatewayV2::Stage` resource.

`StageName`

The name of the API stage. If no name is specified, AWS SAM uses the `$default` stage from API Gateway.

Type: String

Required: No

Default: $default

AWS CloudFormation compatibility: This property is passed directly to the `StageName` property of an `AWS::ApiGatewayV2::Stage` resource.

`StageVariables`

A map that defines the stage variables. Variable names can have alphanumeric and underscore characters. The values must match [A-Za-z0-9-._~:/?#&=,]+.

Type: Json

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `StageVariables` property of an `AWS::ApiGatewayV2::Stage` resource.

`Tags`

A map (string to string) that specifies the tags to add to this API Gateway stage. Keys can be 1 to 128 Unicode characters in length and cannot include the prefix `aws:`. You can use any of the following characters: the set of Unicode letters, digits, whitespace, _, ., /, =, +, and –. Values can be 1 to 256 Unicode characters in length.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Additional notes: The `Tags` property requires AWS SAM to modify your OpenAPI definition, so tags are added only if the `DefinitionBody` property is specified—no tags are added if the `DefinitionUri` property is specified. AWS SAM automatically adds an `httpapi:createdBy:SAM` tag. Tags are also added to the `AWS::ApiGatewayV2::Stage` resource and the `AWS::ApiGatewayV2::DomainName` resource (if `DomainName` is specified).

Return Values

Ref

When you pass the logical ID of this resource to the intrinsic `Ref` function, `Ref` returns the API ID of the underlying `AWS::ApiGatewayV2::Api` resource, for example, `a1bcdef2gh`.

For more information about using the `Ref` function, see `Ref` in the *AWS CloudFormation User Guide*.

Examples

Simple HttpApi

The following example shows the minimum needed to set up an HTTP API endpoint backed by an Lambda function. This example uses the default HTTP API that AWS SAM creates.

YAML

```
AWSTemplateFormatVersion: '2010-09-09'
Description: AWS SAM template with a simple API definition
Resources:
  ApiFunction:
    Type: AWS::Serverless::Function
    Properties:
      Events:
        ApiEvent:
          Type: HttpApi
      Handler: index.handler
      InlineCode: |
        def handler(event, context):
            return {'body': 'Hello World!', 'statusCode': 200}
      Runtime: python3.7
Transform: AWS::Serverless-2016-10-31
```

HttpApi with Auth

The following example shows how to set up authorization on HTTP API endpoints.

YAML

```
Properties:
  FailOnWarnings: true
  Auth:
    DefaultAuthorizer: OAuth2
    Authorizers:
      OAuth2:
        AuthorizationScopes:
          - scope4
        JwtConfiguration:
          issuer: "https://www.example.com/v1/connect/oauth2"
          audience:
            - MyApi
        IdentitySource: "$request.querystring.param"
      OpenIdAuth:
        AuthorizationScopes:
          - scope1
          - scope2
        OpenIdConnectUrl: "https://www.example.com/v1/connect/oidc/.well-known/openid-
configuration"
        JwtConfiguration:
          issuer: "https://www.example.com/v1/connect/oidc"
          audience:
            - MyApi
        IdentitySource: "$request.querystring.param"
```

HttpApi with OpenAPI definition

The following example shows how to add an OpenAPI definition to the template.

Note that AWS SAM fills in any missing Lambda integrations for HttpApi events that reference this HTTP API. AWS SAM also also adds any missing paths that HttpApi events reference.

YAML

```
Properties:
  FailOnWarnings: true
  DefinitionBody:
    info:
      version: '1.0'
      title:
        Ref: AWS::StackName
    paths:
      "/":
        get:
          security:
          - OpenIdAuth:
            - scope1
      - scope2
     responses: {}
  openapi: 3.0.1
  securitySchemes:
   OpenIdAuth:
    type: openIdConnect
    x-amazon-apigateway-authorizer:
     identitySource: "$request.querystring.param"
     type: jwt
     jwtConfiguration:
      audience:
      - MyApi
      issuer: https://www.example.com/v1/connect/oidc
     openIdConnectUrl: https://www.example.com/v1/connect/oidc/.well-known/openid-
configuration
```

HttpApi with configuration settings

The following example shows how to add HTTP API and stage configurations to the template.

YAML

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
Parameters:
 StageName:
  Type: String
  Default: Prod

Resources:
 HttpApiFunction:
  Type: AWS::Serverless::Function
  Properties:
   InlineCode: |
     def handler(event, context):
       import json
       return {
         "statusCode": 200,
         "body": json.dumps(event),
       }
   Handler: index.handler
   Runtime: python3.7
   Events:
    ExplicitApi: # warning: creates a public endpoint
     Type: HttpApi
     Properties:
      ApiId: !Ref HttpApi
      Method: GET
      Path: /path
      TimeoutInMillis: 15000
      PayloadFormatVersion: "2.0"
      RouteSettings:
       ThrottlingBurstLimit: 600

 HttpApi:
  Type: AWS::Serverless::HttpApi
  Properties:
   StageName: !Ref StageName
   Tags:
    Tag: Value
   AccessLogSettings:
    DestinationArn: !GetAtt AccessLogs.Arn
    Format: $context.requestId
   DefaultRouteSettings:
        ThrottlingBurstLimit: 200
      RouteSettings:
        "GET /path":
          ThrottlingBurstLimit: 500 # overridden in HttpApi Event
      StageVariables:
        StageVar: Value
      FailOnWarnings: true

  AccessLogs:
    Type: AWS::Logs::LogGroup

Outputs:
  HttpApiUrl:
    Description: URL of your API endpoint
    Value:
      Fn::Sub: 'https://${HttpApi}.execute-api.${AWS::Region}.${AWS::URLSuffix}/
${StageName}/'
  HttpApiId:
    Description: Api id of HttpApi
    Value:
      Ref: HttpApi
```

HttpApiAuth

Configure authorization to control access to your Amazon API Gateway HTTP API.

For more information about configuring access to HTTP APIs, see Controlling and managing access to an HTTP API in API Gateway in the *API Gateway Developer Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Authorizers: OAuth2Authorizer (p. 142) | LambdaAuthorizer (p. 138)
  DefaultAuthorizer: String
```

Properties

`Authorizers`

The authorizer used to control access to your API Gateway API.

Type: OAuth2Authorizer (p. 142) | LambdaAuthorizer (p. 138)

Required: No

Default: None

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Additional notes: AWS SAM adds the authorizers to the OpenAPI definition.

`DefaultAuthorizer`

Specify the default authorizer to use for authorizing API calls to your API Gateway API.

Type: String

Required: No

Default: None

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

OAuth 2.0 Authorizer

OAuth 2.0 authorizer example

YAML

```
Auth:
  Authorizers:
    OAuth2Authorizer:
      AuthorizationScopes:
        - scope1
        - scope2
      JwtConfiguration:
        issuer: "https://www.example.com/v1/connect/oauth2"
        audience:
          - MyApi
      IdentitySource: "$request.querystring.param"
  DefaultAuthorizer: OAuth2Authorizer
```

LambdaAuthorizer

Configure a Lambda authorizer to control access to your Amazon API Gateway HTTP API with an AWS Lambda function.

For more information and examples, see Working with AWS Lambda authorizers for HTTP APIs in the *API Gateway Developer Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  AuthorizerPayloadFormatVersion: String
  EnableSimpleResponses: Boolean
  FunctionArn: String
  FunctionInvokeRole: String
  Identity: LambdaAuthorizationIdentity (p. 140)
```

Properties

`AuthorizerPayloadFormatVersion`

Specifies the format of the payload sent to an HTTP API Lambda authorizer. Required for HTTP API Lambda authorizers.

This is passed through to the `authorizerPayloadFormatVersion` section of an `x-amazon-apigateway-authorizer` in the `securitySchemes` section of an OpenAPI definition.

Valid values: `1.0` or `2.0`

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`EnableSimpleResponses`

Specifies whether a Lambda authorizer returns a response in a simple format. By default, a Lambda authorizer must return an AWS Identity and Access Management (IAM) policy. If enabled, the Lambda authorizer can return a boolean value instead of an IAM policy.

This is passed through to the `enableSimpleResponses` section of an `x-amazon-apigateway-authorizer` in the `securitySchemes` section of an OpenAPI definition.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`FunctionArn`

The Amazon Resource Name (ARN) of the Lambda function that provides authorization for the API.

This is passed through to the `authorizerUri` section of an `x-amazon-apigateway-authorizer` in the `securitySchemes` section of an OpenAPI definition.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`FunctionInvokeRole`

The ARN of the IAM role that has the credentials required for API Gateway to invoke the authorizer function. Specify this parameter if your function's resource-based policy doesn't grant API Gateway `lambda:InvokeFunction` permission.

This is passed through to the `authorizerCredentials` section of an `x-amazon-apigateway-authorizer` in the `securitySchemes` section of an OpenAPI definition.

For more information, see Create a Lambda authorizer in the *API Gateway Developer Guide*.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Identity`

Specifies an `IdentitySource` in an incoming request for an authorizer.

This is passed through to the `identitySource` section of an `x-amazon-apigateway-authorizer` in the `securitySchemes` section of an OpenAPI definition.

Type: LambdaAuthorizationIdentity (p. 140)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

LambdaAuthorizer

LambdaAuthorizer example

YAML

```
Auth:
  Authorizers:
    MyLambdaAuthorizer:
      AuthorizerPayloadFormatVersion: 2.0
      FunctionArn:
        Fn::GetAtt:
          - MyAuthFunction
          - Arn
      FunctionInvokeRole:
        Fn::GetAtt:
          - LambdaAuthInvokeRole
          - Arn
      Identity:
        Headers:
          - Authorization
```

LambdaAuthorizationIdentity

Use property can be used to specify an IdentitySource in an incoming request for a Lambda authorizer. For more information about identity sources, see Identity sources in the *API Gateway Developer Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Context: List
  Headers: List
  QueryStrings: List
  ReauthorizeEvery: Integer
  StageVariables: List
```

Properties

`Context`

Converts the given context strings to a list of mapping expressions in the format `$context.contextString`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Headers`

Converts the headers to a list of mapping expressions in the format `$request.header.name`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`QueryStrings`

Converts the given query strings to a list of mapping expressions in the format `$request.querystring.queryString`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`ReauthorizeEvery`

The time-to-live (TTL) period, in seconds, that specifies how long API Gateway caches authorizer results. If you specify a value greater than 0, API Gateway caches the authorizer responses. The maximum value is 3600, or 1 hour.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`StageVariables`

Converts the given stage variables to a list of mapping expressions in the format `$stageVariables.stageVariable`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

LambdaRequestIdentity

Lambda request identity example

YAML

```
Identity:
  QueryStrings:
```

```
  - auth
Headers:
  - Authorization
StageVariables:
  - VARIABLE
Context:
  - authcontext
ReauthorizeEvery: 100
```

OAuth2Authorizer

Definition for an OAuth 2.0 authorizer, also known to as a JSON Web Token (JWT) authorizer.

For more information, see Controlling access to HTTP APIs with JWT authorizers in the *API Gateway Developer Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
AuthorizationScopes: List
IdentitySource: String
JwtConfiguration: Map
```

Properties

`AuthorizationScopes`

List of authorization scopes for this authorizer.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IdentitySource`

Identity source expression for this authorizer.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`JwtConfiguration`

JWT configuration for this authorizer.

This is passed through to the `jwtConfiguration` section of an `x-amazon-apigateway-authorizer` in the `securitySchemes` section of an OpenAPI definition.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

OAuth 2.0 authorizer

OAuth 2.0 authorizer Example

YAML

```
Auth:
  Authorizers:
    OAuth2Authorizer:
      AuthorizationScopes:
        - scope1
      JwtConfiguration:
        issuer: "https://www.example.com/v1/connect/oauth2"
        audience:
          - MyApi
      IdentitySource: "$request.querystring.param"
  DefaultAuthorizer: OAuth2Authorizer
```

HttpApiCorsConfiguration

Manage cross-origin resource sharing (CORS) for your HTTP APIs. Specify the domain to allow as a string or specify a dictionary with additional Cors configuration. NOTE: Cors requires SAM to modify your OpenAPI definition, so it only works with inline OpenApi defined in the `DefinitionBody` property.

For more information about CORS, see Configuring CORS for an HTTP API in the *API Gateway Developer Guide*.

Note: If HttpApiCorsConfiguration is set both in OpenAPI and at the property level, AWS SAM merges them with the properties taking precedence.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  AllowCredentials: Boolean
  AllowHeaders: List
  AllowMethods: List
  AllowOrigins: List
  ExposeHeaders: List
  MaxAge: Integer
```

Properties

`AllowCredentials`

Specifies whether credentials are included in the CORS request.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AllowHeaders`

Represents a collection of allowed headers.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AllowMethods`

Represents a collection of allowed HTTP methods.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AllowOrigins`

Represents a collection of allowed origins.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`ExposeHeaders`

Represents a collection of exposed headers.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`MaxAge`

The number of seconds that the browser should cache preflight request results.

Type: Integer

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

HttpApiCorsConfiguration

HTTP API Cors Configuration example.

YAML

```
CorsConfiguration:
  AllowOrigins:
    - "https://example.com"
  AllowHeaders:
    - x-apigateway-header
  AllowMethods:
    - GET
  MaxAge: 600
  AllowCredentials: true
```

HttpApiDefinition

An OpenAPI document defining the API.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Bucket: String
  Key: String
  Version: String
```

Properties

`Bucket`

The name of the Amazon S3 bucket where the OpenAPI file is stored.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `Bucket` property of the `AWS::ApiGatewayV2::Api BodyS3Location` data type.

`Key`

The Amazon S3 key of the OpenAPI file.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `Key` property of the `AWS::ApiGatewayV2::Api BodyS3Location` data type.

`Version`

For versioned objects, the version of the OpenAPI file.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Version` property of the `AWS::ApiGatewayV2::Api BodyS3Location` data type.

Examples

Definition Uri example

API Definition example

YAML

```
DefinitionUri:
  Bucket: mybucket-name
  Key: mykey-name
  Version: 121212
```

HttpApiDomainConfiguration

Configures a custom domain for an API.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  BasePath: List
  CertificateArn: String
  DomainName: String
  EndpointConfiguration: String
  MutualTlsAuthentication: MutualTlsAuthentication
  Route53: Route53Configuration (p. 148)
  SecurityPolicy: String
```

Properties

`BasePath`

A list of the basepaths to configure with the Amazon API Gateway domain name.

Type: List

Required: No

Default: /

AWS CloudFormation compatibility: This property is similar to the `ApiMappingKey` property of an `AWS::ApiGatewayV2::ApiMapping` resource. AWS SAM creates multiple `AWS::ApiGatewayV2::ApiMapping` resources, one per value specified in this property.

`CertificateArn`

The Amazon Resource Name (ARN) of an AWS managed certificate for this domain name's endpoint. AWS Certificate Manager is the only supported source.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `CertificateArn` property of an `AWS::ApiGateway2::DomainName DomainNameConfiguration` resource.

`DomainName`

The custom domain name for your API Gateway API. Uppercase letters are not supported.

AWS SAM generates an `AWS::ApiGatewayV2::DomainName` resource when this property is set. For information about this scenario, see DomainName property is specified (p. 185). For information about generated AWS CloudFormation resources, see Generated AWS CloudFormation resources (p. 177).

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `DomainName` property of an `AWS::ApiGateway2::DomainName` resource.

`EndpointConfiguration`

Defines the type of API Gateway endpoint to map to the custom domain. The value of this property determines how the `CertificateArn` property is mapped in AWS CloudFormation.

The only valid value for HTTP APIs is `REGIONAL`.

Type: String

Required: No

Default: `REGIONAL`

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`MutualTlsAuthentication`

The mutual transport layer security (TLS) authentication configuration for a custom domain name.

Type: MutualTlsAuthentication

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `MutualTlsAuthentication` property of an `AWS::ApiGatewayV2::DomainName` resource.

`Route53`

Defines an Amazon Route 53 configuration.

Type: Route53Configuration (p. 148)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`SecurityPolicy`

The TLS version of the security policy for this domain name.

The only valid value for HTTP APIs is `TLS_1_2`.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `SecurityPolicy` property of the `AWS::ApiGatewayV2::DomainName` `DomainNameConfiguration` data type.

Examples

DomainName

DomainName example

YAML

```
Domain:
  DomainName: www.example.com
  CertificateArn: arn-example
  EndpointConfiguration: REGIONAL
  Route53:
    HostedZoneId: Z1PA6795UKMFR9
  BasePath:
    - /foo
    - /bar
```

Route53Configuration

Configures the Route53 record sets for an API.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  DistributionDomainName: String
  EvaluateTargetHealth: Boolean
  HostedZoneId: String
  HostedZoneName: String
  IpV6: Boolean
```

Properties

`DistributionDomainName`

Configures a custom distribution of the API custom domain name.

Type: String

Required: No

Default: Use the API Gateway distribution.

AWS CloudFormation compatibility: This property is passed directly to the `DNSName` property of an `AWS::Route53::RecordSetGroup AliasTarget` resource.

Additional notes: The domain name of a CloudFront distribution.

`EvaluateTargetHealth`

When EvaluateTargetHealth is true, an alias record inherits the health of the referenced AWS resource, such as an Elastic Load Balancing load balancer or another record in the hosted zone.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `EvaluateTargetHealth` property of an `AWS::Route53::RecordSetGroup AliasTarget` resource.

Additional notes: You can't set EvaluateTargetHealth to true when the alias target is a CloudFront distribution.

`HostedZoneId`

The ID of the hosted zone that you want to create records in.

Specify either `HostedZoneName` or `HostedZoneId`, but not both. If you have multiple hosted zones with the same domain name, you must specify the hosted zone using `HostedZoneId`.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `HostedZoneId` property of an `AWS::Route53::RecordSetGroup RecordSet` resource.

`HostedZoneName`

The name of the hosted zone that you want to create records in.

Specify either `HostedZoneName` or `HostedZoneId`, but not both. If you have multiple hosted zones with the same domain name, you must specify the hosted zone using `HostedZoneId`.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `HostedZoneName` property of an `AWS::Route53::RecordSetGroup RecordSet` resource.

`IpV6`

When this property is set, AWS SAM creates a `AWS::Route53::RecordSet` resource and sets Type to `AAAA` for the provided HostedZone.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Route 53 Configuration Example

This example shows how to configure Route 53.

YAML

```
Domain:
  DomainName: www.example.com
  CertificateArn: arn-example
  EndpointConfiguration: EDGE
  Route53:
    HostedZoneId: Z1PA6795UKMFR9
    EvaluateTargetHealth: true
    DistributionDomainName: xyz
```

AWS::Serverless::LayerVersion

Creates a Lambda LayerVersion that contains library or runtime code needed by a Lambda Function.

The AWS::Serverless::LayerVersion (p. 150) resource also supports the `Metadata` resource attribute, so you can instruct AWS SAM to build layers included in your application. For more information about building layers, see Building layers (p. 209).

Important Note: Since the release of the UpdateReplacePolicy resource attribute in AWS CloudFormation, AWS::Lambda::LayerVersion (recommended) offers the same benefits as AWS::Serverless::LayerVersion (p. 150).

When a Serverless LayerVersion is transformed, SAM also transforms the logical id of the resource so that old LayerVersions are not automatically deleted by CloudFormation when the resource is updated.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Type: AWS::Serverless::LayerVersion
Properties:
  CompatibleArchitectures: List
  CompatibleRuntimes: List
  ContentUri: String | LayerContent (p. 152)
  Description: String
  LayerName: String
  LicenseInfo: String
  RetentionPolicy: String
```

Properties

`CompatibleArchitectures`

Specifies the supported instruction set architectures for the layer version.

For more information about this property, see Lambda instruction set architectures in the *AWS Lambda Developer Guide*.

Valid values: `x86_64`, `arm64`

Type: List

Required: No

Default: `x86_64`

AWS CloudFormation compatibility: This property is passed directly to the `CompatibleArchitectures` property of an `AWS::Lambda::LayerVersion` resource.

`CompatibleRuntimes`

List of runtimes compatible with this LayerVersion.

Type: List

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `CompatibleRuntimes` property of an `AWS::Lambda::LayerVersion` resource.

`ContentUri`

Amazon S3 Uri, path to local folder, or LayerContent object of the layer code.

If an Amazon S3 Uri or LayerContent object is provided, The Amazon S3 object referenced must be a valid ZIP archive that contains the contents of an Lambda layer.

If a path to a local folder is provided, for the content to be transformed properly the template must go through the workflow that includes sam build (p. 252) followed by either sam deploy (p. 258) or sam package (p. 274). By default, relative paths are resolved with respect to the AWS SAM template's location.

Type: String | LayerContent (p. 152)

Required: Yes

AWS CloudFormation compatibility: This property is similar to the `Content` property of an `AWS::Lambda::LayerVersion` resource. The nested Amazon S3 properties are named differently.

`Description`

Description of this layer.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Description` property of an `AWS::Lambda::LayerVersion` resource.

`LayerName`

The name or Amazon Resource Name (ARN) of the layer.

Type: String

Required: No

Default: Resource logical id

AWS CloudFormation compatibility: This property is similar to the `LayerName` property of an `AWS::Lambda::LayerVersion` resource. If you don't specify a name, the logical id of the resource will be used as the name.

`LicenseInfo`

Information about the license for this LayerVersion.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `LicenseInfo` property of an `AWS::Lambda::LayerVersion` resource.

`RetentionPolicy`

Specifies whether old versions of your LayerVersion are retained or deleted after an update.

Valid values: `Retain` or `Delete`

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Additional notes: When you specify `Retain`, AWS SAM adds a Resource attributes (p. 176) of `DeletionPolicy: Retain` to the transformed `AWS::Lambda::LayerVersion` resource.

Return Values

Ref

When the logical ID of this resource is provided to the `Ref` intrinsic function, it returns the resource ARN of the underlying Lambda LayerVersion.

For more information about using the `Ref` function, see `Ref` in the *AWS CloudFormation User Guide*.

Examples

LayerVersionExample

Example of a LayerVersion

YAML

```
Properties:
  LayerName: MyLayer
  Description: Layer description
  ContentUri: 's3://my-bucket/my-layer.zip'
  CompatibleRuntimes:
    - nodejs10.x
    - nodejs12.x
  LicenseInfo: 'Available under the MIT-0 license.'
  RetentionPolicy: Retain
```

LayerContent

A ZIP archive that contains the contents of an Lambda layer.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Bucket: String
  Key: String
  Version: String
```

Properties

`Bucket`

The Amazon S3 bucket of the layer archive.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `S3Bucket` property of the `AWS::Lambda::LayerVersion` `Content` data type.

`Key`

The Amazon S3 key of the layer archive.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `S3Key` property of the `AWS::Lambda::LayerVersion` `Content` data type.

`Version`

For versioned objects, the version of the layer archive object to use.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `S3ObjectVersion` property of the `AWS::Lambda::LayerVersion` `Content` data type.

Examples

LayerContent

Layer Content example

YAML

```
LayerContent:
  Bucket: mybucket-name
  Key: mykey-name
  Version: 121212
```

AWS::Serverless::SimpleTable

Creates a DynamoDB table with a single attribute primary key. It is useful when data only needs to be accessed via a primary key.

To use the more advanced functionality of DynamoDB, use an AWS::DynamoDB::Table resource instead.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Type: AWS::Serverless::SimpleTable
Properties:
  PrimaryKey: PrimaryKeyObject (p. 155)
  ProvisionedThroughput: ProvisionedThroughput
  SSESpecification: SSESpecification
  TableName: String
  Tags: Map
```

Properties

`PrimaryKey`

Attribute name and type to be used as the table's primary key. If not provided, the primary key will be a `String` with a value of `id`.

Note: The value of this property cannot be modified after this resource is created.

Type: PrimaryKeyObject (p. 155)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`ProvisionedThroughput`

Read and write throughput provisioning information.

If `ProvisionedThroughput` is not specified `BillingMode` will be specified as `PAY_PER_REQUEST`.

Type: ProvisionedThroughput

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `ProvisionedThroughput` property of an `AWS::DynamoDB::Table` resource.

`SSESpecification`

Specifies the settings to enable server-side encryption.

Type: SSESpecification

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `SSESpecification` property of an `AWS::DynamoDB::Table` resource.

`TableName`

Name for the DynamoDB Table.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `TableName` property of an `AWS::DynamoDB::Table` resource.

`Tags`

A map (string to string) that specifies the tags to be added to this SimpleTable. For details about valid keys and values for tags, see Resource tag in the *AWS CloudFormation User Guide*.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is similar to the `Tags` property of an `AWS::DynamoDB::Table` resource. The Tags property in SAM consists of Key:Value pairs; in CloudFormation it consists of a list of Tag objects.

Return Values

Ref

When the logical ID of this resource is provided to the Ref intrinsic function, it returns the resource name of the underlying DynamoDB table.

For more information about using the `Ref` function, see `Ref` in the *AWS CloudFormation User Guide*.

Examples

SimpleTableExample

Example of a SimpleTable

YAML

```
Properties:
  TableName: my-table
  Tags:
    Department: Engineering
    AppType: Serverless
```

PrimaryKeyObject

The object describing the properties of a primary key.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Name: String
  Type: String
```

Properties

`Name`

Attribute name of the primary key.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `AttributeName` property of the `AWS::DynamoDB::Table AttributeDefinition` data type.

Additional notes: This property is also passed to the AttributeName property of an `AWS::DynamoDB::Table KeySchema` data type.

`Type`

The data type for the primary key.

Valid values: `String`, `Number`, `Binary`

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `AttributeType` property of the `AWS::DynamoDB::Table AttributeDefinition` data type.

Examples

PrimaryKey

Primary key example.

YAML

```
Properties:
  PrimaryKey:
    Name: MyPrimaryKey
    Type: String
```

AWS::Serverless::StateMachine

Creates an AWS Step Functions state machine, which you can use to orchestrate AWS Lambda functions and other AWS resources to form complex and robust workflows.

For more information about Step Functions, see the AWS Step Functions Developer Guide.

Note: To manage AWS SAM templates that contain Step Functions state machines, you must use version 0.52.0 or later of the AWS SAM CLI. To check which version you have, run the command `sam --version`.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
Type: AWS::Serverless::StateMachine
Properties:
  Definition: Map
  DefinitionSubstitutions: Map
  DefinitionUri: String | S3Location
  Events: EventSource (p. 160)
  Logging: LoggingConfiguration
  Name: String
  PermissionsBoundary: String
  Policies: String | List | Map
  Role: String
  Tags: Map
  Tracing: TracingConfiguration
  Type: String
```

Properties

`Definition`

The state machine definition is an object, where the format of the object matches the format of your AWS SAM template file, for example, JSON or YAML. State machine definitions adhere to the Amazon States Language.

For an example of an inline state machine definition, see Examples (p. 160).

You must provide either a `Definition` or a `DefinitionUri`.

Type: Map

Required: Conditional

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`DefinitionSubstitutions`

A string-to-string map that specifies the mappings for placeholder variables in the state machine definition. This enables you to inject values obtained at runtime (for example, from intrinsic functions) into the state machine definition.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is similar to the `DefinitionSubstitutions` property of an `AWS::StepFunctions::StateMachine` resource. If any intrinsic functions are specified in an inline state machine definition, AWS SAM adds entries to this property to inject them into the state machine definition.

`DefinitionUri`

The Amazon Simple Storage Service (Amazon S3) URI or local file path of the state machine definition written in the Amazon States Language.

If you provide a local file path, the template must go through the workflow that includes the `sam deploy` or `sam package` command to correctly transform the definition. To do this, you must use version 0.52.0 or later of the AWS SAM CLI.

You must provide either a `Definition` or a `DefinitionUri`.

Type: String | S3Location

Required: Conditional

AWS CloudFormation compatibility: This property is passed directly to the `DefinitionS3Location` property of an `AWS::StepFunctions::StateMachine` resource.

`Events`

Specifies the events that trigger this state machine. Events consist of a type and a set of properties that depend on the type.

Type: EventSource (p. 160)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Logging`

Defines which execution history events are logged and where they are logged.

Type: LoggingConfiguration

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `LoggingConfiguration` property of an `AWS::StepFunctions::StateMachine` resource.

`Name`

The name of the state machine.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `StateMachineName` property of an `AWS::StepFunctions::StateMachine` resource.

`PermissionsBoundary`

The ARN of a permissions boundary to use for this state machine's execution role. This property only works if the role is generated for you.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `PermissionsBoundary` property of an `AWS::IAM::Role` resource.

`Policies`

One or more policies that this state machine's execution role needs.

This property accepts a single string or a list of strings. The property can be the name of AWS managed AWS Identity and Access Management (IAM) policies, AWS SAM policy templates, or one or more inline policy documents formatted as a map.

You provide either a `Role` or `Policies`.

If the `Role` property is set, this property is ignored.

Type: String | List | Map

Required: Conditional

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Role`

The ARN of an IAM role to use as this state machine's execution role.

You must provide either a `Role` or `Policies`.

Type: String

Required: Conditional

AWS CloudFormation compatibility: This property is passed directly to the `RoleArn` property of an `AWS::StepFunctions::StateMachine` resource.

`Tags`

A string-to-string map that specifies the tags added to the state machine and the corresponding execution role. For information about valid keys and values for tags, see the Tags property of an AWS::StepFunctions::StateMachine resource.

Type: Map

Required: No

AWS CloudFormation compatibility: This property is similar to the `Tags` property of an `AWS::StepFunctions::StateMachine` resource. AWS SAM automatically adds a `stateMachine:createdBy:SAM` tag to this resource, and to the default role that is generated for it.

`Tracing`

Selects whether or not AWS X-Ray is enabled for the state machine. For more information about using X-Ray with Step Functions, see AWS X-Ray and Step Functions in the *AWS Step Functions Developer Guide*.

Type: TracingConfiguration

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `TracingConfiguration` property of an `AWS::StepFunctions::StateMachine` resource.

`Type`

The type of the state machine.

Valid values: `STANDARD` or `EXPRESS`

Type: String

Required: No

Default: `STANDARD`

AWS CloudFormation compatibility: This property is passed directly to the `StateMachineType` property of an `AWS::StepFunctions::StateMachine` resource.

Return Values

Ref

When you provide the logical ID of this resource to the Ref intrinsic function, Ref returns the Amazon Resource Name (ARN) of the underlying `AWS::StepFunctions::StateMachine` resource.

For more information about using the `Ref` function, see `Ref` in the *AWS CloudFormation User Guide*.

Fn::GetAtt

`Fn::GetAtt` returns a value for a specified attribute of this type. The following are the available attributes and sample return values.

For more information about using `Fn::GetAtt`, see `Fn::GetAtt` in the *AWS CloudFormation User Guide*.

`Name`

Returns the name of the state machine, such as `HelloWorld-StateMachine`.

Examples

State Machine Definition File

The following is an example of a state machine defined with a definition file. The `my_state_machine.asl.json` file must be written in the Amazon States Language.

In this example, the `DefinitionSubstitution` entries allow the state machine to include resources that are declared in the AWS SAM template file.

YAML

```
MySampleStateMachine:
  Type: AWS::Serverless::StateMachine
  Properties:
    DefinitionUri: statemachine/my_state_machine.asl.json
    Role: arn:aws:iam::123456123456:role/service-role/my-sample-role
    Tracing:
      Enabled: true
    DefinitionSubstitutions:
      MyFunctionArn: !GetAtt MyFunction.Arn
      MyDDBTable: !Ref TransactionTable
```

Inline State Machine Definition

The following is an example of an inline state machine definition.

In this example, the AWS SAM template file is written in YAML, so the state machine definition is also in YAML. To declare an inline state machine definition in JSON, write your AWS SAM template file in JSON.

YAML

```
MySampleStateMachine:
  Type: AWS::Serverless::StateMachine
  Properties:
    Definition:
      StartAt: MyLambdaState
      States:
        MyLambdaState:
          Type: Task
          Resource: arn:aws:lambda:us-east-1:123456123456:function:my-sample-lambda-app
          End: true
    Role: arn:aws:iam::123456123456:role/service-role/my-sample-role
    Tracing:
      Enabled: true
```

EventSource

The object describing the source of events which trigger the state machine. Each event consists of a type and a set of properties that depend on that type. For more information about the properties of each event source, see the subtopic corresponding to that type.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Properties: Schedule (p. 172) | CloudWatchEvent (p. 167) | EventBridgeRule (p. 169)
 | Api (p. 161)
  Type: String
```

Properties

`Properties`

An object describing the properties of this event mapping. The set of properties must conform to the defined `Type`.

Type: Schedule (p. 172) | CloudWatchEvent (p. 167) | EventBridgeRule (p. 169) | Api (p. 161)

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Type`

The event type.

Valid values: `Api`, `Schedule`, `CloudWatchEvent`, `EventBridgeRule`

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

API

The following is an example of an event of the `API` type.

YAML

```
ApiEvent:
  Type: Api
  Properties:
    Method: get
    Path: /group/{user}
    RestApiId:
      Ref: MyApi
```

Api

The object describing an `Api` event source type. If an AWS::Serverless::Api (p. 33) resource is defined, the path and method values must correspond to an operation in the OpenAPI definition of the API.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Auth: ApiStateMachineAuth (p. 163)
  Method: String
  Path: String
  RestApiId: String
```

Properties

`Auth`

The authorization configuration for this API, path, and method.

Use this property to override the API's `DefaultAuthorizer` setting for an individual path, when no `DefaultAuthorizer` is specified, or to override the default `ApiKeyRequired` setting.

Type: ApiStateMachineAuth (p. 163)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Method`

The HTTP method for which this function is invoked.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Path`

The URI path for which this function is invoked. The value must start with `/`.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`RestApiId`

The identifier of a `RestApi` resource, which must contain an operation with the given path and method. Typically, this is set to reference an AWS::Serverless::Api (p. 33) resource that is defined in this template.

If you don't define this property, AWS SAM creates a default AWS::Serverless::Api (p. 33) resource using a generated `OpenApi` document. That resource contains a union of all paths and methods defined by `Api` events in the same template that do not specify a `RestApiId`.

This property can't reference an AWS::Serverless::Api (p. 33) resource that is defined in another template.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

ApiEvent

The following is an example of an event of the `Api` type.

YAML

```
Events:
  ApiEvent:
    Type: Api
    Properties:
      Path: /path
      Method: get
      RequestParameters:
        - method.request.header.Authorization
```

ApiStateMachineAuth

Configures authorization at the event level, for a specific API, path, and method.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  ApiKeyRequired: Boolean
  AuthorizationScopes: List
  Authorizer: String
  ResourcePolicy: ResourcePolicyStatement (p. 164)
```

Properties

`ApiKeyRequired`

Requires an API key for this API, path, and method.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AuthorizationScopes`

The authorization scopes to apply to this API, path, and method.

The scopes that you specify will override any scopes applied by the `DefaultAuthorizer` property if you have specified it.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Authorizer`

The `Authorizer` for a specific state machine.

If you have specified a global authorizer for the API and want to make this state machine public, override the global authorizer by setting `Authorizer` to `NONE`.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`ResourcePolicy`

Configure the resource policy for this API and path.

Type: ResourcePolicyStatement (p. 164)

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

StateMachine-Auth

The following example specifies authorization at the state machine level.

YAML

```
Auth:
  ApiKeyRequired: true
  Authorizer: NONE
```

ResourcePolicyStatement

Configures a resource policy for all methods and paths of an API. For more information about resource policies, see Controlling access to an API with API Gateway resource policies in the *API Gateway Developer Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  AwsAccountBlacklist: List
  AwsAccountWhitelist: List
  CustomStatements: List
  IntrinsicVpcBlacklist: List
  IntrinsicVpcWhitelist: List
  IntrinsicVpceBlacklist: List
  IntrinsicVpceWhitelist: List
  IpRangeBlacklist: List
  IpRangeWhitelist: List
  SourceVpcBlacklist: List
  SourceVpcWhitelist: List
```

Properties

`AwsAccountBlacklist`

The AWS accounts to block.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`AwsAccountWhitelist`

The AWS accounts to allow. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`CustomStatements`

A list of custom resource policy statements to apply to this API. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpcBlacklist`

The list of virtual private clouds (VPCs) to block, where each VPC is specified as a reference such as a dynamic reference or the `Ref` intrinsic function. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpcWhitelist`

The list of VPCs to allow, where each VPC is specified as a reference such as a dynamic reference or the `Ref` intrinsic function.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpceBlacklist`

The list of VPC endpoints to block, where each VPC endpoint is specified as a reference such as a dynamic reference or the `Ref` intrinsic function.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IntrinsicVpceWhitelist`

The list of VPC endpoints to allow, where each VPC endpoint is specified as a reference such as a dynamic reference or the `Ref` intrinsic function. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IpRangeBlacklist`

The IP addresses or address ranges to block. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`IpRangeWhitelist`

The IP addresses or address ranges to allow.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`SourceVpcBlacklist`

The source VPC or VPC endpoints to block. Source VPC names must start with `"vpc-"` and source VPC endpoint names must start with `"vpce-"`. For an example use of this property, see the Examples section at the bottom of this page.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`SourceVpcWhitelist`

The source VPC or VPC endpoints to allow. Source VPC names must start with `"vpc-"` and source VPC endpoint names must start with `"vpce-"`.

Type: List

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

Resource Policy Example

The following example blocks two IP addresses and a source VPC, and allows an AWS account.

YAML

```
Auth:
  ResourcePolicy:
    CustomStatements: [{
                         "Effect": "Allow",
                         "Principal": "*",
                         "Action": "execute-api:Invoke",
                         "Resource": "execute-api:/Prod/GET/pets",
                         "Condition": {
                           "IpAddress": {
                             "aws:SourceIp": "1.2.3.4"
                           }
                         }
                       }]
    IpRangeBlacklist:
      - "10.20.30.40"
      - "1.2.3.4"
    SourceVpcBlacklist:
      - "vpce-1a2b3c4d"
    AwsAccountWhitelist:
      - "111122223333"
    IntrinsicVpcBlacklist:
      - "{{resolve:ssm:SomeVPCReference:1}}"
      - !Ref MyVPC
    IntrinsicVpceWhitelist:
      - "{{resolve:ssm:SomeVPCEReference:1}}"
      - !Ref MyVPCE
```

CloudWatchEvent

The object describing a `CloudWatchEvent` event source type.

AWS Serverless Application Model (AWS SAM) generates an AWS::Events::Rule resource when this event type is set.

Important Note: EventBridgeRule (p. 169) is the preferred event source type to use, instead of `CloudWatchEvent`. `EventBridgeRule` and `CloudWatchEvent` use the same underlying service, API, and AWS CloudFormation resources. However, AWS SAM will add support for new features only to `EventBridgeRule`.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```yaml
EventBusName: String
Input: String
InputPath: String
Pattern: EventPattern
```

Properties

`EventBusName`

The event bus to associate with this rule. If you omit this property, AWS SAM uses the default event bus.

Type: String

Required: No

Default: Default event bus

AWS CloudFormation compatibility: This property is passed directly to the `EventBusName` property of an `AWS::Events::Rule` resource.

`Input`

Valid JSON text passed to the target. If you use this property, nothing from the event text itself is passed to the target.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Input` property of an `AWS::Events::Rule Target` resource.

`InputPath`

When you don't want to pass the entire matched event to the target, use the `InputPath` property to describe which part of the event to pass.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `InputPath` property of an `AWS::Events::Rule Target` resource.

`Pattern`

Describes which events are routed to the specified target. For more information, see Events and Event Patterns in EventBridge in the *Amazon EventBridge User Guide*.

Type: EventPattern

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `EventPattern` property of an `AWS::Events::Rule` resource.

Examples

CloudWatchEvent

The following is an example of a `CloudWatchEvent` event source type.

YAML

```
CWEvent:
  Type: CloudWatchEvent
  Properties:
    Input: '{"Key": "Value"}'
    Pattern:
      detail:
        state:
          - terminated
```

EventBridgeRule

The object describing an `EventBridgeRule` event source type, which sets your state machine as the target for an Amazon EventBridge rule. For more information, see What Is Amazon EventBridge? in the *Amazon EventBridge User Guide*.

AWS SAM generates an AWS::Events::Rule resource when this event type is set.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  DeadLetterConfig: DeadLetterConfig (p. 171)
  EventBusName: String
  Input: String
  InputPath: String
  Pattern: EventPattern
  RetryPolicy: RetryPolicy
```

Properties

`DeadLetterConfig`

Configure the Amazon Simple Queue Service (Amazon SQS) queue where EventBridge sends events after a failed target invocation. Invocation can fail, for example, when sending an event to a Lambda function that doesn't exist, or when EventBridge has insufficient permissions to invoke the Lambda function. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Type: DeadLetterConfig (p. 171)

Required: No

AWS CloudFormation compatibility: This property is similar to the `DeadLetterConfig` property of the `AWS::Events::Rule` `Target` data type. The AWS SAM version of this property includes additional subproperties, in case you want AWS SAM to create the dead-letter queue for you.

`EventBusName`

The event bus to associate with this rule. If you omit this property, AWS SAM uses the default event bus.

Type: String

Required: No

Default: Default event bus

AWS CloudFormation compatibility: This property is passed directly to the `EventBusName` property of an `AWS::Events::Rule` resource.

`Input`

Valid JSON text passed to the target. If you use this property, nothing from the event text itself is passed to the target.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Input` property of an `AWS::Events::Rule Target` resource.

`InputPath`

When you don't want to pass the entire matched event to the target, use the `InputPath` property to describe which part of the event to pass.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `InputPath` property of an `AWS::Events::Rule Target` resource.

`Pattern`

Describes which events are routed to the specified target. For more information, see Events and Event Patterns in EventBridge in the *Amazon EventBridge User Guide*.

Type: EventPattern

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `EventPattern` property of an `AWS::Events::Rule` resource.

`RetryPolicy`

A `RetryPolicy` object that includes information about the retry policy settings. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Type: RetryPolicy

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `RetryPolicy` property of the `AWS::Events::Rule Target` data type.

Examples

EventBridgeRule

The following is an example of an `EventBridgeRule` event source type.

YAML

```
EBRule:
  Type: EventBridgeRule
  Properties:
    Input: '{"Key": "Value"}'
    Pattern:
      detail:
        state:
          - terminated
```

DeadLetterConfig

The object used to specify the Amazon Simple Queue Service (Amazon SQS) queue where EventBridge sends events after a failed target invocation. Invocation can fail, for example, when sending an event to a state machine that doesn't exist, or insufficient permissions to invoke the state machine. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Arn: String
  QueueLogicalId: String
  Type: String
```

Properties

`Arn`

The Amazon Resource Name (ARN) of the Amazon SQS queue specified as the target for the dead-letter queue.

Note: Specify either the `Type` property or `Arn` property, but not both.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Arn` property of the `AWS::Events::Rule DeadLetterConfig` data type.

`QueueLogicalId`

The custom name of the dead letter queue that AWS SAM creates if `Type` is specified.

Note: If the `Type` property is not set, this property is ignored.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Type`

The type of the queue. When this property is set, AWS SAM automatically creates a dead-letter queue and attaches necessary resource-based policy to grant permission to rule resource to send events to the queue.

Note: Specify either the `Type` property or `Arn` property, but not both.

Valid values: `SQS`

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

DeadLetterConfig

DeadLetterConfig

YAML

```
DeadLetterConfig:
  Type: SQS
  QueueLogicalId: MyDLQ
```

Schedule

The object describing a `Schedule` event source type, which sets your state machine as the target of an EventBridge rule that triggers on a schedule. For more information, see What Is Amazon EventBridge? in the *Amazon EventBridge User Guide*.

AWS Serverless Application Model (AWS SAM) generates an AWS::Events::Rule resource when this event type is set.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  DeadLetterConfig: DeadLetterConfig (p. 174)
  Description: String
  Enabled: Boolean
  Input: String
  Name: String
  RetryPolicy: RetryPolicy
  Schedule: String
```

Properties

`DeadLetterConfig`

Configure the Amazon Simple Queue Service (Amazon SQS) queue where EventBridge sends events after a failed target invocation. Invocation can fail, for example, when sending an event to a Lambda function that doesn't exist, or when EventBridge has insufficient permissions to invoke the Lambda function. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Type: DeadLetterConfig (p. 174)

Required: No

AWS CloudFormation compatibility: This property is similar to the `DeadLetterConfig` property of the `AWS::Events::Rule` `Target` data type. The AWS SAM version of this property includes additional subproperties, in case you want AWS SAM to create the dead-letter queue for you.

`Description`

A description of the rule.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Description` property of an `AWS::Events::Rule` resource.

`Enabled`

Indicates whether the rule is enabled.

To disable the rule, set this property to `false`.

Type: Boolean

Required: No

AWS CloudFormation compatibility: This property is similar to the `State` property of an `AWS::Events::Rule` resource. If this property is set to `true` then AWS SAM passes `ENABLED`, otherwise it passes `DISABLED`.

`Input`

Valid JSON text passed to the target. If you use this property, nothing from the event text itself is passed to the target.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Target` property of an `AWS::Events::Rule Target` resource.

`Name`

The name of the rule. If you don't specify a name, AWS CloudFormation generates a unique physical ID and uses that ID for the rule name.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Name` property of an `AWS::Events::Rule` resource.

`RetryPolicy`

A `RetryPolicy` object that includes information about the retry policy settings. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Type: RetryPolicy

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `RetryPolicy` property of the `AWS::Events::Rule` `Target` data type.

`Schedule`

The scheduling expression that determines when and how often the rule runs. For more information, see Schedule Expressions for Rules.

Type: String

Required: Yes

AWS CloudFormation compatibility: This property is passed directly to the `ScheduleExpression` property of an `AWS::Events::Rule` resource.

Examples

CloudWatch Schedule Event

CloudWatch Schedule Event Example

YAML

```
CWSchedule:
  Type: Schedule
  Properties:
    Schedule: 'rate(1 minute)'
    Name: TestSchedule
    Description: test schedule
    Enabled: false
```

DeadLetterConfig

The object used to specify the Amazon Simple Queue Service (Amazon SQS) queue where EventBridge sends events after a failed target invocation. Invocation can fail, for example, when sending an event to a state machine that doesn’t exist, or insufficient permissions to invoke the state machine. For more information, see Event retry policy and using dead-letter queues in the *Amazon EventBridge User Guide*.

Syntax

To declare this entity in your AWS Serverless Application Model (AWS SAM) template, use the following syntax.

YAML

```
  Arn: String
  QueueLogicalId: String
  Type: String
```

Properties

`Arn`

The Amazon Resource Name (ARN) of the Amazon SQS queue specified as the target for the dead-letter queue.

Note: Specify either the `Type` property or `Arn` property, but not both.

Type: String

Required: No

AWS CloudFormation compatibility: This property is passed directly to the `Arn` property of the `AWS::Events::Rule` `DeadLetterConfig` data type.

`QueueLogicalId`

The custom name of the dead letter queue that AWS SAM creates if `Type` is specified.

Note: If the `Type` property is not set, this property is ignored.

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

`Type`

The type of the queue. When this property is set, AWS SAM automatically creates a dead-letter queue and attaches necessary resource-based policy to grant permission to rule resource to send events to the queue.

Note: Specify either the `Type` property or `Arn` property, but not both.

Valid values: `SQS`

Type: String

Required: No

AWS CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an AWS CloudFormation equivalent.

Examples

DeadLetterConfig

DeadLetterConfig

YAML

```
DeadLetterConfig:
  Type: SQS
  QueueLogicalId: MyDLQ
```

For reference information for all the AWS resource and property types that are supported by AWS CloudFormation and AWS SAM, see AWS Resource and Property Types Reference in the *AWS CloudFormation User Guide*.

Resource attributes

Resource attributes are attributes that you can add to AWS SAM and AWS CloudFormation resources to control additional behaviors and relationships. For more information about resource attributes, see Resource Attribute Reference in the *AWS CloudFormation User Guide*.

AWS SAM support a subset of resource attributes that are defined by AWS CloudFormation. Of the supported resource attributes, some are copied to only the base generated AWS CloudFormation resource of the corresponding AWS SAM resource, and some are copied to all generated AWS CloudFormation resources resulting from the corresponding AWS SAM resource. For more information about AWS CloudFormation resources generated from corresponding AWS SAM resources, see Generated AWS CloudFormation resources (p. 177).

The following table summarizes resource attribute support by AWS SAM, subject to the Exceptions (p. 176) listed below.

Resource attributes	Destination generated resource(s)
DependsOn **Metadata** [1, 2]	Base AWS CloudFormation generated resource only. For information about the mapping between AWS SAM resources and base AWS CloudFormation resources, see Generated AWS CloudFormation resource scenarios (p. 178).
Condition **DeletionPolicy** **UpdateReplacePolicy**	All generated AWS CloudFormation resources from the corresponding AWS SAM resource. For information about scenarios for generated AWS CloudFormation resources, see Generated AWS CloudFormation resource scenarios (p. 178).

Notes:

1. For more information about using the `Metadata` resource attribute with the `AWS::Serverless::Function` resource type, see Building custom runtimes (p. 211).
2. For more information about using the `Metadata` resource attribute with the `AWS::Serverless::LayerVersion` resource type, see Building layers (p. 209).

Exceptions

There are a number of exceptions to the resource attribute rules described previously:

- For `AWS::Lambda::LayerVersion`, the AWS SAM-only custom field `RetentionPolicy` sets the `DeletionPolicy` for the generated AWS CloudFormation resources. This has a higher precedence than `DeletionPolicy` itself. If neither is set, then by default `DeletionPolicy` is set to `Retain`.
- For `AWS::Lambda::Version`, if `DeletionPolicy` is not specified, the default is `Retain`.
- For the scenario where `DeploymentPreferences` is specified for a serverless function, resource attributes are not copied to the following generated AWS CloudFormation resources:
  - `AWS::CodeDeploy::Application`
  - `AWS::CodeDeploy::DeploymentGroup`
  - The `AWS::IAM::Role` named `CodeDeployServiceRole` that is created for this scenario
- If your AWS SAM template contains multiple functions with API event sources that are implicitly created, then the functions will share the generated `AWS::ApiGateway::RestApi` resource. In this scenario, if the functions have different resource attributes, then for the generated

AWS::ApiGateway::RestApi resource, AWS SAM copies the resource attributes according to the following prioritized lists:

- UpdateReplacePolicy:
  1. Retain
  2. Snapshot
  3. Delete
- DeletionPolicy:
  1. Retain
  2. Delete

Intrinsic functions

Intrinsic functions are built-in functions that enable you to assign values to properties that are only available at runtime. For more information about intrinsic functions, see Intrinsic Function Reference in the *AWS CloudFormation User Guide*.

Generated AWS CloudFormation resources

When AWS Serverless Application Model (AWS SAM) processes your AWS SAM template file, it generates one or more AWS CloudFormation resources. The set of AWS CloudFormation resources that AWS SAM generates differs depending on the scenarios that you specify. A *scenario* is the combination of AWS SAM resources and properties specified in your template file. You can reference the generated AWS CloudFormation resources elsewhere within your template file, similar to how you reference resources that you declare explicitly in your template file.

For example, if you specify an AWS::Serverless::Function resource in your AWS SAM template file, AWS SAM always generates an AWS::Lambda::Function base resource. If you also specify the optional AutoPublishAlias property, AWS SAM additionally generates AWS::Lambda::Alias and AWS::Lambda::Version resources.

This section lists the scenarios and the AWS CloudFormation resources that they generate, and shows how to reference the generated AWS CloudFormation resources in your AWS SAM template file.

Referencing generated AWS CloudFormation resources

You have two options for referencing generated AWS CloudFormation resources within your AWS SAM template file, by LogicalId or by referenceable property.

Referencing generated AWS CloudFormation resources by LogicalId

The AWS CloudFormation resources that AWS SAM generates each have a LogicalId, which is an alphanumeric (A-Z, a-z, 0-9) identifier that is unique within a template file. AWS SAM uses the LogicalIds of the AWS SAM resources in your template file to construct the LogicalIds of the AWS CloudFormation resources it generates. You can use the LogicalId of a generated AWS CloudFormation resource to access properties of that resource within your template file, just like you would for an AWS CloudFormation resource that you have explicitly declared. For more information about LogicalIds in AWS CloudFormation and AWS SAM templates, see Resources in the *AWS CloudFormation User Guide*.

> **Note**
>
> The `LogicalIds` of some generated resources include a unique hash value to avoid namespace clashes. The `LogicalIds` of these resources are derived when the stack is created. You can retrieve them only after the stack has been created using the AWS Management Console, AWS CLI, or one of the AWS SDKs. We don't recommend referencing these resources by `LogicalId` because the hash values might change.

Referencing generated AWS CloudFormation resources by referenceable property

For some generated resources, AWS SAM provides a referenceable property of the AWS SAM resource. You can use this property to reference a generated AWS CloudFormation resource and its properties within your AWS SAM template file.

> **Note**
>
> Not all generated AWS CloudFormation resources have referenceable properties. For those resources, you must use the `LogicalId`.

Generated AWS CloudFormation resource scenarios

The following table summarizes the AWS SAM resources and properties that make up the scenarios that generate AWS CloudFormation resources. The topics in the **Scenarios** column provide details about the additional AWS CloudFormation resources that AWS SAM generates for that scenario.

AWS SAM resource	Base AWS CloudFormation resource	Scenarios
`AWS::Serverless::Api` (p. 179)	`AWS::ApiGateway::RestApi`	• DomainName property is specified (p. 180) • UsagePlan property is specified (p. 180)
`AWS::Serverless::Application` (p. 180)	`AWS::CloudFormation::Stack`	• Other than generating the base AWS CloudFormation resource, there are no additional scenarios for this serverless resource.
`AWS::Serverless::Function` (p. 181)	`AWS::Lambda::Function`	• AutoPublishAlias property is specified (p. 181) • Role property is not specified (p. 182) • DeploymentPreference property is specified (p. 182) • An Api event source is specified (p. 182) • An HttpApi event source is specified (p. 183) • A streaming event source is specified (p. 183) • An event bridge (or event bus) event source is specified (p. 183) • An IotRule event source is specified (p. 183) • OnSuccess (or OnFailure) property is specified for Amazon SNS events (p. 184) • OnSuccess (or OnFailure) property is specified for Amazon SQS events (p. 184)
`AWS::Serverless::HttpApi` (p. 184)	`AWS::ApiGatewayV2::Api`	• StageName property is specified (p. 185) • StageName property is *not* specified (p. 185) • DomainName property is specified (p. 185)

AWS SAM resource	Base AWS CloudFormation resource	Scenarios
AWS::Serverless::LayerVersion (p. 186)	AWS::Lambda::LayerVersion	• Other than generating the base AWS CloudFormation resource, there are no additional scenarios for this serverless resource.
AWS::Serverless::SimpleTable (p. 186)	AWS::DynamoDB::Table	• Other than generating the base AWS CloudFormation resource, there are no additional scenarios for this serverless resource.
AWS::Serverless::StateMachine (p. 186)	AWS::StepFunctions::StateMachine	• Role property is not specified (p. 186) • An Api event source is specified (p. 187) • An event bridge (or event bus) event source is specified (p. 187)

Topics

- AWS CloudFormation resources generated when AWS::Serverless::Api is specified (p. 179)
- AWS CloudFormation resources generated when AWS::Serverless::Application is specified (p. 180)
- AWS CloudFormation resources generated when AWS::Serverless::Function is specified (p. 181)
- AWS CloudFormation resources generated when AWS::Serverless::HttpApi is specified (p. 184)
- AWS CloudFormation resources generated when AWS::Serverless::LayerVersion is specified (p. 186)
- AWS CloudFormation resources generated when AWS::Serverless::SimpleTable is specified (p. 186)
- AWS CloudFormation resources generated when AWS::Serverless::StateMachine is specified (p. 186)

AWS CloudFormation resources generated when AWS::Serverless::Api is specified

When an `AWS::Serverless::Api` is specified, AWS Serverless Application Model (AWS SAM) always generates an `AWS::ApiGateway::RestApi` base AWS CloudFormation resource. In addition, it also always generates an `AWS::ApiGateway::Stage` and an `AWS::ApiGateway::Deployment` resource.

`AWS::ApiGateway::RestApi`

`LogicalId`: *`<api#LogicalId>`*

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

`AWS::ApiGateway::Stage`

`LogicalId`: *`<api#LogicalId><stage#name>`*`Stage`

`<stage#name>` is the string that the `StageName` property is set to. For example, if you set `StageName` to `Gamma`, the `LogicalId` is *`MyRestApiGamma`*`Stage`.

Referenceable property: *`<api#LogicalId>`*`.Stage`

`AWS::ApiGateway::Deployment`

`LogicalId`: *`<api#LogicalId>`*`Deployment`*`<sha>`*

<sha> is a unique hash value that is generated when the stack is created. For example, *MyRestApi*Deployment*926eeb5ff1*.

Referenceable property: *<api#LogicalId>*.Deployment

In addition to these AWS CloudFormation resources, when AWS::Serverless::Api is specified, AWS SAM generates additional AWS CloudFormation resources for the following scenarios.

Scenarios

- DomainName property is specified (p. 180)
- UsagePlan property is specified (p. 180)

DomainName property is specified

When the DomainName property of the Domain property of an AWS::Serverless::Api is specified, AWS SAM generates the AWS::ApiGateway::DomainName AWS CloudFormation resource.

AWS::ApiGateway::DomainName

LogicalId: ApiGatewayDomainName*<sha>*

<sha> is a unique hash value that is generated when the stack is created. For example: ApiGatewayDomainName*926eeb5ff1*.

Referenceable property: *<api#LogicalId>*.DomainName

UsagePlan property is specified

When the UsagePlan property of the Auth property of an AWS::Serverless::Api is specified, AWS SAM generates the following AWS CloudFormation resources: AWS::ApiGateway::UsagePlan, AWS::ApiGateway::UsagePlanKey, and AWS::ApiGateway::ApiKey.

AWS::ApiGateway::UsagePlan

LogicalId: *<api#LogicalId>*UsagePlan

Referenceable property: *<api#LogicalId>*.UsagePlan

AWS::ApiGateway::UsagePlanKey

LogicalId: *<api#LogicalId>*UsagePlanKey

Referenceable property: *<api#LogicalId>*.UsagePlanKey

AWS::ApiGateway::ApiKey

LogicalId: *<api#LogicalId>*ApiKey

Referenceable property: *<api#LogicalId>*.ApiKey

AWS CloudFormation resources generated when AWS::Serverless::Application is specified

When an AWS::Serverless::Application is specified, AWS Serverless Application Model (AWS SAM) generates an AWS::CloudFormation::Stack base AWS CloudFormation resource.

AWS::CloudFormation::Stack

> *LogicalId*: *<application#LogicalId>*
>
> *Referenceable property:* N/A (you must use the LogicalId to reference this AWS CloudFormation resource)

AWS CloudFormation resources generated when AWS::Serverless::Function is specified

When an AWS::Serverless::Function is specified, AWS Serverless Application Model (AWS SAM) always creates an AWS::Lambda::Function base AWS CloudFormation resource.

AWS::Lambda::Function

> *LogicalId*: *<function#LogicalId>*
>
> *Referenceable property:* N/A (you must use the LogicalId to reference this AWS CloudFormation resource)

In addition to this AWS CloudFormation resource, when AWS::Serverless::Function is specified, AWS SAM also generates AWS CloudFormation resources for the following scenarios.

Scenarios

- AutoPublishAlias property is specified (p. 181)
- Role property is not specified (p. 182)
- DeploymentPreference property is specified (p. 182)
- An Api event source is specified (p. 182)
- An HttpApi event source is specified (p. 183)
- A streaming event source is specified (p. 183)
- An event bridge (or event bus) event source is specified (p. 183)
- An IotRule event source is specified (p. 183)
- OnSuccess (or OnFailure) property is specified for Amazon SNS events (p. 184)
- OnSuccess (or OnFailure) property is specified for Amazon SQS events (p. 184)

AutoPublishAlias property is specified

When the AutoPublishAlias property of an AWS::Serverless::Function is specified, AWS SAM generates the following AWS CloudFormation resources: AWS::Lambda::Alias and AWS::Lambda::Version.

AWS::Lambda::Alias

> *LogicalId*: *<function#LogicalId>*Alias*<alias#name>*
>
> *<alias#name>* is the string that AutoPublishAlias is set to. For example, if you set AutoPublishAlias to live, the LogicalId is: *MyFunction*Alias*live*.
>
> *Referenceable property:* *<function#LogicalId>*.Alias

AWS::Lambda::Version

> *LogicalId*: *<function#LogicalId>*Version*<sha>*

<sha> is a unique hash value that is generated when the stack is created. For example, *MyFunction*Version*926eeb5ff1*.

Referenceable property: *<function#LogicalId>*`.Version`

Role property is not specified

When the `Role` property of an `AWS::Serverless::Function` is *not* specified, AWS SAM generates an `AWS::IAM::Role` AWS CloudFormation resource.

`AWS::IAM::Role`

`LogicalId`: *<function#LogicalId>*`Role`

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

DeploymentPreference property is specified

When the `DeploymentPreference` property of an `AWS::Serverless::Function` is specified, AWS SAM generates the following resources AWS CloudFormation resources: `AWS::CodeDeploy::Application` and `AWS::CodeDeploy::DeploymentGroup`. In addition, if the `Role` property of the `DeploymentPreference` object is *not* specified, AWS SAM also generates an `AWS::IAM::Role` AWS CloudFormation resource.

`AWS::CodeDeploy::Application`

`LogicalId`: `ServerlessDeploymentApplication`

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

`AWS::CodeDeploy::DeploymentGroup`

`LogicalId`: *<function#LogicalId>*`DeploymentGroup`

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

`AWS::IAM::Role`

`LogicalId`: `CodeDeployServiceRole`

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

An Api event source is specified

When the `Event` property of an `AWS::Serverless::Function` is set to `Api`, but the `RestApiId` property is *not* specified, AWS SAM generates the `AWS::ApiGateway::RestApi` AWS CloudFormation resource.

`AWS::ApiGateway::RestApi`

`LogicalId`: `ServerlessRestApi`

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

An HttpApi event source is specified

When the `Event` property of an `AWS::Serverless::Function` is set to `HttpApi`, but the `ApiId` property is *not* specified, AWS SAM generates the `AWS::ApiGatewayV2::Api` AWS CloudFormation resource.

`AWS::ApiGatewayV2::Api`

`LogicalId`: `ServerlessHttpApi`

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

A streaming event source is specified

When the `Event` property of an `AWS::Serverless::Function` is set to one of the streaming types, AWS SAM generates the `AWS::Lambda::EventSourceMapping` AWS CloudFormation resource. This applies to the following types: `DynamoDB`, `Kinesis`, `MQ`, `MSK`, and `SQS`.

`AWS::Lambda::EventSourceMapping`

`LogicalId`: *`<function#LogicalId><event#LogicalId>`*

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

An event bridge (or event bus) event source is specified

When the `Event` property of an `AWS::Serverless::Function` is set to one of the event bridge (or event bus) types, AWS SAM generates the `AWS::Events::Rule` AWS CloudFormation resource. This applies to the following types: `EventBridgeRule`, `Schedule`, and `CloudWatchEvents`.

`AWS::Events::Rule`

`LogicalId`: *`<function#LogicalId><event#LogicalId>`*

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

An IotRule event source is specified

When the `Event` property of an `AWS::Serverless::Function` is set to IoTRule, AWS SAM generates the `AWS::IoT::TopicRule` AWS CloudFormation resource.

`AWS::IoT::TopicRule`

`LogicalId`: *`<function#LogicalId><event#LogicalId>`*

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

OnSuccess (or OnFailure) property is specified for Amazon SNS events

When the `OnSuccess` (or `OnFailure`) property of the `DestinationConfig` property of the `EventInvokeConfig` property of an `AWS::Serverless::Function` is specified, and the destination type is `SNS` but the destination ARN is *not* specified, AWS SAM generates the following AWS CloudFormation resources: `AWS::Lambda::EventInvokeConfig` and `AWS::SNS::Topic`.

`AWS::Lambda::EventInvokeConfig`

`LogicalId`: *`<function#LogicalId>`*`EventInvokeConfig`

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

`AWS::SNS::Topic`

`LogicalId`: *`<function#LogicalId>`*`OnSuccessTopic` (or *`<function#LogicalId>`*`OnFailureTopic`)

Referenceable property: *`<function#LogicalId>`*`.DestinationTopic`

If both `OnSuccess` and `OnFailure` are specified for an Amazon SNS event, to distinguish between the generated resources, you must use the `LogicalId`.

OnSuccess (or OnFailure) property is specified for Amazon SQS events

When the `OnSuccess` (or `OnFailure`) property of the `DestinationConfig` property of the `EventInvokeConfig` property of an `AWS::Serverless::Function` is specified, and the destination type is `SQS` but the destination ARN is *not* specified, AWS SAM generates the following AWS CloudFormation resources: `AWS::Lambda::EventInvokeConfig` and `AWS::SQS::Queue`.

`AWS::Lambda::EventInvokeConfig`

`LogicalId`: *`<function#LogicalId>`*`EventInvokeConfig`

Referenceable property: N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

`AWS::SQS::Queue`

`LogicalId`: *`<function#LogicalId>`*`OnSuccessQueue` (or *`<function#LogicalId>`*`OnFailureQueue`)

Referenceable property: *`<function#LogicalId>`*`.DestinationQueue`

If both `OnSuccess` and `OnFailure` are specified for an Amazon SQS event, to distinguish between the generated resources, you must use the `LogicalId`.

AWS CloudFormation resources generated when AWS::Serverless::HttpApi is specified

When an `AWS::Serverless::HttpApi` is specified, AWS Serverless Application Model (AWS SAM) generates an `AWS::ApiGatewayV2::Api` base AWS CloudFormation resource.

`AWS::ApiGatewayV2::Api`

> *`LogicalId`:* *`<httpapi#LogicalId>`*
>
> *Referenceable property:* N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

In addition to this AWS CloudFormation resource, when `AWS::Serverless::HttpApi` is specified, AWS SAM also generates AWS CloudFormation resources for the following scenarios:

Scenarios

- StageName property is specified (p. 185)
- StageName property is not specified (p. 185)
- DomainName property is specified (p. 185)

StageName property is specified

When the `StageName` property of an `AWS::Serverless::HttpApi` is specified, AWS SAM generates the `AWS::ApiGatewayV2::Stage` AWS CloudFormation resource.

`AWS::ApiGatewayV2::Stage`

> *`LogicalId`:* *`<httpapi#LogicalId><stage#name>`*`Stage`
>
> *`<stage#name>`* is the string that the `StageName` property is set to. For example, if you set `StageName` to `Gamma`, the `LogicalId` is: *`MyHttpApiGamma`*Stage.
>
> *Referenceable property:* *`<httpapi#LogicalId>`*`.Stage`

StageName property is *not* specified

When the `StageName` property of an `AWS::Serverless::HttpApi` is *not* specified, AWS SAM generates the `AWS::ApiGatewayV2::Stage` AWS CloudFormation resource.

`AWS::ApiGatewayV2::Stage`

> *`LogicalId`:* *`<httpapi#LogicalId>`*`ApiGatewayDefaultStage`
>
> *Referenceable property:* *`<httpapi#LogicalId>`*`.Stage`

DomainName property is specified

When the `DomainName` property of the `Domain` property of an `AWS::Serverless::HttpApi` is specified, AWS SAM generates the `AWS::ApiGatewayV2::DomainName` AWS CloudFormation resource.

`AWS::ApiGatewayV2::DomainName`

> *`LogicalId`:* `ApiGatewayDomainNameV2`*`<sha>`*
>
> *`<sha>`* is a unique hash value that is generated when the stack is created. For example, `ApiGatewayDomainNameV2`*`926eeb5ff1`*.
>
> *Referenceable property:* *`<httpapi#LogicalId>`*`.DomainName`

AWS CloudFormation resources generated when AWS::Serverless::LayerVersion is specified

When an `AWS::Serverless::LayerVersion` is specified, AWS Serverless Application Model (AWS SAM) generates an `AWS::Lambda::LayerVersion` base AWS CloudFormation resource.

`AWS::Lambda::LayerVersion`

> *`LogicalId`:* *`<layerversion#LogicalId>`*
>
> *Referenceable property:* N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

AWS CloudFormation resources generated when AWS::Serverless::SimpleTable is specified

When an `AWS::Serverless::SimpleTable` is specified, AWS Serverless Application Model (AWS SAM) generates an `AWS::DynamoDB::Table` base AWS CloudFormation resource.

`AWS::DynamoDB::Table`

> *`LogicalId`:* *`<simpletable#LogicalId>`*
>
> *Referenceable property:* N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

AWS CloudFormation resources generated when AWS::Serverless::StateMachine is specified

When an `AWS::Serverless::StateMachine` is specified, AWS Serverless Application Model (AWS SAM) generates an `AWS::StepFunctions::StateMachine` base AWS CloudFormation resource.

`AWS::StepFunctions::StateMachine`

> *`LogicalId`:* *`<statemachine#LogicalId>`*
>
> *Referenceable property:* N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

In addition to this AWS CloudFormation resource, when `AWS::Serverless::StateMachine` is specified, AWS SAM also generates AWS CloudFormation resources for the following scenarios:

Scenarios

- Role property is not specified (p. 186)
- An Api event source is specified (p. 187)
- An event bridge (or event bus) event source is specified (p. 187)

Role property is not specified

When the `Role` property of an `AWS::Serverless::StateMachine` is *not* specified, AWS SAM generates an `AWS::IAM::Role` AWS CloudFormation resource.

`AWS::IAM::Role`

> *`LogicalId`:* *`<statemachine#LogicalId>`*`Role`
>
> *Referenceable property:* N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

An Api event source is specified

When the `Event` property of an `AWS::Serverless::StateMachine` is set to `Api`, but the `RestApiId` property is *not* specified, AWS SAM generates the `AWS::ApiGateway::RestApi` AWS CloudFormation resource.

`AWS::ApiGateway::RestApi`

> *`LogicalId`:* `ServerlessRestApi`
>
> *Referenceable property:* N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

An event bridge (or event bus) event source is specified

When the `Event` property of an `AWS::Serverless::StateMachine` is set to one of the event bridge (or event bus) types, AWS SAM generates the `AWS::Events::Rule` AWS CloudFormation resource. This applies to the following types: `EventBridgeRule`, `Schedule`, and `CloudWatchEvents`.

`AWS::Events::Rule`

> *`LogicalId`:* *`<statemachine#LogicalId><event#LogicalId>`*
>
> *Referenceable property:* N/A (you must use the `LogicalId` to reference this AWS CloudFormation resource)

API Gateway extensions

API Gateway extensions are extensions to the OpenAPI specification that support the AWS-specific authorization and API Gateway-specific API integrations. For more information about API Gateway extensions, see API Gateway Extensions to OpenAPI.

AWS SAM supports a subset of API Gateway extensions. To see which API Gateway extensions are supported by AWS SAM, see the following table.

API Gateway Extension	Supported by AWS SAM
x-amazon-apigateway-any-method Object	Yes
x-amazon-apigateway-api-key-source Property	No
x-amazon-apigateway-auth Object	Yes
x-amazon-apigateway-authorizer Object	Yes
x-amazon-apigateway-authtype Property	Yes

x-amazon-apigateway-binary-media-types Property	Yes
x-amazon-apigateway-documentation Object	No
x-amazon-apigateway-endpoint-configuration Object	No
x-amazon-apigateway-gateway-responses Object	Yes
x-amazon-apigateway-gateway-responses.gatewayResponse Object	Yes
x-amazon-apigateway-gateway-responses.responseParameters Object	Yes
x-amazon-apigateway-gateway-responses.responseTemplates Object	Yes
x-amazon-apigateway-integration Object	Yes
x-amazon-apigateway-integration.requestTemplates Object	Yes
x-amazon-apigateway-integration.requestParameters Object	No
x-amazon-apigateway-integration.responses Object	Yes
x-amazon-apigateway-integration.response Object	Yes
x-amazon-apigateway-integration.responseTemplates Object	Yes
x-amazon-apigateway-integration.responseParameters Object	Yes
x-amazon-apigateway-request-validator Property	No
x-amazon-apigateway-request-validators Object	No
x-amazon-apigateway-request-validators.requestValidator Object	No

Authoring serverless applications

When you author a serverless application using AWS SAM, you construct an AWS SAM template to declare and configure the components of your application.

This section contains topics about validating your AWS SAM template and building your application with dependencies. It also contains topics about using AWS SAM for certain use cases such as working with Lambda layers, using nested applications, controlling access to API Gateway APIs, orchestrating AWS resources with Step Functions, and code signing your applications.

Topics

- Validating AWS SAM template files (p. 189)
- Working with layers (p. 189)
- Using nested applications (p. 191)
- Controlling access to API Gateway APIs (p. 193)
- Orchestrating AWS resources with AWS Step Functions (p. 202)
- Configuring code signing for AWS SAM applications (p. 203)

Validating AWS SAM template files

Validate your templates with `sam validate (p. 279)`. Currently, this command validates that the template provided is valid JSON / YAML. As with most AWS SAM CLI commands, it looks for a `template.[yaml|yml]` file in your current working directory by default. You can specify a different template file/location with the `-t` or `--template` option.

Example:

```
sam validate
<path-to-file>/template.yml is a valid SAM Template
```

> **Note**
> The `sam validate` command requires AWS credentials to be configured. For more information, see Configuration and Credential Files.

Working with layers

Using AWS SAM, you can include layers in your serverless applications. For more information about layers, see AWS Lambda layers in the *AWS Lambda Developer Guide*.

This topic provides information about the following:

- Including layers in your application
- How layers are cached locally

For information about building custom layers, see Building layers (p. 209).

Including layers in your application

To include layers in your application, use the `Layers` property of the AWS::Serverless::Function (p. 68) resource type.

Following is an example AWS SAM template with a Lambda function that includes a layer:

```
ServerlessFunction:
  Type: AWS::Serverless::Function
  Properties:
    CodeUri: .
    Handler: my_handler
    Runtime: Python3.7
    Layers:
        - <LayerVersion ARN>
```

How layers are cached locally

When you invoke your function using one of the `sam local` commands, the layers package of your function is downloaded and cached on your local host.

The following table shows the default cache directory locations for different operating systems.

OS	Location
Windows 7	`C:\Users\<user>\AppData\Roaming\AWS SAM`
Windows 8	`C:\Users\<user>\AppData\Roaming\AWS SAM`
Windows 10	`C:\Users\<user>\AppData\Roaming\AWS SAM`
macOS	`~/.aws-sam/layers-pkg`
Unix	`~/.aws-sam/layers-pkg`

After the package is cached, the AWS SAM CLI overlays the layers onto a Docker image that's used to invoke your function. The AWS SAM CLI generates the names of the images it builds, as well as the LayerVersions that are held in the cache. You can find more details about the schema in the following sections.

To inspect the overlaid layers, execute the following command to start a bash session in the image that you want to inspect:

```
docker run -it --entrypoint=/bin/bash samcli/lambda:<Tag following the schema outlined in
 Docker Image Tag Schema> -i
```

Layer Caching Directory name schema

Given a LayerVersionArn that's defined in your template, the AWS SAM CLI extracts the LayerName and Version from the ARN. It creates a directory to place the layer contents in named `LayerName-Version-<first 10 characters of sha256 of ARN>`.

Example:

```
ARN = arn:aws:lambda:us-west-2:111111111111:layer:myLayer:1
Directory name = myLayer-1-926eeb5ff1
```

Docker Images tag schema

To compute the unique layers hash, combine all unique layer names with a delimiter of '-', take the SHA256 hash, and then take the first 10 characters.

Example:

```
ServerlessFunction:
  Type: AWS::Serverless::Function
  Properties:
    CodeUri: .
    Handler: my_handler
    Runtime: Python3.7
    Layers:
        - arn:aws:lambda:us-west-2:111111111111:layer:myLayer:1
        - arn:aws:lambda:us-west-2:111111111111:layer:mySecondLayer:1
```

Unique names are computed the same as the Layer Caching Directory name schema:

```
arn:aws:lambda:us-west-2:111111111111:layer:myLayer:1 = myLayer-1-926eeb5ff1
arn:aws:lambda:us-west-2:111111111111:layer:mySecondLayer:1 = mySecondLayer-1-6bc1022bdf
```

To compute the unique layers hash, combine all unique layer names with a delimiter of '-', take the sha256 hash, and then take the first 25 characters:

```
myLayer-1-926eeb5ff1-mySecondLayer-1-6bc1022bdf = 2dd7ac5ffb30d515926aef
```

Then combine this value with the function's runtime and architecture, with a delimiter of '-':

```
python3.7-x86_64-2dd7ac5ffb30d515926aefffd
```

Using nested applications

A serverless application can include one or more **nested applications**. You can deploy a nested application as a stand-alone artifact or as a component of a larger application.

As serverless architectures grow, common patterns emerge in which the same components are defined in multiple application templates. You can now separate out common patterns as dedicated applications, and then nest them as part of new or existing application templates. With nested applications, you can stay more focused on the business logic that's unique to your application.

To define a nested application in your serverless application, use the AWS::Serverless::Application (p. 65) resource type.

You can define nested applications from the following two sources:

- An **AWS Serverless Application Repository application** – You can define nested applications by using applications that are available to your account in the AWS Serverless Application Repository. These can be *private* applications in your account, applications that are *privately shared* with your account, or applications that are *publicly shared* in the AWS Serverless Application Repository. For more information about the different deployment permissions levels, see Application Deployment Permissions and Publishing Applications in the *AWS Serverless Application Repository Developer Guide*.
- A **local application** – You can define nested applications by using applications that are stored on your local file system.

See the following sections for details on how to use AWS SAM to define both of these types of nested applications in your serverless application.

> **Note**
> The maximum number of applications that can be nested in a serverless application is 200.
> The maximum number of parameters a nested application can have is 60.

Defining a nested application from the AWS Serverless Application Repository

You can define nested applications by using applications that are available in the AWS Serverless Application Repository. You can also store and distribute applications that contain nested applications using the AWS Serverless Application Repository. To review details of a nested application in the AWS Serverless Application Repository, you can use the AWS SDK, the AWS CLI, or the Lambda console.

To define an application that's hosted in the AWS Serverless Application Repository in your serverless application's AWS SAM template, use the **Copy as SAM Resource** button on the detail page of every AWS Serverless Application Repository application. To do this, follow these steps:

1. Make sure that you're signed in to the AWS Management Console.
2. Find the application that you want to nest in the AWS Serverless Application Repository by using the steps in the Browsing, Searching, and Deploying Applications section of the *AWS Serverless Application Repository Developer Guide*.
3. Choose the **Copy as SAM Resource** button. The SAM template section for the application that you're viewing is now in your clipboard.
4. Paste the SAM template section into the `Resources:` section of the SAM template file for the application that you want to nest in this application.

The following is an example SAM template section for a nested application that's hosted in the AWS Serverless Application Repository:

```
Transform: AWS::Serverless-2016-10-31

Resources:
  applicationaliasname:
    Type: AWS::Serverless::Application
    Properties:
      Location:
        ApplicationId: arn:aws:serverlessrepo:us-east-1:123456789012:applications/application-alias-name
        SemanticVersion: 1.0.0
      Parameters:
        # Optional parameter that can have default value overridden
        # ParameterName1: 15 # Uncomment to override default value
        # Required parameter that needs value to be provided
        ParameterName2: YOUR_VALUE
```

If there are no required parameter settings, you can omit the `Parameters:` section of the template.

> **Important**
> Applications that contain nested applications hosted in the AWS Serverless Application Repository inherit the nested applications' sharing restrictions.
> For example, suppose an application is publicly shared, but it contains a nested application that's only privately shared with the AWS account that created the parent application. In this case, if your AWS account doesn't have permission to deploy the nested application, you aren't able to deploy the parent application. For more information about permissions to deploy

applications, see Application Deployment Permissions and Publishing Applications in the *AWS Serverless Application Repository Developer Guide*.

Defining a nested application from the local file system

You can define nested applications by using applications that are stored on your local file system. You do this by specifying the path to the AWS SAM template file that's stored on your local file system.

The following is an example SAM template section for a nested local application:

```
Transform: AWS::Serverless-2016-10-31

Resources:
  applicationaliasname:
    Type: AWS::Serverless::Application
    Properties:
      Location: ../my-other-app/template.yaml
      Parameters:
        # Optional parameter that can have default value overridden
        # ParameterName1: 15 # Uncomment to override default value
        # Required parameter that needs value to be provided
        ParameterName2: YOUR_VALUE
```

If there are no parameter settings, you can omit the `Parameters:` section of the template.

Deploying nested applications

You can deploy your nested application by using the AWS SAM CLI command `sam deploy`. For more details, see Deploying serverless applications (p. 221).

> **Note**
> When you deploy an application that contains nested applications, you must acknowledge that. You do this by passing CAPABILITY_AUTO_EXPAND to the CreateCloudFormationChangeSet API,or using the `aws serverlessrepo create-cloud-formation-change-set` AWS CLI command.
> For more information about acknowledging nested applications, see Acknowledging IAM Roles, Resource Policies, and Nested Applications when Deploying Applications in the *AWS Serverless Application Repository Developer Guide*.

Controlling access to API Gateway APIs

To control who can access your Amazon API Gateway APIs, you can enable authorization within your AWS SAM template.

AWS SAM supports several mechanisms for controlling access to your API Gateway APIs. The set of supported mechanisms differs between `AWS::Serverless::HttpApi` and `AWS::Serverless::Api` resource types.

The following table summarizes the mechanisms that each resource type supports.

Mechanisms for controlling access	AWS::Serverless::HttpApi	AWS::Serverless::Api
Lambda authorizers	✓	✓

Mechanisms for controlling access	AWS::Serverless::HttpApi	AWS::Serverless::Api
IAM permissions		✓
Amazon Cognito user pools	✓ *	✓
API keys		✓
Resource policies		✓
OAuth 2.0/JWT authorizers	✓	

* You can use Amazon Cognito as a JSON Web Token (JWT) issuer with the `AWS::Serverless::HttpApi` resource type.

- **Lambda authorizers** – A Lambda authorizer (formerly known as a *custom authorizer*) is a Lambda function that you provide to control access to your API. When your API is called, this Lambda function is invoked with a request context or an authorization token that the client application provides. The Lambda function responds whether the caller is authorized to perform the requested operation.

  Both the `AWS::Serverless::HttpApi` and `AWS::Serverless::Api` resource types support Lambda authorizers.

  For more information about Lambda authorizers with `AWS::Serverless::HttpApi`, see Working with AWS Lambda authorizers for HTTP APIs in the *API Gateway Developer Guide*. For more information about Lambda authorizers with `AWS::Serverless::Api`, see Use API Gateway Lambda authorizers in the *API Gateway Developer Guide*.

  For examples of Lambda authorizers for either resource type, see Lambda authorizer examples (p. 196).

- **IAM permissions** – You can control who can invoke your API using AWS Identity and Access Management (IAM) permissions. Users calling your API must be authenticated with IAM credentials. Calls to your API succeed only if there is an IAM policy attached to the IAM user that represents the API caller, an IAM group that contains the user, or an IAM role that the user assumes.

  Only the `AWS::Serverless::Api` resource type supports IAM permissions.

  For more information, see Control access to an API with IAM permissions in the *API Gateway Developer Guide*. For an example, see IAM permission example (p. 198).
- **Amazon Cognito user pools** – Amazon Cognito user pools are user directories in Amazon Cognito. A client of your API must first sign in a user to the user pool and obtain an identity or access token for the user. Then the client calls your API with one of the returned tokens. The API call succeeds only if the required token is valid.

  The `AWS::Serverless::Api` resource type supports Amazon Cognito user pools. The `AWS::Serverless::HttpApi` resource type supports the use of Amazon Cognito as a JWT issuer.

  For more information, see Control access to a REST API using Amazon Cognito user pools as authorizer in the *API Gateway Developer Guide*. For an example, see Amazon Cognito user pool example (p. 198).
- **API keys** – API keys are alphanumeric string values that you distribute to application developer customers to grant access to your API.

  Only the `AWS::Serverless::Api` resource type supports API keys.

  For more information about API keys, see Creating and using usage plans with API keys in the *API Gateway Developer Guide*. For an example of API keys, see API key example (p. 199).

- **Resource policies** – Resource policies are JSON policy documents that you can attach to an API Gateway API. Use resource policies to control whether a specified principal (typically an IAM user or role) can invoke the API.

  Only the `AWS::Serverless::Api` resource type supports resource policies as a mechanism for controlling access to API Gateway APIs.

  For more information about resource policies, see Controlling access to an API with API Gateway resource policies in the *API Gateway Developer Guide*. For an example of resource policies, see Resource policy example (p. 200).
- **OAuth 2.0/JWT authorizers** – You can use JWTs as a part of OpenID Connect (OIDC) and OAuth 2.0 frameworks to control access to your APIs. API Gateway validates the JWTs that clients submit with API requests, and allows or denies requests based on token validation and, optionally, scopes in the token.

  Only the `AWS::Serverless::HttpApi` resource type supports OAuth 2.0/JWT authorizers.

  For more information, see Controlling access to HTTP APIs with JWT authorizers in the *API Gateway Developer Guide*. For an example, see OAuth 2.0/JWT authorizer example (p. 200).

Choosing a mechanism to control access

The mechanism that you choose to use for controlling access to your API Gateway APIs depends on a few factors. For example, if you have a greenfield project without either authorization or access control set up, then Amazon Cognito user pools might be your best option. This is because when you set up user pools, you also automatically set up both authentication and access control.

However, if your application already has authentication set up, then using Lambda authorizers might be your best option. This is because you can call your existing authentication service and return a policy document based on the response. Also, if your application requires custom authentication or access control logic that user pools don't support, then Lambda authorizers might be your best option.

When you've chosen which mechanism to use, see the corresponding section in Examples (p. 195) for how to use AWS SAM to configure your application to use that mechanism.

Customizing error responses

You can use AWS SAM to customize the content of some API Gateway error responses. Only the `AWS::Serverless::Api` resource type supports customized API Gateway responses.

For more information about API Gateway responses, see Gateway responses in API Gateway in the *API Gateway Developer Guide*. For an example of customized responses, see Customized response example (p. 201).

Examples

- Lambda authorizer examples (p. 196)
- IAM permission example (p. 198)
- Amazon Cognito user pool example (p. 198)
- API key example (p. 199)
- Resource policy example (p. 200)
- OAuth 2.0/JWT authorizer example (p. 200)
- Customized response example (p. 201)

Lambda authorizer examples

The `AWS::Serverless::Api` resource type supports two types of Lambda authorizers: `TOKEN` authorizers and `REQUEST` authorizers. The `AWS::Serverless::HttpApi` resource type supports only `REQUEST` authorizers. The following are examples of each type.

Lambda `TOKEN` authorizer example (AWS::Serverless::Api)

You can control access to your APIs by defining a Lambda `TOKEN` authorizer within your AWS SAM template. To do this, you use the ApiAuth (p. 41) data type.

The following is an example AWS SAM template section for a Lambda `TOKEN` authorizer:

```
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      Auth:
        DefaultAuthorizer: MyLambdaTokenAuthorizer
        Authorizers:
          MyLambdaTokenAuthorizer:
            FunctionArn: !GetAtt MyAuthFunction.Arn

  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: ./src
      Handler: index.handler
      Runtime: nodejs12.x
      Events:
        GetRoot:
          Type: Api
          Properties:
            RestApiId: !Ref MyApi
            Path: /
            Method: get

  MyAuthFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: ./src
      Handler: authorizer.handler
      Runtime: nodejs12.x
```

For more information about Lambda authorizers, see Use API Gateway Lambda authorizers in the *API Gateway Developer Guide*.

Lambda `REQUEST` authorizer example (AWS::Serverless::Api)

You can control access to your APIs by defining a Lambda `REQUEST` authorizer within your AWS SAM template. To do this, you use the ApiAuth (p. 41) data type.

The following is an example AWS SAM template section for a Lambda `REQUEST` authorizer:

```
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      Auth:
        DefaultAuthorizer: MyLambdaRequestAuthorizer
        Authorizers:
          MyLambdaRequestAuthorizer:
            FunctionPayloadType: REQUEST
            FunctionArn: !GetAtt MyAuthFunction.Arn
            Identity:
              QueryStrings:
                - auth

  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: ./src
      Handler: index.handler
      Runtime: nodejs12.x
      Events:
        GetRoot:
          Type: Api
          Properties:
            RestApiId: !Ref MyApi
            Path: /
            Method: get

  MyAuthFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: ./src
      Handler: authorizer.handler
      Runtime: nodejs12.x
```

For more information about Lambda authorizers, see Use API Gateway Lambda authorizers in the *API Gateway Developer Guide*.

Lambda authorizer example (AWS::Serverless::HttpApi)

You can control access to your HTTP APIs by defining a Lambda authorizer within your AWS SAM template. To do this, you use the HttpApiAuth (p. 137) data type.

The following is an example AWS SAM template section for a Lambda authorizer:

```
Resources:
  MyApi:
    Type: AWS::Serverless::HttpApi
    Properties:
      StageName: Prod
      Auth:
        DefaultAuthorizer: MyLambdaRequestAuthorizer
        Authorizers:
          MyLambdaRequestAuthorizer:
            FunctionArn: !GetAtt MyAuthFunction.Arn
            FunctionInvokeRole: !GetAtt MyAuthFunctionRole.Arn
            Identity:
              Headers:
                - Authorization
            AuthorizerPayloadFormatVersion: 2.0
            EnableSimpleResponses: true

  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: ./src
      Handler: index.handler
      Runtime: nodejs12.x
      Events:
        GetRoot:
          Type: HttpApi
          Properties:
            ApiId: !Ref MyApi
            Path: /
            Method: get
            PayloadFormatVersion: "2.0"

  MyAuthFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: ./src
      Handler: authorizer.handler
      Runtime: nodejs12.x
```

IAM permission example

You can control access to your APIs by defining IAM permissions within your AWS SAM template. To do this, you use the ApiAuth (p. 41) data type.

The following is an example AWS SAM template section for IAM permissions:

```
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      Auth:
        DefaultAuthorizer: AWS_IAM

  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: .
      Handler: index.handler
      Runtime: nodejs12.x
      Events:
        GetRoot:
          Type: Api
          Properties:
            RestApiId: !Ref MyApi
            Path: /
            Method: get
```

For more information about IAM permissions, see Control access for invoking an API in the *API Gateway Developer Guide*.

Amazon Cognito user pool example

You can control access to your APIs by defining Amazon Cognito user pools within your AWS SAM template. To do this, you use the ApiAuth (p. 41) data type.

The following is an example AWS SAM template section for a user pool:

```
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      Cors: "'*'"
      Auth:
        DefaultAuthorizer: MyCognitoAuthorizer
        Authorizers:
          MyCognitoAuthorizer:
            UserPoolArn: !GetAtt MyCognitoUserPool.Arn

  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: ./src
      Handler: lambda.handler
      Runtime: nodejs12.x
      Events:
        Root:
          Type: Api
          Properties:
            RestApiId: !Ref MyApi
            Path: /
            Method: GET

  MyCognitoUserPool:
    Type: AWS::Cognito::UserPool
    Properties:
      UserPoolName: !Ref CognitoUserPoolName
      Policies:
        PasswordPolicy:
          MinimumLength: 8
      UsernameAttributes:
        - email
      Schema:
        - AttributeDataType: String
          Name: email
          Required: false

  MyCognitoUserPoolClient:
    Type: AWS::Cognito::UserPoolClient
    Properties:
      UserPoolId: !Ref MyCognitoUserPool
      ClientName: !Ref CognitoUserPoolClientName
      GenerateSecret: false
```

For more information about Amazon Cognito user pools, see Control access to a REST API using Amazon Cognito user pools as authorizer in the *API Gateway Developer Guide*.

API key example

You can control access to your APIs by requiring API keys within your AWS SAM template. To do this, you use the ApiAuth (p. 41) data type.

The following is an example AWS SAM template section for API keys:

```
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      Auth:
        ApiKeyRequired: true # sets for all methods

  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: .
      Handler: index.handler
      Runtime: nodejs12.x
      Events:
        ApiKey:
          Type: Api
          Properties:
            RestApiId: !Ref MyApi
            Path: /
            Method: get
            Auth:
              ApiKeyRequired: true
```

For more information about API keys, see Creating and using usage plans with API keys in the *API Gateway Developer Guide*.

Resource policy example

You can control access to your APIs by attaching a resource policy within your AWS SAM template. To do this, you use the ApiAuth (p. 41) data type.

The following is an example AWS SAM template section for resource policies:

```
Resources:
  ExplicitApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      EndpointConfiguration: PRIVATE
      Auth:
        ResourcePolicy:
          CustomStatements: {
              Effect: 'Allow',
              Action: 'execute-api:Invoke',
              Resource: ['execute-api:/*/*/*'],
              Principal: '*'
            }
  MinimalFunction:
    Type: 'AWS::Serverless::Function'
    Properties:
      CodeUri: s3://sam-demo-bucket/hello.zip
      Handler: hello.handler
      Runtime: python2.7
      Events:
        AddItem:
          Type: Api
          Properties:
            RestApiId:
              Ref: ExplicitApi
            Path: /add
            Method: post
```

For more information about resource policies, see Controlling access to an API with API Gateway resource policies in the *API Gateway Developer Guide*.

OAuth 2.0/JWT authorizer example

You can control access to your APIs using JWTs as part of OpenID Connect (OIDC) and OAuth 2.0 frameworks. To do this, you use the HttpApiAuth (p. 137) data type.

The following is an example AWS SAM template section for an OAuth 2.0/JWT authorizer:

```
Resources:
  MyApi:
    Type: AWS::Serverless::HttpApi
    Properties:
      Auth:
        Authorizers:
          MyOauth2Authorizer:
            AuthorizationScopes:
              - scope
            IdentitySource: $request.header.Authorization
            JwtConfiguration:
              audience:
                - audience1
                - audience2
              issuer: "https://www.example.com/v1/connect/oidc"
        DefaultAuthorizer: MyOauth2Authorizer
      StageName: Prod
  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: ./src
      Events:
        GetRoot:
          Properties:
            ApiId: MyApi
            Method: get
            Path: /
            PayloadFormatVersion: "2.0"
          Type: HttpApi
      Handler: index.handler
      Runtime: nodejs12.x
```

For more information about OAuth 2.0/JWT authorizers, see Controlling access to HTTP APIs with JWT authorizers in the *API Gateway Developer Guide*.

Customized response example

You can customize some API Gateway error responses by defining response headers within your AWS SAM template. To do this, you use the Gateway Response Object data type.

The following is an example AWS SAM template section for API Gateway responses:

```
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      GatewayResponses:
        DEFAULT_4xx:
          ResponseParameters:
            Headers:
              Access-Control-Expose-Headers: "'WWW-Authenticate'"
              Access-Control-Allow-Origin: "'*'"

  GetFunction:
    Type: AWS::Serverless::Function
    Properties:
      Handler: index.get
      Runtime: nodejs12.x
      InlineCode: module.exports = async () => throw new Error('Check out the response
 headers!')
      Events:
        GetResource:
          Type: Api
          Properties:
            Path: /error
            Method: get
            RestApiId: !Ref MyApi
```

For more information about API Gateway responses, see Gateway responses in API Gateway in the *API Gateway Developer Guide*.

Orchestrating AWS resources with AWS Step Functions

You can use AWS Step Functions to orchestrate AWS Lambda functions and other AWS resources to form complex and robust workflows.

> **Note**
> To manage AWS SAM templates that contain Step Functions state machines, you must use version 0.52.0 or later of the AWS SAM CLI. To check which version you have, execute the command `sam --version`.

Step Functions is based on the concepts of tasks and state machines. You define state machines using the JSON-based Amazon States Language. The Step Functions console displays a graphical view of your state machine's structure so you can visually check your state machine's logic and monitor executions.

With Step Functions support in AWS Serverless Application Model (AWS SAM), you can do the following:

- Define state machines, either directly within an AWS SAM template or in a separate file
- Create state machine execution roles through AWS SAM policy templates, inline policies, or managed policies
- Trigger state machine executions with API Gateway or Amazon EventBridge events, on a schedule within an AWS SAM template, or by calling APIs directly
- Use available AWS SAM Policy Templates for common Step Functions development patterns.

Example

The following example snippet from a AWS SAM template file defines a Step Functions state machine in a definition file. Note that the `my_state_machine.asl.json` file must be written in Amazon States Language.

```
AWSTemplateFormatVersion: "2010-09-09"
Transform: AWS::Serverless-2016-10-31
Description: Sample SAM template with Step Functions State Machine

Resources:
  MyStateMachine:
    Type: AWS::Serverless::StateMachine
    Properties:
      DefinitionUri: statemachine/my_state_machine.asl.json
      ...
```

To download a sample AWS SAM application that includes a Step Functions state machine, see Create a Step Functions State Machine Using AWS SAM in the *AWS Step Functions Developer Guide*.

More information

To learn more about Step Functions and using it with AWS SAM, see the following:

- How AWS Step Functions works
- AWS Step Functions and AWS Serverless Application Model
- Tutorial: Create a Step Functions State Machine Using AWS SAM
- AWS SAM Specification: AWS::Serverless::StateMachine (p. 156)

Configuring code signing for AWS SAM applications

You can use AWS SAM to enable code signing with your serverless applications to help ensure that only trusted code is deployed. For more information about the code signing feature, see Configuring code signing for Lambda functions in the *AWS Lambda Developer Guide*.

Before you can configure code signing for your serverless application, you must create a signing profile using AWS Signer. You use this signing profile for the following tasks:

1. **Creating a code signing configuration** – Declare an `AWS::Lambda::CodeSigningConfig` resource to specify the signing profiles of trusted publishers and to set the policy action for validation checks. You can declare this object in the same AWS SAM template as your serverless function, in a different AWS SAM template, or in an AWS CloudFormation template. You then enable code signing for a serverless function by specify the `CodeSigningConfigArn` property the function with the Amazon Resource Name (ARN) of an `AWS::Lambda::CodeSigningConfig` resource.
2. **Signing your code** – Use the `sam package` or `sam deploy` command with the `--signing-profiles` option.

Note
In order to successfully sign your code with the `sam package` or `sam deploy` commands, versioning must be enabled for the Amazon S3 bucket you use with these commands. If you are using the Amazon S3 Bucket that AWS SAM creates for you, versioning is enabled automatically. For more information about Amazon S3 bucket versioning and instructions for enabling versioning on an Amazon S3 bucket that you provide, see Using versioning in Amazon S3 buckets in the *Amazon Simple Storage Service User Guide*.

When you deploy a serverless application, Lambda performs validation checks on all functions that you've enabled code signing for. Lambda also performs validation checks on any layers that those functions depend on. For more information about Lambda's validation checks, see Signature validation in the *AWS Lambda Developer Guide*.

Example

Creating a signing profile

To create a signing profile, run the following command:

```
aws signer put-signing-profile --platform-id "AWSLambda-SHA384-ECDSA" --profile-
name MySigningProfile
```

If the previous command is successful, you see the signing profile's ARN returned. For example:

```
{
    "arn": "arn:aws:signer:us-east-1:111122223333:/signing-profiles/MySigningProfile",
    "profileVersion": "SAMPLEverx",
    "profileVersionArn": "arn:aws:signer:us-east-1:111122223333:/signing-
profiles/MySigningProfile/SAMPLEverx"
}
```

The `profileVersionArn` field contains the ARN to use when you create the code signing configuration.

Creating a code signing configuration and enabling code signing for a function

The following example AWS SAM template declares an `AWS::Lambda::CodeSigningConfig` resource and enables code signing for a Lambda function. In this example, there is one trusted profile, and deployments are rejected if the signature checks fail.

```
Resources:
  HelloWorld:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: hello_world/
      Handler: app.lambda_handler
      Runtime: python3.7
      CodeSigningConfigArn: !Ref MySignedFunctionCodeSigningConfig

  MySignedFunctionCodeSigningConfig:
    Type: AWS::Lambda::CodeSigningConfig
    Properties:
      Description: "Code Signing for MySignedLambdaFunction"
      AllowedPublishers:
        SigningProfileVersionArns:
          - MySigningProfile-profileVersionArn
      CodeSigningPolicies:
        UntrustedArtifactOnDeployment: "Enforce"
```

Signing your code

You can sign your code when packaging or deploying your application. Specify the `--signing-profiles` option with either the `sam package` or `sam deploy` command, as shown in the following example commands.

Signing your function code when packaging your application:

```
sam package --signing-profiles HelloWorld=MySigningProfile --s3-bucket test-bucket --
output-template-file packaged.yaml
```

Signing both your function code and a layer that your function depends on, when packaging your application:

```
sam package --signing-profiles HelloWorld=MySigningProfile MyLayer=MySigningProfile --s3-
bucket test-bucket --output-template-file packaged.yaml
```

Signing your function code and a layer, then performing a deployment:

```
sam deploy --signing-profiles HelloWorld=MySigningProfile MyLayer=MySigningProfile --
s3-bucket test-bucket --template-file packaged.yaml --stack-name --region us-east-1 --
capabilities CAPABILITY_IAM
```

Note

In order to successfully sign your code with the `sam package` or `sam deploy` commands, versioning must be enabled for the Amazon S3 bucket you use with these commands. If you are using the Amazon S3 Bucket that AWS SAM creates for you, versioning is enabled automatically. For more information about Amazon S3 bucket versioning and instructions for enabling versioning on an Amazon S3 bucket that you provide, see Using versioning in Amazon S3 buckets in the *Amazon Simple Storage Service User Guide*.

Providing signing profiles with `sam deploy --guided`

When you run the `sam deploy --guided` command with a serverless application that's configured with code signing, AWS SAM prompts you to provide the signing profile to use for code signing. For more information about `sam deploy --guided` prompts, see sam deploy (p. 258) in the AWS SAM CLI command reference.

Building serverless applications

Building your serverless application involves taking your AWS SAM template file, application code, and any applicable language-specific files and dependencies, and placing all build artifacts in the proper format and location for subsquent steps in your workflow.

For example, you might want to locally test your application, or you might want to deploy your application using the AWS SAM CLI. Both of these activities use the build artifacts of your application as inputs.

This section shows you how to use the `sam build` (p. 252) command to build serverless applications using AWS SAM. You have the option to build all functions and layers of your application, or individual components of your application, like a specific function or layer.

Topics

- Building applications (p. 206)
- Building layers (p. 209)
- Building custom runtimes (p. 211)

Building applications

To build your serverless application, use the `sam build` (p. 252) command. This command also gathers the build artifacts of your application's dependencies and places them in the proper format and location for next steps, such as locally testing, packaging, and deploying.

You specify your application's dependencies in a manifest file, such as `requirements.txt` (Python) or `package.json` (Node.js), or by using the `Layers` property of a function resource. The `Layers` property contains a list of AWS Lambda layer resources that the Lambda function depends on.

The format of your application's build artifacts depends on each function's `PackageType` property. The options for this property are:

- **`Zip`** – A .zip file archive, which contains your application code and its dependencies. If you package your code as a .zip file archive, you must specify a Lambda runtime for your function.
- **`Image`** – A container image, which includes the base operating system, runtime, and extensions, in addition to your application code and its dependencies.

For more information about Lambda package types, see Lambda deployment packages in the *AWS Lambda Developer Guide*.

Building a .zip file archive

To build your serverless application as a .zip file archive, declare `PackageType: Zip` for your serverless function.

AWS SAM builds your application for the architecture (p. 69) that you specify. If you don't specify an architecture, AWS SAM uses `x86_64` by default.

If your Lambda function depends on packages that have natively compiled programs, use the `--use-container` flag. This flag locally compiles your functions in a Docker container that behaves like a Lambda environment, so they're in the right format when you deploy them to the AWS Cloud.

When you use the `--use-container` option, by default AWS SAM pulls the container image from Amazon ECR Public. If you would like to pull a container image from another repository, for example DockerHub, you can use the `--build-image` option and provide the URI of an alternate container image. Following are two example commands for building applications using container images from the DockerHub repository:

```
# Build a Node.js 12 application using a container image pulled from DockerHub
sam build --use-container --build-image amazon/aws-sam-cli-build-image-nodejs12.x

# Build a function resource using the Python 3.8 container image pulled from DockerHub
sam build --use-container --build-image Function1=amazon/aws-sam-cli-build-image-python3.8
```

For a list of URIs you can use with `--build-image`, see Image repositories (p. 324) which contains DockerHub URIs for a number of supported runtimes.

For additional examples of building a .zip file archive application, see the Examples section later in this topic.

Building a container image

To build your serverless application as a container image, declare `PackageType: Image` for your serverless function. You must also declare the `Metadata` resource attribute with the following entries:

`Dockerfile`

The name of the Dockerfile associated with the Lambda function.

`DockerContext`

The location of the Dockerfile.

`DockerTag`

(Optional) A tag to apply to the built image.

`DockerBuildArgs`

Build arguments for the build.

The following is an example `Metadata` resource attribute section:

```
    Metadata:
      Dockerfile: Dockerfile
      DockerContext: ./hello_world
      DockerTag: v1
```

To download a sample application that's configured with the `Image` package type, see Step 1: Download a sample AWS SAM application (p. 17) in **Tutorial: Deploying a Hello World application**. At the prompt asking which package type you want to install, choose `Image`.

> **Note**
> If you specify a multi-architecture base image in your Dockerfile, AWS SAM builds your container image for your host machine's architecture. To build for a different architecture, specify a base image that uses the specific target architecture.

Container environment variable file

To provide a JSON file that contains environment variables for the build container, use the `--container-env-var-file` argument with the `sam build` command. You can provide a single environment variable that applies to all serverless resources, or different environment variables for each resource.

Format

The format for passing environment variables to a build container depends on how many environment variables you provide for your resources.

To provide a single environment variable for all resources, specify a `Parameters` object like the following:

```
{
  "Parameters": {
    "GITHUB_TOKEN": "TOKEN_GLOBAL"
  }
}
```

To provide different environment variables for each resource, specify objects for each resource like the following:

```
{
  "MyFunction1": {
    "GITHUB_TOKEN": "TOKEN1"
  },
  "MyFunction2": {
    "GITHUB_TOKEN": "TOKEN2"
  }
}
```

Save your environment variables as a file, for example, named `env.json`. The following command uses this file to pass your environment variables to the build container:

```
sam build --use-container --container-env-var-file env.json
```

Precedence

- The environment variables that you provide for specific resources take precedence over the single environment variable for all resources.
- Environment variables that you provide on the command line take precedence over environment variables in a file.

Examples

Example 1: .zip file archive

The following `sam build` commands build a .zip file archive:

```
# Build all functions and layers, and their dependencies
sam build

# Run the build process inside a Docker container that functions like a Lambda environment
sam build --use-container

# Build a Node.js 12 application using a container image pulled from DockerHub
sam build --use-container --build-image amazon/aws-sam-cli-build-image-nodejs12.x
```

```
# Build a function resource using the Python 3.8 container image pulled from DockerHub
sam build --use-container --build-image Function1=amazon/aws-sam-cli-build-image-python3.8

# Build and run your functions locally
sam build && sam local invoke

# For more options
sam build --help
```

Example 2: Container image

The following AWS SAM template builds as a container image:

```
Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function
    Properties:
      PackageType: Image
      ImageConfig:
        Command: ["app.lambda_handler"]
    Metadata:
      Dockerfile: Dockerfile
      DockerContext: ./hello_world
      DockerTag: v1
```

The following is an example Dockerfile:

```
FROM public.ecr.aws/lambda/python:3.8

COPY app.py requirements.txt ./

RUN python3.8 -m pip install -r requirements.txt

# Overwrite the command by providing a different command directly in the template.
CMD ["app.lambda_handler"]
```

Building layers

You can use AWS SAM to build custom layers. For information about layers, see AWS Lambda layers in the *AWS Lambda Developer Guide*.

To build a custom layer, declare it in your AWS Serverless Application Model (AWS SAM) template file and include a `Metadata` resource attribute section with a `BuildMethod` entry. Valid values for `BuildMethod` are identifiers for an AWS Lambda runtime, or `makefile`. Include a `BuildArchitecture` entry to specify the instruction set architectures that your layer supports. Valid values for `BuildArchitecture` are Lambda instruction set architectures.

If you specify `makefile`, provide the custom makefile, where you declare a build target of the form `build-`*`layer-logical-id`* that contains the build commands for your layer. Your makefile is responsible for compiling the layer if necessary, and copying the build artifacts into the proper location required for subsequent steps in your workflow. The location of the makefile is specified by the `ContentUri` property of the layer resource, and must be named `Makefile`.

> **Note**
> When you create a custom layer, AWS Lambda depends on environment variables to find your layer code. Lambda runtimes include paths in the `/opt` directory where your layer code is copied

into. Your project's build artifact folder structure must match the runtime's expected folder structure so your custom layer code can be found.
For example, for Python you can place your code in the `python/` subdirectory. For NodeJS, you can place your code in the `nodejs/node_modules/` subdirectory.
For more information, see Including library dependencies in a layer in the *AWS Lambda Developer Guide*.

The following is an example `Metadata` resource attribute section.

```
    Metadata:
      BuildMethod: python3.8
      BuildArchitecture: arm64
```

> **Note**
> If you don't include the `Metadata` resource attribute section, AWS SAM doesn't build the layer. Instead, it copies the build artifacts from the location specified in the `CodeUri` property of the layer resource. For more information, see the ContentUri (p. 151) property of the `AWS::Serverless::LayerVersion` resource type.

When you include the `Metadata` resource attribute section, you can use the `sam build (p. 252)` command to build the layer, both as an independent object, or as a dependency of an AWS Lambda function.

- **As an independent object.** You might want to build just the layer object, for example when you're locally testing a code change to the layer and don't need to build your entire application. To build the layer independently, specify the layer resource with the `sam build` *`layer-logical-id`* command.
- **As a dependency of a Lambda function.** When you include a layer's logical ID in the `Layers` property of a Lambda function in the same AWS SAM template file, the layer is a dependency of that Lambda function. When that layer also includes a `Metadata` resource attribute section with a `BuildMethod` entry, you build the layer either by building the entire application with the `sam build` command or by specifying the function resource with the `sam build` *`function-logical-id`* command.

Examples

Template example 1: Build a layer against the Python 3.6 runtime environment

The following example AWS SAM template builds a layer against the Python 3.6 runtime environment.

```
Resources:
  MyLayer:
    Type: AWS::Serverless::LayerVersion
    Properties:
      ContentUri: my_layer
      CompatibleRuntimes:
        - python3.6
    Metadata:
      BuildMethod: python3.6              # Required to have AWS SAM build this layer
```

Template example 2: Build a layer using a custom makefile

The following example AWS SAM template uses a custom `makefile` to build the layer.

```
Resources:
  MyLayer:
    Type: AWS::Serverless::LayerVersion
    Properties:
      ContentUri: my_layer
      CompatibleRuntimes:
        - python3.8
    Metadata:
      BuildMethod: makefile
```

The following `makefile` contains the build target and commands that will be executed. Note that the `ContentUri` property is set to `my_layer`, so the makefile must be located in the root of the `my_layer` subdirectory, and the filename must be `Makefile`. Note also that the build artifacts are copied into the `python/` subdirectory so that AWS Lambda will be able to find the layer code.

```
build-MyLayer:
    mkdir -p "$(ARTIFACTS_DIR)/python"
    cp *.py "$(ARTIFACTS_DIR)/python"
    python -m pip install -r requirements.txt -t "$(ARTIFACTS_DIR)/python"
```

Example sam build commands

The following `sam build` commands build layers that include the `Metadata` resource attribute sections.

```
# Build the 'layer-logical-id' resource independently
sam build layer-logical-id

# Build the 'function-logical-id' resource and layers that this function depends on
sam build function-logical-id

# Build the entire application, including the layers that any function depends on
sam build
```

Building custom runtimes

You can use the `sam build` (p. 252) command to build custom runtimes required for your Lambda function. You declare your Lambda function to use a custom runtime by specifying `Runtime: provided` for the function.

To build a custom runtime, declare the `Metadata` resource attribute with a `BuildMethod: makefile` entry. You provide a custom makefile, where you declare a build target of the form `build-`*`function-logical-id`* that contains the build commands for your runtime. Your makefile is responsible for compiling the custom runtime if necessary, and copying the build artifacts into the proper location required for subsequent steps in your workflow. The location of the makefile is specified by the `CodeUri` property of the function resource, and must be named `Makefile`.

Examples

Example 1: Custom runtime for a function written in Rust

The following AWS SAM template declares a function that uses a custom runtime for a Lambda function written in Rust, and instructs `sam build` to execute the commands for the `build-HelloRustFunction` build target.

```
Resources:
  HelloRustFunction:
    Type: AWS::Serverless::Function
    Properties:
      FunctionName: HelloRust
      Handler: bootstrap.is.real.handler
      Runtime: provided
      MemorySize: 512
      CodeUri: .
    Metadata:
      BuildMethod: makefile
```

The following makefile contains the build target and commands that will be executed. Note that the `CodeUri` property is set to `.`, so the makefile must be located in the project root directory (that is, the same directory as the application's AWS SAM template file). The filename must be `Makefile`.

```
build-HelloRustFunction:
  cargo build --release --target x86_64-unknown-linux-musl
  cp ./target/x86_64-unknown-linux-musl/release/bootstrap $(ARTIFACTS_DIR)
```

For more information about setting up your development environment in order to execute the `cargo build` command in the previous `makefile`, see the Rust Runtime for AWS Lambda blog post.

Example 2: Makefile builder for Python3.7 (alternative to using the bundled builder)

You might want to use a library or module that is not included in a bundled builder. This example shows a AWS SAM template for a Python3.7 runtime with a makefile builder.

```
Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: hello_world/
      Handler: app.lambda_handler
      Runtime: python3.7
    Metadata:
      BuildMethod: makefile
```

The following makefile contains the build target and commands that will be executed. Note that the `CodeUri` property is set to `hello_world`, so the makefile must be located in the root of the `hello_world` subdirectory, and the filename must be `Makefile`.

```
build-HelloWorldFunction:
    cp *.py $(ARTIFACTS_DIR)
    cp requirements.txt $(ARTIFACTS_DIR)
    python -m pip install -r requirements.txt -t $(ARTIFACTS_DIR)
    rm -rf $(ARTIFACTS_DIR)/bin
```

Testing and debugging serverless applications

With the AWS SAM command line interface (CLI), you can locally test and "step-through" debug your serverless applications before uploading your application to the AWS Cloud. You can verify whether your application is behaving as expected, debug what's wrong, and fix any issues, before going through the steps of packaging and deploying your application.

When you locally invoke a Lambda function in debug mode within the AWS SAM CLI, you can then attach a debugger to it. With the debugger, you can step through your code line by line, see the values of various variables, and fix issues the same way you would for any other application.

> **Note**
> If your application includes one or more layers, when you locally run and debug your application the layers package is downloaded and cached on your local host. For more information, see How layers are cached locally (p. 190).

Topics

- Invoking functions locally (p. 213)
- Running API Gateway locally (p. 214)
- Integrating with automated tests (p. 216)
- Generating sample event payloads (p. 217)
- Step-through debugging Lambda functions locally (p. 217)
- Passing additional runtime debug arguments (p. 219)

Invoking functions locally

You can invoke your function locally by using the `sam local invoke (p. 266)` command and providing its function logical ID and an event file. Alternatively, `sam local invoke` also accepts `stdin` as an event. For more information about events, see Event in the *AWS Lambda Developer Guide*. For details about event message formats from different AWS services, see Working with other services in the *AWS Lambda Developer Guide*.

> **Note**
> The `sam local invoke` command described in this section corresponds to the AWS CLI command `aws lambda invoke`. You can use either version of this command to invoke a Lambda function that you've uploaded to the AWS Cloud.

You must execute `sam local invoke` in the project directory containing the function you want to invoke.

Examples:

```
# Invoking function with event file
$ sam local invoke "Ratings" -e event.json

# Invoking function with event via stdin
$ echo '{"message": "Hey, are you there?" }' | sam local invoke --event - "Ratings"

# For more options
$ sam local invoke --help
```

Environment variable file

You can use the `--env-vars` argument with the `invoke` or `start-api` commands. You do this to provide a JSON file that contains values to override the environment variables that are already defined in your function template. You can structure the file as follows:

```
{
  "MyFunction1": {
    "TABLE_NAME": "localtable",
    "BUCKET_NAME": "testBucket"
  },
  "MyFunction2": {
    "TABLE_NAME": "localtable",
    "STAGE": "dev"
  }
}
```

Alternatively, your environment file can contain a single `Parameters` entry with the environment variables for all functions. Note that you can't mix this format with the example above.

```
{
  "Parameters": {
    "TABLE_NAME": "localtable",
    "BUCKET_NAME": "testBucket",
    "STAGE": "dev"
  }
}
```

Save your environment variables in a file named `env.json`. The following command uses this file to override the included environment variables:

```
sam local invoke --env-vars env.json
```

Layers

If your application includes layers, see Working with layers (p. 189) for more information about how to debug layers issues on your local host.

Running API Gateway locally

Use the `sam local start-api (p. 268)` command to start a local instance of API Gateway that you will use to test HTTP request/response functionality. This functionality features hot reloading to enable you to quickly develop and iterate over your functions.

> **Note**
> "Hot reloading" is when only the files that changed are refreshed without losing the state of the application. In contrast, "live reloading" is when the entire application is refreshed, such that the state of the application is lost.

You must execute `sam local start-api` in the project directory containing the function you want to invoke.

By default, AWS SAM uses Lambda proxy integrations, and supports both `HttpApi` and `Api` resource types. For more information about proxy integrations for `HttpApi` resource types, see Working with Lambda proxy integrations for HTTP APIs. For more information about proxy integrations with `Api` resource types, see Understand API Gateway Lambda proxy integration.

Example:

```
sam local start-api
```

AWS SAM automatically finds any functions within your AWS SAM template that have `HttpApi` or `Api` event sources defined. Then, it mounts them at the defined HTTP paths.

In the following `Api` example, the `Ratings` function mounts `ratings.py:handler()` at `/ratings` for `GET` requests:

```
Ratings:
  Type: AWS::Serverless::Function
  Properties:
    Handler: ratings.handler
    Runtime: python3.6
    Events:
      Api:
        Type: Api
        Properties:
          Path: /ratings
          Method: get
```

Here is an example `Api` response:

```
// Example of a Proxy Integration response
exports.handler = (event, context, callback) => {
    callback(null, {
        statusCode: 200,
        headers: { "x-custom-header" : "my custom header value" },
        body: "hello world"
    });
}
```

Environment Variable File

You can use the `--env-vars` argument with the `invoke` or `start-api` commands to provide a JSON file that contains values to override the environment variables already defined in your function template. You can structure the file as follows:

```
{
  "MyFunction1": {
    "TABLE_NAME": "localtable",
    "BUCKET_NAME": "testBucket"
  },
  "MyFunction2": {
    "TABLE_NAME": "localtable",
    "STAGE": "dev"
  },
}
```

Alternatively, your environment file can contain a single `Parameters` entry with the environment variables for all functions. Note that you can't mix this format with the example above.

```
{
  "Parameters": {
    "TABLE_NAME": "localtable",
    "BUCKET_NAME": "testBucket",
    "STAGE": "dev"
  }
}
```

Save your environment variables in a file named `env.json`. The following command uses this file to override the included environment variables:

```
sam local start-api --env-vars env.json
```

Layers

If your application includes layers, see Working with layers (p. 189) for more information about how to debug layers issues on your local host.

Integrating with automated tests

You can use the `sam local invoke` command to manually test your code by running Lambda functions locally. With the AWS SAM CLI, you can easily author automated integration tests by first running tests against local Lambda functions before deploying to the AWS Cloud.

The `sam local start-lambda` command starts a local endpoint that emulates the AWS Lambda invoke endpoint. You can invoke it from your automated tests. Because this endpoint emulates the AWS Lambda invoke endpoint, you can write tests once, and then run them (without any modifications) against the local Lambda function, or against a deployed Lambda function. You can also run the same tests against a deployed AWS SAM stack in your CI/CD pipeline.

This is how the process works:

1. Start the local Lambda endpoint.

   Start the local Lambda endpoint by running the following command in the directory that contains your AWS SAM template:

   ```
   sam local start-lambda
   ```

   This command starts a local endpoint at `http://127.0.0.1:3001` that emulates AWS Lambda. You can run your automated tests against this local Lambda endpoint. When you invoke this endpoint using the AWS CLI or SDK, it locally executes the Lambda function that's specified in the request, and returns a response.
2. Run an integration test against the local Lambda endpoint.

   In your integration test, you can use the AWS SDK to invoke your Lambda function with test data, wait for response, and verify that the response is what you expect. To run the integration test locally, you should configure the AWS SDK to send a Lambda Invoke API call to invoke the local Lambda endpoint that you started in previous step.

   The following is a Python example (the AWS SDKs for other languages have similar configurations):

   ```
   import boto3
   import botocore

   # Set "running_locally" flag if you are running the integration test locally
   running_locally = True

   if running_locally:

       # Create Lambda SDK client to connect to appropriate Lambda endpoint
   ```

```
    lambda_client = boto3.client('lambda',
        region_name="us-west-2",
        endpoint_url="http://127.0.0.1:3001",
        use_ssl=False,
        verify=False,
        config=botocore.client.Config(
            signature_version=botocore.UNSIGNED,
            read_timeout=1,
            retries={'max_attempts': 0},
        )
    )
else:
    lambda_client = boto3.client('lambda')


# Invoke your Lambda function as you normally usually do. The function will run
# locally if it is configured to do so
response = lambda_client.invoke(FunctionName="HelloWorldFunction")

# Verify the response
assert response == "Hello World"
```

You can use this code to test deployed Lambda functions by setting `running_locally` to `False`. This sets up the AWS SDK to connect to AWS Lambda in the AWS Cloud.

Generating sample event payloads

To make local development and testing of Lambda functions easier, you can generate and customize event payloads for a number of AWS services like API Gateway, AWS CloudFormation, Amazon S3, and so on.

For the full list of services that you can generate sample event payloads for, use this command:

```
sam local generate-event --help
```

For the list of options you can use for a particular service, use this command:

```
sam local generate-event [SERVICE] --help
```

Examples:

```
#Generates the event from S3 when a new object is created
sam local generate-event s3 put

# Generates the event from S3 when an object is deleted
sam local generate-event s3 delete
```

Step-through debugging Lambda functions locally

You can use AWS SAM with a variety of AWS toolkits and debuggers to test and debug your serverless applications locally.

For example, you can perform local step-through debugging of your Lambda functions by setting breakpoints, inspecting variables, and executing function code one line at a time. Local step-through debugging tightens the feedback loop by making it possible for you to find and troubleshoot issues that you might run into in the cloud.

Using AWS Toolkits

AWS Toolkits are integrated development environment (IDE) plugins that provide you with the ability to perform many common debugging tasks, like setting breakpoints, inspecting variables, and executing function code one line at a time. AWS Toolkits make it easier for you to develop, debug, and deploy serverless applications that are built using AWS SAM. They provide an experience for building, testing, debugging, deploying, and invoking Lambda functions that's integrated into your IDE.

For more information about AWS Toolkits that you can use with AWS SAM, see the following:

- AWS Toolkit for Visual Studio Code
- AWS Cloud9
- AWS Toolkit for JetBrains

There are a variety AWS Toolkits that work with different combinations of IDEs and runtimes. The following table lists common IDE/runtime combinations that support step-through debugging of AWS SAM applications:

IDE	Runtime	AWS Toolkit	Instructions for step-through debugging
Visual Studio Code	• Node.js • Python • .NET • Java • Go	AWS Toolkit for Visual Studio Code	Working with AWS Serverless Application in the *AWS Toolkit for Visual Studio Code User Guide*
AWS Cloud9	• Node.js • Python	AWS Cloud9, with AWS Toolkit enabled[1]	Working with AWS serverless applications using the AWS Toolkit in the *AWS Cloud9 User Guide*.
WebStorm	Node.js	AWS Toolkit for JetBrains[2]	Running (invoking) or debugging a local function in the *AWS Toolkit for JetBrains*
PyCharm	Python	AWS Toolkit for JetBrains[2]	Running (invoking) or debugging a local function in the *AWS Toolkit for JetBrains*
Rider	.NET	AWS Toolkit for JetBrains[2]	Running (invoking) or debugging a local function in the *AWS Toolkit for JetBrains*
IntelliJ	Java	AWS Toolkit for JetBrains[2]	Running (invoking) or debugging a local function in the *AWS Toolkit for JetBrains*

IDE	Runtime	AWS Toolkit	Instructions for step-through debugging
GoLand	Go	AWS Toolkit for JetBrains[2]	Running (invoking) or debugging a local function in the *AWS Toolkit for JetBrains*

Notes:

1. To use AWS Cloud9 to step-through debug AWS SAM applications, the AWS Toolkit must be enabled. For more information, see Enabling the AWS Toolkit in the *AWS Cloud9 User Guide*.
2. To use the AWS Toolkit for JetBrains to step-through debug AWS SAM applications, you must first install and configure it by following the instructions found in Installing the AWS Toolkit for JetBrains in the *AWS Toolkit for JetBrains*.

Running AWS SAM locally in debug mode

In addition to integrating with AWS Toolkits, you can also run AWS SAM in "debug mode" to attach to third-party debuggers like ptvsd or delve.

To run AWS SAM in debug mode, use commands sam local invoke (p. 266) or sam local start-api (p. 268) with the `--debug-port` or `-d` option.

For example:

```
# Invoke a function locally in debug mode on port 5858
sam local invoke -d 5858 <function logical id>

# Start local API Gateway in debug mode on port 5858
sam local start-api -d 5858
```

Note
If you're using `sam local start-api`, the local API Gateway instance exposes all of your Lambda functions. However, because you can specify a single debug port, you can only debug one function at a time. You need to call your API before the AWS SAM CLI binds to the port, which allows the debugger to connect.

Passing additional runtime debug arguments

To pass additional runtime arguments when you're debugging your function, use the environment variable `DEBUGGER_ARGS`. This passes a string of arguments directly into the run command that the AWS SAM CLI uses to start your function.

For example, if you want to load a debugger like iKPdb at the runtime of your Python function, you could pass the following as `DEBUGGER_ARGS: -m ikpdb --ikpdb-port=5858 --ikpdb-working-directory=/var/task/ --ikpdb-client-working-directory=/myApp --ikpdb-address=0.0.0.0`. This would load iKPdb at runtime with the other arguments you've specified.

In this case, your full AWS SAM CLI command would be:

```
DEBUGGER_ARGS="-m ikpdb --ikpdb-port=5858 --ikpdb-working-directory=/var/task/ --ikpdb-
client-working-directory=/myApp --ikpdb-address=0.0.0.0" echo {} | sam local invoke -d 5858
 myFunction
```

You can pass debugger arguments to the functions of all runtimes.

Deploying serverless applications

AWS SAM uses AWS CloudFormation as the underlying deployment mechanism. For more information, see What is AWS CloudFormation? in the *AWS CloudFormation User Guide*. The standard inputs to deploying serverless applications are the build artifacts created using the **sam build (p. 252)** command. For more information about **sam build**, see Building serverless applications (p. 206).

You can deploy your application manually using AWS SAM command line interface (CLI) commands. You can also automate the deployments of your application using a continuous integration and continuous deployment (CI/CD) system. You can use many common CI/CD systems for deploying AWS SAM applications, including AWS CodePipeline, Jenkins, GitLab CI/CD, and GitHub Actions.

Deploying using CI/CD systems

AWS SAM helps organizations create pipelines for their preferred CI/CD systems, so that they can realize the benefits of CI/CD with minimal effort, such as accelerating deployment frequency, shortening lead time for changes, and reducing deployment errors.

AWS SAM simplifies CI/CD tasks for serverless applications with the help of build container images. The images that AWS SAM provides include the AWS SAM CLI and build tools for a number of supported AWS Lambda runtimes. This makes it easier to build and package serverless applications using the AWS SAM CLI. These images also alleviate the need for teams to create and manage their own images for CI/CD systems. For more information about AWS SAM build container images, see Image repositories (p. 324).

Multiple CI/CD systems support AWS SAM build container images. Which CI/CD system you should use depends on several factors. These include whether your application uses a single runtime or multiple runtimes, or whether you want to build your application within a container image or directly on a host machine, either a virtual machine (VM) or bare metal host.

AWS SAM also provides a set of default pipeline templates for multiple CI/CD systems that encapsulate AWS's deployment best practices. These default pipeline templates use standard JSON/YAML pipeline configuration formats, and the built-in best practices help perform multi-account and multi-region deployments, and verify that pipelines cannot make unintended changes to infrastructure.

You have two main options for using AWS SAM to deploy your serverless applications: 1) Modify your existing pipeline configuration to use AWS SAM CLI commands, or 2) Generate an example CI/CD pipeline configuration that you can use as a starting point for your own application.

For more information about these options, see the following topics:

- Modifying your existing CI/CD pipelines (p. 222)
- Generating starter CI/CD pipelines (p. 225)

Deploying using the AWS SAM CLI

After you develop and test your serverless application locally, you can deploy your application using the **sam deploy (p. 258)** command.

To have AWS SAM guide you through the deployment with prompts, specify the **--guided** flag. When you specify this flag, the **sam deploy** command zips your application artifacts, uploads them either to Amazon Simple Storage Service (Amazon S3) (for .zip file archives) or to Amazon Elastic Container Registry (Amazon ECR) (for contain images). The command then deploys your application to the AWS Cloud.

Example:

```
# Deploy an application using prompts:
sam deploy --guided
```

Troubleshooting deployments using the AWS SAM CLI

AWS SAM CLI error: "Security Constraints Not Satisfied"

When running **sam deploy --guided**, you're prompted with the question `HelloWorldFunction may not have authorization defined, Is this okay? [y/N]`. If you respond to this prompt with **`N`** (the default response), you see the following error:

```
Error: Security Constraints Not Satisfied
```

The prompt is informing you that the application you're about to deploy might have an Amazon API Gateway API configured without authorization. By responding **`N`** to this prompt, you're saying that this is not OK.

To fix this, you have the following options:

- Configure your application with authorization. For information about configuring authorization, see Controlling access to API Gateway APIs (p. 193).
- Respond to this question with **`Y`** to indicate that you're OK with deploying an application that has an API Gateway API configured without authorization.

Gradual deployments

If you want to deploy your AWS SAM application gradually rather than all at once, you can specify deployment configurations that AWS CodeDeploy provides. For more information, see Working with deployment configurations in CodeDeploy in the *AWS CodeDeploy User Guide*.

For information about configuring your AWS SAM application to deploy gradually, see Deploying serverless applications gradually (p. 326).

Modifying your existing CI/CD pipelines

The procedures for your existing CI/CD pipeline to deploy serverless applications using AWS SAM are slightly different depending on which CI/CD system you are using.

The following topics provide examples for configuring your CI/CD system to build serverless applications within an AWS SAM build container image:

- Deploying using AWS CodePipeline (p. 223)
- Deploying using Jenkins (p. 223)

- Deploying using GitLab CI/CD (p. 224)
- Deploying using GitHub Actions (p. 224)

Deploying using AWS CodePipeline

To configure your AWS CodePipeline pipeline to automate the build and deployment of your AWS SAM application, your AWS CloudFormation template and `buildspec.yml` file must contain lines that do the following:

1. Reference a build container image with the necessary runtime from the available images. The following example uses the `public.ecr.aws/sam/build-nodejs14.x` build container image.
2. Configure the pipeline stages to run the necessary AWS SAM command line interface (CLI) commands. The following example runs two AWS SAM CLI commands: **sam build** and **sam deploy** (with necessary options).

This example assumes that you have declared all functions and layers in your AWS SAM template file with `runtime: nodejs14.x`.

AWS CloudFormation template snippet:

```
  CodeBuildProject:
    Type: AWS::CodeBuild::Project
    Properties:
      Environment:
        ComputeType: BUILD_GENERAL1_SMALL
        Image: public.ecr.aws/sam/build-nodejs14.x
        Type: LINUX_CONTAINER
      ...
```

`buildspec.yml` snippet:

```
version: 0.2
phases:
  build:
    commands:
      - sam build
      - sam deploy --no-confirm-changeset --no-fail-on-empty-changeset
```

For a list of available Amazon Elastic Container Registry (Amazon ECR) build container images for different runtimes, see Image repositories (p. 324).

Deploying using Jenkins

To configure your Jenkins pipeline to automate the build and deployment of your AWS SAM application, your `Jenkinsfile` must contain lines that do the following:

1. Reference a build container image with the necessary runtime from the available images. The following example uses the `public.ecr.aws/sam/build-nodejs14.x` build container image.
2. Configure the pipeline stages to run the necessary AWS SAM command line interface (CLI) commands. The following example runs two AWS SAM CLI commands: **sam build** and **sam deploy** (with necessary options).

This example assumes that you have declared all functions and layers in your AWS SAM template file with `runtime: nodejs14.x`.

```
pipeline {
    agent { docker { image 'public.ecr.aws/sam/build-nodejs14.x' } }
    stages {
        stage('build') {
            steps {
                sh 'sam build'
                sh 'sam deploy --no-confirm-changeset --no-fail-on-empty-changeset'
            }
        }
    }
}
```

For a list of available Amazon Elastic Container Registry (Amazon ECR) build container images for different runtimes, see Image repositories (p. 324).

Deploying using GitLab CI/CD

To configure your GitLab pipeline to automate the build and deployment of your AWS SAM application, your `gitlab-ci.yml` file must contain lines that do the following:

1. Reference a build container image with the necessary runtime from the available images. The following example uses the `public.ecr.aws/sam/build-nodejs14.x` build container image.
2. Configure the pipeline stages to run the necessary AWS SAM command line interface (CLI) commands. The following example runs two AWS SAM CLI commands: **sam build** and **sam deploy** (with necessary options).

This example assumes that you have declared all functions and layers in your AWS SAM template file with `runtime: nodejs14.x`.

```
image: public.ecr.aws/sam/build-nodejs14.x
deploy:
  script:
    - sam build
    - sam deploy --no-confirm-changeset --no-fail-on-empty-changeset
```

For a list of available Amazon Elastic Container Registry (Amazon ECR) build container images for different runtimes, see Image repositories (p. 324).

Deploying using GitHub Actions

To configure your GitHub pipeline to automate the build and deployment of your AWS SAM application, you must first install the AWS SAM command line interface (CLI) on your host. You can use GitHub Actions in your GitHub workflow to help with this setup.

The following example GitHub workflow sets up an Ubuntu host using a series of GitHub Actions, then runs AWS SAM CLI commands to build and deploy an AWS SAM application:

```
on:
  push:
    branches:
      - main
jobs:
  deploy:
    runs-on: ubuntu-latest
    steps:
      - uses: actions/checkout@v2
      - uses: actions/setup-python@v2
      - uses: aws-actions/setup-sam@v1
      - uses: aws-actions/configure-aws-credentials@v1
        with:
          aws-access-key-id: ${{ secrets.AWS_ACCESS_KEY_ID }}
          aws-secret-access-key: ${{ secrets.AWS_SECRET_ACCESS_KEY }}
          aws-region: us-east-2
      - run: sam build --use-container
      - run: sam deploy --no-confirm-changeset --no-fail-on-empty-changeset
```

For a list of available Amazon Elastic Container Registry (Amazon ECR) build container images for different runtimes, see Image repositories (p. 324).

Generating starter CI/CD pipelines

When you are ready to deploy your serverless application in an automated manner, you can generate a deployment pipeline for your CI/CD system of choice. AWS SAM provides a set of starter pipeline templates with which you can generate pipelines in minutes using the sam pipeline init (p. 277) command.

The starter pipeline templates use the familiar JSON/YAML syntax of the CI/CD system, and incorporate best practices such as managing artifacts across multiple accounts and regions, and using the minimum amount of permissions required to deploy the application. Currently, the AWS SAM CLI supports generating starter CI/CD pipeline configurations for AWS CodePipeline, Jenkins, GitLab CI/CD, and GitHub Actions.

Here are the high-level tasks you need to perform to generate a starter pipeline configuration:

1. **Create infrastructure resources** – Your pipeline requires certain AWS resources, for example the IAM user and roles with necessary permissions, an Amazon S3 bucket, and optionally an Amazon ECR repository.
2. **Connect your Git repository with your CI/CD system** – Your CI/CD system needs to know which Git repository will trigger the pipeline to run. Note that this step may not be necessary, depending on which combination of Git repository and CI/CD system you are using.
3. **Generate your pipeline configuration** – This step generates a starter pipeline configuration that includes two deployment stages.
4. **Commit your pipeline configuration to your Git repository** – This step is necessary to ensure your CI/CD system is aware of your pipeline configuration, and will run when changes are committed.

After you've generated the starter pipeline configuration and committed it to your Git repository, whenever someone commits a code change to that repository your pipeline will be triggered to run automatically.

The ordering of these steps, and details of each step, vary based on your CI/CD system:

- If you are using AWS CodePipeline, see Generating starter pipeline for AWS CodePipeline (p. 225).
- If you are using Jenkins, GitLab CI/CD, or GitHub Actions, see Generating starter pipelines for Jenkins, GitLab CI/CD, or GitHub Actions (p. 227).

Generating starter pipeline for AWS CodePipeline

To generate a starter pipeline configuration for AWS CodePipeline, perform the following tasks in this order:

1. Create infrastructure resources

2. Generate the pipeline configuration
3. Commit your pipeline configuration to Git
4. Connect your Git repository with your CI/CD system

> **Note**
> The following procedure utilizes two AWS SAM CLI commands, `sam pipeline bootstrap` (p. 276) and `sam pipeline init` (p. 277). The reason there are two commands is to handle the use case where administrators (that is, users who need permission to set up infrastructure AWS resource like IAM users and roles) have more permission that developers (that is, users who just need permission to set up individual pipelines, but not the required infrastructure AWS resources).

Step 1: Create infrastructure resources

Pipelines that use AWS SAM require certain AWS resources, like an IAM user and roles with necessary permissions, an Amazon S3 bucket, and optionally an Amazon ECR repository. You must have a set of infrastructure resources for each deployment stage of the pipeline.

You can run the following command to help with this setup:

```
sam pipeline bootstrap
```

Note that you need to run the previous command once for each deployment stage of your pipeline.

Step 2: Generate the pipeline configuration

To generate the pipeline configuration, run the following command:

```
sam pipeline init
```

Step 3: Commit your pipeline configuration to Git repository

This step is necessary to ensure your CI/CD system is aware of your pipeline configuration, and will run when changes are committed.

Step 4: Connect your Git repository with your CI/CD system

For AWS CodePipeline you can now create the connection by running the following command:

```
sam deploy -t codepipeline.yaml --stack-name <pipeline-stack-name> --
capabilities=CAPABILITY_IAM --region <region-X>
```

If you are using GitHub or BitBucket, after running the **sam deploy** command previously, complete the connection by following the steps under **To complete a connection** found on the Update a pending connection topic in the *Developer Tools console user guide*. In addition, store a copy of the `CodeStarConnectionArn` from the output of the **sam deploy** command, because you will need it if you want to use AWS CodePipeline with another branch than `main`.

Configuring other branches

By default, AWS CodePipeline uses the `main` branch with AWS SAM. If you want to use a branch other than `main`, you must run the **sam deploy** command again. Note that depending on which Git repository you are using, you may also need to provide the `CodeStarConnectionArn`:

```
# For GitHub and BitBucket
sam deploy -t codepipeline.yaml --stack-name <feature-pipeline-stack-name> --
capabilities=CAPABILITY_IAM --parameter-overrides="FeatureGitBranch=<branch-name>
 CodeStarConnectionArn=<codestar-connection-arn>"

# For AWS CodeCommit
sam deploy -t codepipeline.yaml --stack-name <feature-pipeline-stack-name> --
capabilities=CAPABILITY_IAM --parameter-overrides="FeatureGitBranch=<branch-name>"
```

Generating starter pipelines for Jenkins, GitLab CI/CD, or GitHub Actions

To generate a starter pipeline configuration for Jenkins, GitLab CI/CD, and GitHub Actions, perform the following tasks in this order:

1. Create infrastructure resources
2. Connect your Git repository with your CI/CD system
3. Create credential objects
4. Generate the pipeline configuration
5. Commit your pipeline configuration to Git repository

> **Note**
> The following procedure utilizes two AWS SAM CLI commands, `sam pipeline bootstrap (p. 276)` and `sam pipeline init (p. 277)`. The reason there are two commands is to handle the use case where administrators (that is, users who need permission to set up infrastructure AWS resource like IAM users and roles) have more permission that developers (that is, users who just need permission to set up individual pipelines, but not the required infrastructure AWS resources).

Step 1: Create infrastructure resources

Pipelines that use AWS SAM require certain AWS resources, like an IAM user and roles with necessary permissions, an Amazon S3 bucket, and optionally an Amazon ECR repository. You must have a set of infrastructure resources for each deployment stage of the pipeline.

You can run the following command to help with this setup:

```
sam pipeline bootstrap
```

Note that you need to run the previous command once for each deployment stage of your pipeline.

You must capture the AWS credentials (key id and secret key) for the pipeline users for each deployment stage of your pipeline, because they are needed for subsequent steps.

Step 2: Connect your Git repository with your CI/CD system

Connecting your Git repository to your CI/CD system is necessary so that the CI/CD system is able to access your application source code for builds and deployments.

> **Note**
> You can skip this step if you are using one of the following combinations, because the connection is done for you automatically:
>
> 1. GitHub Actions with GitHub repository

2. GitLab CI/CD with GitLab repository

To connect your Git repository with your CI/CD system, do one of the following:

- If you're using Jenkins, see the Jenkins documentation for "Adding a branch source."
- If you're using GitLab CI/CD and a Git repository other than GitLab, see the GitLab documentation for "connecting an external repository."

Step 3: Create credential objects

Each CI/CD system has its own way of managing credentials needed for the CI/CD system to access your Git repository.

To create the necessary credential objects, do one of the following:

- If you're using Jenkins, create a single "credential" that stores both the key id and secret key. Follow the instructions in the Building a Jenkins Pipeline with AWS SAM blog, in the **Configure Jenkins** section. You will need the "Credential id" for the next step.
- If you're using GitLab CI/CD, create two "protected variables" one for each of key id and secret key. Follow the instructions in the GitLab documentation – you will need two "variable keys" for the next step.
- If you're using GitHub Actions, create two "encrypted secrets" one for each of key and secret key. Follow the instructions in the GitHub documentation - you will need two "secret names" for the next step.

Step 4: Generate the pipeline configuration

To generate the pipeline configuration, run the following command. You will need to input the credential object that you created in the previous step:

```
sam pipeline init
```

Step 5: Commit your pipeline configuration to Git repository

This step is necessary to ensure your CI/CD system is aware of your pipeline configuration, and will run when changes are committed.

Customizing starter pipelines

As a CI/CD administrator, you may want to customize a starter pipeline template, and associated guided prompts, that developers in your organization can use to create pipeline configurations.

The AWS SAM CLI uses Cookiecutter templates when creating starter templates. For details about cookie cutter templates, Cookiecutter.

You can also customize the prompts that the AWS SAM CLI displays to users when creating pipeline configurations using the `sam pipeline init` command. To customize user prompts, do the following:

1. **Create a `questions.json` file** – The `questions.json` file must be in the root of the project respository. This is the same directory as the `cookiecutter.json` file. To view the schema for the `questions.json` file, see questions.json.schema. To view an example `questions.json` file, see questions.json.

2. **Map question keys with cookiecutter names** – Each object in the `questions.json` file needs a key that matches a name in the cookiecutter template. This key matching is how the AWS SAM CLI maps user prompt responses to the cookie cutter template. To see examples of this key matching, see the Example files (p. 229) section later in this topic.
3. **Create a `metadata.json` file** – Declare the number of stages the pipeline will have in the `metadata.json` file. The number of stages instructs the `sam pipeline init` command how many stages to prompt information about, or in the case of the `--bootstrap` option, how many stages to create infrastructure resources for. To view an example `metadata.json` file that declares a pipeline with two stages, see metadata.json.

Example projects

Here are example projects, which each include a Cookiecutter template, a `questions.json` file, and a `metadata.json` file:

- Jenkins example: Two-stage Jenkins pipeline template
- CodePipeline example: Two stage CodePipeline pipeline template

Example files

The following set of files show how questions in the `questions.json` file are associated with entries in the Cookiecutter template file. Note that these examples are file snippets, not full files. To see examples of full files, see the Example projects (p. 229) section earlier in this topic.

Example **`questions.json`**:

```
{
  "questions": [{
    "key": "intro",
    "question": "\nThis template configures a pipeline that deploys a serverless
 application to a testing and a production stage.\n",
    "kind": "info"
  }, {
    "key": "pipeline_user_jenkins_credential_id",
    "question": "What is the Jenkins credential ID (via Jenkins plugin \"aws-credentials\")
 for pipeline user access key?",
    "isRequired": true
  }, {
    "key": "sam_template",
    "question": "What is the template file path?",
    "default": "template.yaml"
  }, {
    ...
```

Example **`cookiecutter.json`**:

```
{
  "outputDir": "aws-sam-pipeline",
  "pipeline_user_jenkins_credential_id": "",
  "sam_template": "",
    ...
```

Example **`Jenkinsfile`**:

```
pipeline {
  agent any
  environment {
    PIPELINE_USER_CREDENTIAL_ID = '{{cookiecutter.pipeline_user_jenkins_credential_id}}'
    SAM_TEMPLATE = '{{cookiecutter.sam_template}}'
    ...
```

Monitoring serverless applications

After you deploy your serverless application to the AWS Cloud, you need to verify that it's operating properly on an ongoing basis.

Topics

- Working with logs (p. 231)

Working with logs

To simplify troubleshooting, the AWS SAM CLI has a command called `sam logs (p. 273)`. This command lets you fetch logs generated by your Lambda function from the command line.

> **Note**
> The `sam logs` command works for all AWS Lambda functions, not just the ones you deploy using AWS SAM.

Fetching logs by AWS CloudFormation stack

When your function is a part of an AWS CloudFormation stack, you can fetch logs by using the function's logical ID:

```
sam logs -n HelloWorldFunction --stack-name mystack
```

Fetching logs by Lambda function name

Or, you can fetch logs by using the function's name:

```
sam logs -n mystack-HelloWorldFunction-1FJ8PD
```

Tailing logs

Add the `--tail` option to wait for new logs and see them as they arrive. This is helpful during deployment or when you're troubleshooting a production issue.

```
sam logs -n HelloWorldFunction --stack-name mystack --tail
```

Viewing logs for a specific time range

You can view logs for a specific time range by using the `-s` and `-e` options:

```
sam logs -n HelloWorldFunction --stack-name mystack -s '10min ago' -e '2min ago'
```

Filtering logs

Use the `--filter` option to quickly find logs that match terms, phrases, or values in your log events:

```
sam logs -n HelloWorldFunction --stack-name mystack --filter "error"
```

In the output, the AWS SAM CLI underlines all occurrences of the word "error" so you can easily locate the filter keyword within the log output.

Error highlighting

When your Lambda function crashes or times out, the AWS SAM CLI highlights the timeout message in red. This helps you easily locate specific executions that are timing out within a giant stream of log output.

JSON pretty printing

If your log messages print JSON strings, the AWS SAM CLI automatically pretty prints the JSON to help you visually parse and understand the JSON.

Publishing serverless applications using the AWS SAM CLI

To make your AWS SAM application available for others to find and deploy, you can use the AWS SAM CLI to publish it to the AWS Serverless Application Repository. To publish your application using the AWS SAM CLI, you must define it using an AWS SAM template. You also must have tested it locally or in the AWS Cloud.

Follow the instructions in this topic to create a new application, create a new version of an existing application, or update the metadata of an existing application. (What you do depends on whether the application already exists in the AWS Serverless Application Repository, and whether any application metadata is changing.) For more information about application metadata, see AWS SAM template Metadata section properties (p. 236).

Prerequisites

Before you publish an application to the AWS Serverless Application Repository using the AWS SAM CLI, you must have the following:

- The AWS SAM CLI installed. For more information, see Installing the AWS SAM CLI (p. 3). To determine whether the AWS SAM CLI is installed, run the following command:

```
sam --version
```

- A valid AWS SAM template.
- Your application code and dependencies that the AWS SAM template references.
- A semantic version, required only to share your application publicly. This value can be as simple as 1.0.
- A URL that points to your application's source code.
- A `README.md` file. This file should describe how customers can use your application and how to configure it before deploying it in their own AWS accounts.
- A `LICENSE.txt` file, required only to share your application publicly.
- If your application contains any nested applications, you must have already published them to the AWS Serverless Application Repository.
- A valid Amazon Simple Storage Service (Amazon S3) bucket policy that grants the service read permissions for artifacts that you upload to Amazon S3 when you package your application. To set up this policy, do the following:

  1. Open the Amazon S3 console at https://console.aws.amazon.com/s3/.
  2. Choose the name of the Amazon S3 bucket that you used to package your application.
  3. Choose **Permissions**.
  4. On the **Permissions** tab, under **Bucket policy**, choose **Edit**.
  5. On the **Edit bucket policy** page, paste the following policy statement into the **Policy** editor. In the policy statement, make sure to use your bucket name in the `Resource` element and your AWS account ID in the `Condition` element. The expression in the `Condition` element ensures that AWS Serverless Application Repository has permission to access only applications from the specified AWS account. For more information about policy statements, see IAM JSON policy elements reference in the *IAM User Guide*.

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": {
                "Service":  "serverlessrepo.amazonaws.com"
            },
            "Action": "s3:GetObject",
            "Resource": "arn:aws:s3:::<your-bucket-name>/*",
            "Condition" : {
                "StringEquals": {
                    "aws:SourceAccount": "123456789012"
                }
            }
        }
    ]
}
```

6. Choose **Save changes**.

Publishing a new application

Step 1: Add a Metadata section to the AWS SAM template

First, add a `Metadata` section to your AWS SAM template. Provide the application information to be published to the AWS Serverless Application Repository.

The following is an example `Metadata` section:

```
Metadata:
  AWS::ServerlessRepo::Application:
    Name: my-app
    Description: hello world
    Author: user1
    SpdxLicenseId: Apache-2.0
    LicenseUrl: LICENSE.txt
    ReadmeUrl: README.md
    Labels: ['tests']
    HomePageUrl: https://github.com/user1/my-app-project
    SemanticVersion: 0.0.1
    SourceCodeUrl: https://github.com/user1/my-app-project

Resources:
  HelloWorldFunction:
    Type: AWS::Lambda::Function
      Properties:
        ...
        CodeUri: source-code1
        ...
```

For more information about the `Metadata` section of the AWS SAM template, see AWS SAM template Metadata section properties (p. 236).

Step 2: Package the application

Run the following AWS SAM CLI command, which uploads the application's artifacts to Amazon S3 and outputs a new template file called `packaged.yaml`:

```
sam package --template-file template.yaml --output-template-file packaged.yaml --s3-
bucket <your-bucket-name>
```

You use the `packaged.yaml` template file in the next step to publish the application to the AWS Serverless Application Repository. This file is similar to the original template file (`template.yaml`), but it has a key difference—the `CodeUri`, `LicenseUrl`, and `ReadmeUrl` properties point to the Amazon S3 bucket and objects that contain the respective artifacts.

The following snippet from an example `packaged.yaml` template file shows the `CodeUri` property:

```
MySampleFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: s3://bucketname/fbd77a3647a4f47a352fcObjectGUID

...
```

Step 3: Publish the application

To publish a private version of your AWS SAM application to the AWS Serverless Application Repository, run the following AWS SAM CLI command:

```
sam publish --template packaged.yaml --region us-east-1
```

The output of the `sam publish` command includes a link to your application on the AWS Serverless Application Repository. You can also go directly to the AWS Serverless Application Repository landing page and search for your application.

Step 4: Share the application (optional)

By default, your application is set to private, so it isn't visible to other AWS accounts. To share your application with others, you must either make it public or grant permission to a specific list of AWS accounts.

For information about sharing your application using the AWS CLI, see AWS Serverless Application Repository Resource-Based Policy Examples in the *AWS Serverless Application Repository Developer Guide*. For information on sharing your application using the AWS Management Console, see Sharing an Application in the *AWS Serverless Application Repository Developer Guide*.

Publishing a new version of an existing application

After you've published an application to the AWS Serverless Application Repository, you might want to publish a new version of it. For example, you might have changed your Lambda function code or added a new component to your application architecture.

To update an application that you've previously published, publish the application again using the same process detailed previously. In the `Metadata` section of the AWS SAM template file, provide the same application name that you originally published it with, but include a new `SemanticVersion` value.

For example, consider an application published with the name `SampleApp` and a `SemanticVersion` of `1.0.0`. To update that application, the AWS SAM template must have the application name `SampleApp` and a `SemanticVersion` of `1.0.1` (or anything other than `1.0.0`).

Additional topics

- AWS SAM template Metadata section properties (p. 236)

AWS SAM template Metadata section properties

`AWS::ServerlessRepo::Application` is a metadata key that you can use to specify application information that you want published to the AWS Serverless Application Repository.

> **Note**
> AWS CloudFormation intrinsic functions aren't supported by the `AWS::ServerlessRepo::Application` metadata key.

Properties

This table provides information about the properties of the `Metadata` section of the AWS SAM template. This section is required to publish applications to the AWS Serverless Application Repository using the AWS SAM CLI.

Property	Type	Required	Description
`Name`	String	TRUE	The name of the application. Minimum length=1. Maximum length=140. Pattern: `"[a-zA-Z0-9\\-]+";`
`Description`	String	TRUE	The description of the application. Minimum length=1. Maximum length=256.
`Author`	String	TRUE	The name of the author publishing the application. Minimum length=1. Maximum length=127. Pattern: `"^[a-z0-9](([a-z0-9]|-(?!-))*[a-z0-9])?$";`
`SpdxLicenseId`	String	FALSE	A valid license identifier. To view the list of valid license identifiers, see SPDX License List on the *Software Package Data Exchange (SPDX)* website.
`LicenseUrl`	String	FALSE	The reference to a local license file, or an Amazon S3 link to a license file, that matches the spdxLicenseID value of your application. An AWS SAM template file that hasn't been packaged using the `sam package` command can have a reference to a local file for this property. However, for an application to be published using the `sam publish` command, this property must be a reference to an Amazon S3 bucket. Maximum size: 5 MB. You must provide a value for this property in order to make your application public. Note that you cannot

Property	Type	Required	Description
			update this property after your application has been published. So, to add a license to an application, you must either delete it first, or publish a new application with a different name.
`ReadmeUrl`	String	FALSE	The reference to a local readme file or an Amazon S3 link to the readme file that contains a more detailed description of the application and how it works. An AWS SAM template file that hasn't been packaged using the `sam package` command can have a reference to a local file for this property. However, to be published using the `sam publish` command, this property must be a reference to an Amazon S3 bucket. Maximum size: 5 MB.
`Labels`	String	FALSE	The labels that improve discovery of applications in search results. Minimum length=1. Maximum length=127. Maximum number of labels: 10. Pattern: `"^[a-zA-Z0-9+\\-_:\\/@]+$";`
`HomePageUrl`	String	FALSE	A URL with more information about the application—for example, the location of your GitHub repository for the application.
`SemanticVersion`	String	FALSE	The semantic version of the application. For the Semantic Versioning specification, see the Semantic Versioning website. You must provide a value for this property in order to make your application public.
`SourceCodeUrl`	String	FALSE	A link to a public repository for the source code of your application.

Use cases

This section lists the use cases for publishing applications, along with the `Metadata` properties that are processed for that use case. Properties that are *not* listed for a given use case are ignored.

- **Creating a new application** – A new application is created if there is no application in the AWS Serverless Application Repository with a matching name for an account.
  - `Name`
  - `SpdxLicenseId`
  - `LicenseUrl`
  - `Description`
  - `Author`
  - `ReadmeUrl`
  - `Labels`
  - `HomePageUrl`

  - `SourceCodeUrl`
  - `SemanticVersion`
  - The content of the AWS SAM template (for example, any event sources, resources, and Lambda function code)

- **Creating an application version** – An application version is created if there is already an application in the AWS Serverless Application Repository with a matching name for an account *and* the SemanticVersion *is* changing.
  - `Description`
  - `Author`
  - `ReadmeUrl`
  - `Labels`
  - `HomePageUrl`
  - `SourceCodeUrl`
  - `SemanticVersion`
  - The content of the AWS SAM template (for example, any event sources, resources, and Lambda function code)

- **Updating an application** – An application is updated if there is already an application in the AWS Serverless Application Repository with a matching name for an account *and* the SemanticVersion *is not* changing.
  - `Description`
  - `Author`
  - `ReadmeUrl`
  - `Labels`
  - `HomePageUrl`

Example

The following is an example `Metadata` section:

```
Metadata:
  AWS::ServerlessRepo::Application:
    Name: my-app
    Description: hello world
    Author: user1
    SpdxLicenseId: Apache-2.0
    LicenseUrl: LICENSE.txt
    ReadmeUrl: README.md
    Labels: ['tests']
    HomePageUrl: https://github.com/user1/my-app-project
    SemanticVersion: 0.0.1
    SourceCodeUrl: https://github.com/user1/my-app-project
```

Example serverless applications

The following examples show you how to download, test, and deploy a number of additional serverless applications—including how to configure event sources and AWS resources.

Topics

- Process DynamoDB events (p. 239)
- Process Amazon S3 events (p. 241)

Process DynamoDB events

With this example application, you build on what you learned in the overview and the Quick Start guide, and install another example application. This application consists of a Lambda function that's invoked by a DynamoDB table event source. The Lambda function is very simple—it logs data that was passed in through the event source message.

This exercise shows you how to mimic event source messages that are passed to Lambda functions when they're invoked.

Before you begin

Make sure that you've completed the required setup in the Installing the AWS SAM CLI (p. 3).

Step 1: Initialize the application

In this section, you download the application package, which consists of an AWS SAM template and application code.

To initialize the application

1. Run the following command at an AWS SAM CLI command prompt.

   ```
   sam init \
   --location gh:aws-samples/cookiecutter-aws-sam-dynamodb-python \
   --no-input
   ```

   Note that `gh:` in the command above gets expanded to the GitHub url `https://github.com/`.
2. Review the contents of the directory that the command created (`dynamodb_event_reader/`):

   - `template.yaml` – Defines two AWS resources that the Read DynamoDB application needs: a Lambda function and a DynamoDB table. The template also defines mapping between the two resources.
   - `read_dynamodb_event/` directory – Contains the DynamoDB application code.

Step 2: Test the application locally

For local testing, use the AWS SAM CLI to generate a sample DynamoDB event and invoke the Lambda function:

```
sam local generate-event dynamodb update | sam local invoke --event - ReadDynamoDBEvent
```

The `generate-event` command creates a test event source message like the messages that are created when all components are deployed to the AWS Cloud. This event source message is piped to the Lambda function ReadDynamoDBEvent.

Verify that the expected messages are printed to the console, based on the source code in `app.py`.

Step 3: Package the application

After testing your application locally, you use the AWS SAM CLI to create a deployment package, which you use to deploy the application to the AWS Cloud.

To create a Lambda deployment package

1. Create an S3 bucket in the location where you want to save the packaged code. If you want to use an existing S3 bucket, skip this step.

   ```
   aws s3 mb s3://bucketname
   ```

2. Create the deployment package by running the following `package` CLI command at the command prompt.

   ```
   sam package \
       --template-file template.yaml \
       --output-template-file packaged.yaml \
       --s3-bucket bucketname
   ```

   You specify the new template file, `packaged.yaml`, when you deploy the application in the next step.

Step 4: Deploy the application

Now that you've created the deployment package, you use it to deploy the application to the AWS Cloud. You then test the application.

To deploy the serverless application to the AWS Cloud

- In the AWS SAM CLI, use the `deploy` CLI command to deploy all of the resources that you defined in the template.

  ```
  sam deploy \
      --template-file packaged.yaml \
      --stack-name sam-app \
      --capabilities CAPABILITY_IAM \
      --region us-east-1
  ```

  In the command, the `--capabilities` parameter allows AWS CloudFormation to create an IAM role.

  AWS CloudFormation creates the AWS resources that are defined in the template. You can access the names of these resources in the AWS CloudFormation console.

To test the serverless application in the AWS Cloud

1. Open the DynamoDB console.
2. Insert a record into the table that you just created.
3. Go to the **Metrics** tab of the table, and choose **View all CloudWatch metrics**. In the CloudWatch console, choose **Logs** to be able to view the log output.

Next steps

The AWS SAM GitHub repository contains additional example applications for you to download and experiment with. To access this repository, see AWS SAM example applications.

Process Amazon S3 events

With this example application, you build on what you learned in the previous examples, and install a more complex application. This application consists of a Lambda function that's invoked by an Amazon S3 object upload event source. This exercise shows you how to access AWS resources and make AWS service calls through a Lambda function.

This sample serverless application processes object-creation events in Amazon S3. For each image that's uploaded to a bucket, Amazon S3 detects the object-created event and invokes a Lambda function. The Lambda function invokes Amazon Rekognition to detect text that's in the image. It then stores the results returned by Amazon Rekognition in a DynamoDB table.

> **Note**
> With this example application, you perform steps in a slightly different order than in previous examples. The reason for this is that this example requires that AWS resources are created and IAM permissions are configured *before* you can test the Lambda function locally. We're going to leverage AWS CloudFormation to create the resources and configure the permissions for you. Otherwise, you would need to do this manually before you can test the Lambda function locally. Because this example is more complicated, be sure that you're familiar with installing the previous example applications before executing this one.

Before you begin

Make sure that you've completed the required setup in the Installing the AWS SAM CLI (p. 3).

Step 1: Initialize the application

In this section, you download the sample application, which consists of an AWS SAM template and application code.

To initialize the application

1. Run the following command at an AWS SAM CLI command prompt.

```
sam init \
--location https://github.com/aws-samples/cookiecutter-aws-sam-s3-rekognition-dynamodb-python \
--no-input
```

2. Review the contents of the directory that the command created (`aws_sam_ocr/`):

- `template.yaml` – Defines three AWS resources that the Amazon S3 application needs: a Lambda function, an Amazon S3 bucket, and a DynamoDB table. The template also defines the mappings and permissions between these resources.
- `src/` directory – Contains the Amazon S3 application code.
- `SampleEvent.json` – The sample event source, which is used for local testing.

Step 2: Package the application

Before you can test this application locally, you must use the AWS SAM CLI to create a deployment package, which you use to deploy the application to the AWS Cloud. This deployment creates the necessary AWS resources and permissions that are required to test the application locally.

To create a Lambda deployment package

1. Create an S3 bucket in the location where you want to save the packaged code. If you want to use an existing S3 bucket, skip this step.

   ```
   aws s3 mb s3://bucketname
   ```

2. Create the deployment package by running the following `package` CLI command at the command prompt.

   ```
   sam package \
       --template-file template.yaml \
       --output-template-file packaged.yaml \
       --s3-bucket bucketname
   ```

   You specify the new template file, `packaged.yaml`, when you deploy the application in the next step.

Step 3: Deploy the application

Now that you've created the deployment package, you use it to deploy the application to the AWS Cloud. You then test the application by invoking it in the AWS Cloud.

To deploy the serverless application to the AWS Cloud

- In the AWS SAM CLI, use the `deploy` command to deploy all of the resources that you defined in the template.

  ```
  sam deploy \
      --template-file packaged.yaml \
      --stack-name aws-sam-ocr \
      --capabilities CAPABILITY_IAM \
      --region us-east-1
  ```

  In the command, the `--capabilities` parameter allows AWS CloudFormation to create an IAM role.

  AWS CloudFormation creates the AWS resources that are defined in the template. You can access the names of these resources in the AWS CloudFormation console.

To test the serverless application in the AWS Cloud

1. Upload an image to the Amazon S3 bucket that you created for this sample application.
2. Open the DynamoDB console and find the table that was created. See the table for results returned by Amazon Rekognition.
3. Verify that the DynamoDB table contains new records that contain text that Amazon Rekognition found in the uploaded image.

Step 4: Test the application locally

Before you can test the application locally, you must first retrieve the names of the AWS resources that were created by AWS CloudFormation.

- Retrieve the Amazon S3 key name and bucket name from AWS CloudFormation. Modify the `SampleEvent.json` file by replacing the values for the object key, bucket name, and bucket ARN.
- Retrieve the DynamoDB table name. This name is used for the following `sam local invoke` command.

Use the AWS SAM CLI to generate a sample Amazon S3 event and invoke the Lambda function:

```
TABLE_NAME=Table name obtained from AWS CloudFormation console sam local invoke --event
 SampleEvent.json
```

The `TABLE_NAME=` portion sets the DynamoDB table name. The `--event` parameter specifies the file that contains the test event message to pass to the Lambda function.

You can now verify that the expected DynamoDB records were created, based on the results returned by Amazon Rekognition.

Next steps

The AWS SAM GitHub repository contains additional example applications for you to download and experiment with. To access this repository, see AWS SAM example applications.

AWS Cloud Development Kit (CDK) (Preview)

CDK integration with the AWS SAM CLI is currently in public preview. During public preview, CDK integration with the AWS SAM CLI may be subject to backwards incompatible changes.

You can use the AWS SAM CLI to locally test, build, package, and deploy serverless applications defined using the AWS Cloud Development Kit (CDK). Because the AWS SAM CLI works within the AWS CDK project structure, you can still use the AWS CDK Toolkit for creating, modifying, and deploying your AWS CDK applications.

For information about installing and configuring the AWS CDK, see Getting started with the AWS CDK in the *AWS Cloud Development Kit (CDK) Developer Guide*.

> **Note**
> The AWS SAM CLI only supports Lambda functions created with the standard Lambda construct. For information about the standard Lambda construct, see @aws-cdk/aws-lambda module.

Topics

- Getting started with AWS SAM and the AWS CDK (p. 244)
- Locally testing AWS CDK applications (p. 246)
- Building AWS CDK applications (p. 247)
- Packaging AWS CDK applications (p. 248)
- Deploying AWS CDK applications (p. 249)

Getting started with AWS SAM and the AWS CDK

CDK integration with the AWS SAM CLI is currently in public preview. During public preview, CDK integration with the AWS SAM CLI may be subject to backwards incompatible changes.

This topic describes what you need to use the AWS SAM CLI with AWS CDK applications, and provides instructions for building and locally testing a simple AWS CDK application.

Prerequisites

To use the AWS SAM CLI with AWS CDK, you must install the AWS CDK, and the public preview version of the AWS SAM CLI.

- For information about installing the AWS CDK, see Getting started with the AWS CDK in the *AWS Cloud Development Kit (CDK) Developer Guide*.
- To install the public preview version of the AWS SAM CLI, follow the same instructions for Installing the AWS SAM CLI (p. 3) the OS of your development host, but use the public preview download link or installation command as listed below:

- **Linux:** The private preview build is available with this download link: AWS SAM CLI beta CDK build.
- **Windows:** The private preview is available with this download link: AWS SAM CLI beta CDK build.
- **macOS:** The private preview is available using the following command `brew install aws-sam-cli-beta-cdk`.

To verify you have installed the public preview version, run the `sam-beta-cdk --version` command. The output of this command is in the form `1.X.Y.dev<YYYYMMDDHHmm>`, for example:

```
SAM CLI, version 1.22.0.dev202104281200
```

Downloading and locally testing an AWS CDK application

To locally test an AWS CDK application using the AWS SAM CLI, you must start with a AWS CDK application that contains a Lambda function. If you don't already have a AWS CDK application that contains a Lambda function, you can either download a sample AWS CDK application using the AWS SAM CLI, or follow the instructions for Creating a serverless application using the AWS CDK in the *AWS Cloud Development Kit (CDK) Developer Guide*.

> **Note**
> The AWS SAM CLI only supports Lambda functions created with the standard Lambda construct. For information about the standard Lambda construct, see @aws-cdk/aws-lambda module.

To download a sample AWS CDK application using the AWS SAM CLI, run the **sam init** command and specify a `CDK` project type. There are two ways to do this:

- **On the command line**: Use the `--project-type CDK` option. For example:

```
sam-beta-cdk init --project-type CDK --package-type Zip --runtime python3.8 --dependency-
manager pip --app-template hello-world --cdk-language python --name sam-cdk-app-demo
```

- **Using interactive prompts**: Run the **sam-beta-cdk init** command. Then, at the prompt asking `Which type of project would you like to create?` answer `CDK`. Answer all other necessary prompts based on your needs for the sample project.

You can use the AWS SAM CLI to locally invoke a Lambda function defined in your application. To do this, you need the function identifier that you want to invoke, and the stack name where the function is defined.

For example, consider a stack and a function that are declared with the following sample:

```
app = new HelloCdkStack(app, "HelloCdkStack",
   ...
)

class HelloCdkStack extends cdk.Stack {
  constructor(scope: cdk.Construct, id: string, props?: cdk.StackProps) {
    ...
    const fn = new lambda.Function(this, 'MyFunction', {
    ...
 });
}
```

The following command locally invokes the Lambda function defined in example presented above:

```
sam-beta-cdk local invoke HelloCdkStack/MyFunction
```

For more information about options available for test AWS CDK applications using AWS SAM CLI, see Locally testing AWS CDK applications (p. 246).

Locally testing AWS CDK applications

CDK integration with the AWS SAM CLI is currently in public preview. During public preview, CDK integration with the AWS SAM CLI may be subject to backwards incompatible changes.

You can use the AWS SAM CLI to locally test your AWS CDK applications by running the following commands from the project root directory of your AWS CDK application:

- sam local invoke (p. 266)
- sam local start-api (p. 268)
- sam local start-lambda (p. 270)

Note
The AWS SAM CLI only supports Lambda functions created with the standard Lambda construct. For information about the standard Lambda construct, see @aws-cdk/aws-lambda module.

When you run any of the **sam local** commands with a AWS CDK application, the AWS SAM CLI runs **cdk synth** on your behalf if the cloud assembly doesn't already exist. The default location of the cloud assembly relative to the project root directory is `./aws-sam/build`.

When running **sam local invoke** you need the function identifier that you want to invoke, and the stack name where the function is defined.

Usage:

```
# Invoke the function FUNCTION_IDENTIFIER declared in the stack STACK_NAME
sam-beta-cdk local invoke [OPTIONS] [STACK_NAME/FUNCTION_IDENTIFIER]

# Start all APIs declared in the AWS CDK application
sam-beta-cdk local start-api [OPTIONS]

# Start a local endpoint that emulates AWS Lambda
sam-beta-cdk local start-lambda [OPTIONS]
```

Options:

For the public preview version of the AWS SAM CLI, the following options are available in addition to the options available in the production version of the `sam local` functions described in this topic.

Option	Description
`--project-type [CFN | CDK]`	Specifies whether this is an AWS SAM or AWS CDK application. If this option is not specified, the AWS SAM CLI will attempt to determine which type of project it is based on the existance of `template.yaml` (AWS SAM) or `cdk.json` (AWS CDK) in the project root directory.

Option	Description
`--cdk-app TEXT`	Command-line for executing your app, or a cloud assembly directory. This option is passed directly to the `--app` option of the `cdk synth` command. For more information, see Toolkit reference in the *AWS Cloud Development Kit (CDK) Developer Guide*.
`--cdk-context`	Runtime context in key-value pairs for your AWS CDK application. This option is passed directly to the `--context` option of the `cdk synth` command. For more information, see Toolkit reference in the *AWS Cloud Development Kit (CDK) Developer Guide*.

Example

Consider a stack and a function that are declared with the following sample:

```
app = new HelloCdkStack(app, "HelloCdkStack",
   ...
)
class HelloCdkStack extends cdk.Stack {
  constructor(scope: cdk.Construct, id: string, props?: cdk.StackProps) {
    ...
    const fn = new lambda.Function(this, 'MyFunction', {
    ...
 });
}
```

In this example the stack name is *`HelloCdkStack`* and the function identifier is *`MyFunction`*. The following command locally invokes the Lambda function defined in example presented above:

```
sam-beta-cdk local invoke HelloCdkStack/MyFunction
```

Building AWS CDK applications

CDK integration with the AWS SAM CLI is currently in public preview. During public preview, CDK integration with the AWS SAM CLI may be subject to backwards incompatible changes.

The AWS SAM CLI provides support for building Lambda functions and layers defined in your AWS CDK application by detecting that the following command is run from the project root directory of your AWS CDK application:

- sam build (p. 252)

When you run the **sam build** command with a AWS CDK application, AWS SAM runs **cdk synth** on your behalf to produce the cloud assembly that will be needed for subsequent steps in your development workflow. The default location of the cloud assembly relative to the project root directory is `./aws-sam/build`.

Options:

For the public preview version of the AWS SAM CLI, the following options are available in addition to the options available in the production version of the **sam build** command.

Option	Description
`--project-type [CFN | CDK]`	Specifies whether this is an AWS SAM or AWS CDK application. If this option is not specified, the AWS SAM CLI will attempt to determine which type of project it is based on the existance of `template.yaml` (AWS SAM) or `cdk.json` (AWS CDK) in the project root directory.
`--cdk-app`	Command-line for executing your app, or a cloud assembly directory. This option is passed directly to the `--app` option of the `cdk synth` command. For more information, see Toolkit reference in the *AWS Cloud Development Kit (CDK) Developer Guide*.
`--cdk-context`	Runtime context in key-value pairs for your AWS CDK application. This option is passed directly to the `--context` option of the `cdk synth` command. For more information, see Toolkit reference in the *AWS Cloud Development Kit (CDK) Developer Guide*.

Example

Running the following command from the AWS CDK project root directory will build the application and place the cloud assembly in default location of `./aws-sam/build`.

```
sam-beta-cdk build
```

Packaging AWS CDK applications

CDK integration with the AWS SAM CLI is currently in public preview. During public preview, CDK integration with the AWS SAM CLI may be subject to backwards incompatible changes.

The AWS SAM CLI provides support for packaging AWS CDK applications by detecting that the following command is run from the project root directory of your AWS CDK application:

- sam package (p. 274)

When you run the **sam package** command with a AWS CDK application, AWS SAM runs **cdk synth** on your behalf if the cloud assembly doesn't already exist. The default location of the cloud assembly relative to the project root directory is `./aws-sam/build`.

The following options are available with this command for packaging AWS CDK applications:

Options:

For the public preview version of the AWS SAM CLI, the following options are available in addition to the options available in the production version of the **sam package** command.

Option	Description
`--project-type [CFN | CDK]`	Specifies whether this is an AWS SAM or AWS CDK application. If this option is not specified, the AWS SAM CLI will attempt to determine which type of project it is based on the existance of `template.yaml` (AWS SAM) or `cdk.json` (AWS CDK) in the project root directory.

Option	Description
`--cdk-app TEXT`	Command-line for executing your app, or a cloud assembly directory. This option is passed directly to the `--app` option of the `cdk synth` command. For more information, see Toolkit reference in the *AWS Cloud Development Kit (CDK) Developer Guide*.
`--cdk-context`	Runtime context in key-value pairs for your AWS CDK application. This option is passed directly to the `--context` option of the `cdk synth` command. For more information, see Toolkit reference in the *AWS Cloud Development Kit (CDK) Developer Guide*.

Examples

Running the following command from the AWS CDK project root directory will package the application.

```
sam-beta-cdk package
```

Deploying AWS CDK applications

CDK integration with the AWS SAM CLI is currently in public preview. During public preview, CDK integration with the AWS SAM CLI may be subject to backwards incompatible changes.

The AWS SAM CLI provides support for deploying AWS CDK applications by detecting that the following command is run from the project root directory of your AWS CDK application:

- sam deploy (p. 258)

When you run the **sam deploy** command with a AWS CDK application, AWS SAM runs **cdk synth** on your behalf if the cloud assembly doesn't already exist. The default location of the cloud assembly relative to the project root directory is `./aws-sam/build`.

The following options are available with this command for deploying AWS CDK applications:

Options:

For the public preview version of the AWS SAM CLI, the following options are available in addition to the options available in the production version of the **sam deploy** command.

Option	Description
`--project-type [CFN | CDK]`	Specifies whether this is an AWS SAM or AWS CDK application. If this option is not specified, the AWS SAM CLI will attempt to determine which type of project it is based on the existance of `template.yaml` (AWS SAM) or `cdk.json` (AWS CDK) in the project root directory.
`--cdk-app TEXT`	Command-line for executing your app, or a cloud assembly directory. This option is passed directly to the `--app` option of the `cdk synth` command. For more information, see Toolkit reference in the *AWS Cloud Development Kit (CDK) Developer Guide*.

Option	Description
`--cdk-context`	Runtime context in key-value pairs for your AWS CDK application. This option is passed directly to the `--context` option of the `cdk synth` command. For more information, see Toolkit reference in the *AWS Cloud Development Kit (CDK) Developer Guide*.

Examples

Running the following command from the AWS CDK project root directory will deploy the application.

```
sam-beta-cdk deploy
```

AWS SAM reference

AWS SAM specification

The AWS SAM specification is an open-source specification under the Apache 2.0 license. The current version of the AWS SAM specification is available in the AWS Serverless Application Model (AWS SAM) specification (p. 27).

AWS SAM templates are an extension of AWS CloudFormation templates. For the full reference for AWS CloudFormation templates, see AWS CloudFormation Template Reference.

AWS SAM CLI command reference

The **AWS SAM CLI** is a command line tool that operates on an AWS SAM template and application code. With the AWS SAM CLI, you can invoke Lambda functions locally, create a deployment package for your serverless application, deploy your serverless application to the AWS Cloud, and so on.

You can use the AWS SAM CLI commands to develop, test, and deploy your serverless applications to the AWS Cloud. The following are some examples of AWS SAM CLI commands:

- `sam init` – If you're a first-time AWS SAM CLI user, you can run the `sam init` command without any parameters to create a Hello World application. The command generates a preconfigured AWS SAM template and example application code in the language that you choose.
- `sam local invoke` and `sam local start-api` – Use these commands to test your application code locally, before deploying it to the AWS Cloud.
- `sam logs` – Use this command to fetch logs generated by your Lambda function. This can help you with testing and debugging your application after you've deployed it to the AWS Cloud.
- `sam package` – Use this command to bundle your application code and dependencies into a "deployment package". The deployment package is needed to upload your application to the AWS Cloud.
- `sam deploy` – Use this command to deploy your serverless application to the AWS Cloud. It creates the AWS resources and sets permissions and other configurations that are defined in the AWS SAM template.

For instructions about installing the AWS SAM CLI, see Installing the AWS SAM CLI (p. 3).

AWS SAM policy templates

AWS SAM allows you to choose from a list of policy templates to scope the permissions of your Lambda functions to the resources that are used by your application.

Topics

- AWS Serverless Application Model (AWS SAM) specification (p. 27)
- AWS SAM CLI command reference (p. 252)
- AWS SAM CLI configuration file (p. 280)

- AWS SAM policy templates (p. 283)
- Image repositories (p. 324)
- Telemetry in the AWS SAM CLI (p. 328)
- Permissions (p. 330)

AWS SAM CLI command reference

This section is the reference for the AWS SAM CLI commands. For instructions about installing the AWS SAM CLI, see Installing the AWS SAM CLI (p. 3).

Topics

- sam build (p. 252)
- sam delete (p. 257)
- sam deploy (p. 258)
- sam init (p. 262)
- sam local generate-event (p. 264)
- sam local invoke (p. 266)
- sam local start-api (p. 268)
- sam local start-lambda (p. 270)
- sam logs (p. 273)
- sam package (p. 274)
- sam pipeline bootstrap (p. 276)
- sam pipeline init (p. 277)
- sam publish (p. 278)
- sam validate (p. 279)

sam build

Builds a serverless application and prepares it for subsequent steps in your workflow, like locally testing the application or deploying it to the AWS Cloud. If you provide a `RESOURCE_LOGICAL_ID`, then AWS SAM builds only that resource. To build a resource of a nested application or stack, you can provide the application or stack logical ID along with the resource logical ID using the format `StackLogicalId/ResourceLogicalId`.

The `sam build` command processes your AWS SAM template file, application code, and any applicable language-specific files and dependencies. The command also copies build artifacts in the format and location expected for subsequent steps in your workflow. You specify dependencies in a manifest file that you include in your application, such as `requirements.txt` for Python functions, or `package.json` for Node.js functions.

The format of your application's build artifacts depends on its package type. You specify your AWS Lambda function's package type with the `PackageType` property. The options are:

- **`Zip`** – A .zip file archive, which contains your application code and its dependencies. If you package your code as a .zip file archive, you must specify a Lambda runtime for your function.
- **`Image`** – A container image, which includes the base operating system, runtime, and extensions, in addition to your application code and its dependencies.

For more information about Lambda package types, see Lambda deployment packages in the *AWS Lambda Developer Guide*.

If a resource includes a `Metadata` resource attribute with a `BuildMethod` entry, `sam build` builds that resource according to the value of the `BuildMethod` entry. Valid values for `BuildMethod` are 1) One of the identifiers for a Lambda runtime, or 2) The `makefile` identifier.

- **Lambda runtime identifier** – Build the resource against a Lambda runtime. For the list of supported runtime identifiers, see Lambda runtimes in the *AWS Lambda Developer Guide*.
- **`makefile`** identifier – Run the commands of the build target for the resource. In this case, your makefile must be named `Makefile` and include a build target named `build-`*`resource-logical-id`*.

To build layers and custom runtimes, you can also use the `Metadata` resource attribute with a `BuildMethod` entry. For information about building layers, see Building layers (p. 209). For information about building custom runtimes, see Building custom runtimes (p. 211).

For serverless function resources that have the `Image` package type, use the `Metadata` resource attribute to configure Docker image settings that are required to build a container image. For more information about building container images, see Building a container image (p. 207).

For a complete example that uses this command, including locally testing and deploying to the AWS Cloud, see Tutorial: Deploying a Hello World application (p. 16). The `sam build` command is part of Step 2: Build your application (p. 18).

Usage:

```
sam build [OPTIONS] [RESOURCE_LOGICAL_ID]
```

Examples:

```
To use these commands, update your SAM template to specify the path
to your function's source code in the resource's Code or CodeUri property.

To build on your workstation, run this command in the directory containing your
SAM template. Built artifacts are written to the .aws-sam/build directory.
$ sam build

To build inside a Lambda-like Docker container
$ sam build --use-container

To build with environment variables passed to the build container from the command line
$ sam build --use-container --container-env-var Function1.GITHUB_TOKEN=<token1> --
container-env-var GLOBAL_ENV_VAR=<global-token>

To build with environment variables passed to the build container from a file
$ sam build --use-container --container-env-var-file <env-file.json>

Build a Node.js 12 application using a container image pulled from DockerHub
$ sam build --use-container --build-image amazon/aws-sam-cli-build-image-nodejs12.x

Build a function resource using the Python 3.8 container image pulled from DockerHub
$ sam build --use-container --build-image Function1=amazon/aws-sam-cli-build-image-
python3.8

To build and run your functions locally
$ sam build && sam local invoke

To build and package for deployment
$ sam build && sam package --s3-bucket <bucketname>

To build the 'MyFunction' resource
$ sam build MyFunction
```

```
To build the 'MyFunction' resource of the 'MyNestedStack' nested stack
$ sam build MyNestedStack/MyFunction
```

Arguments:

Argument	Description
`RESOURCE_LOGICAL_ID`	Optional. Instructs AWS SAM to build a single resource declared in the AWS SAM template. The build artifacts for the specified resource will be the only ones available for subsequent commands in the workflow, i.e. `sam package` and `sam deploy`.

Options:

Option	Description
`-b`, `--build-dir DIRECTORY`	The path to a directory where the built artifacts are stored. This directory and all of its content are removed with this option.
`-s`, `--base-dir DIRECTORY`	Resolves relative paths to the function's or layer's source code with respect to this directory. Use this option if you want to change how relative paths to source code folders are resolved. By default, relative paths are resolved with respect to the AWS SAM template's location. In addition to the resources in the root application or stack you are building, this option also applies nested applications or stacks. This option applies to the following resource types and properties: • Resource type: `AWS::Serverless::Function` Property: `CodeUri` • Resource type: `AWS::Serverless::Function` Resource attribute: `Metadata` Entry: `DockerContext` • Resource type: `AWS::Serverless::LayerVersion` Property: `ContentUri` • Resource type: `AWS::Lambda::Function` Property: `Code` • Resource type: `AWS::Lambda::LayerVersion` Property: `Content`
`-u`, `--use-container`	If your functions depend on packages that have natively compiled dependencies, use this option to build your function inside a Lambda-like Docker container.
`-e`, `--container-env-var TEXT`	Environment variables to pass to the build container. You can specify this option multiple times. Each instance of this option takes a key-value pair, where the key is the resource and environment variable, and the value is the environment variable's value. For example: `--container-env-var Function1.GITHUB_TOKEN=TOKEN1 --container-env-var Function2.GITHUB_TOKEN=TOKEN2`. This option only applies if the `--use-container` option is specified, otherwise an error will result.
`-ef`, `--container-env-var-file PATH`	The path and file name of a JSON file that contains values for the container's environment variables. For more information about container environment variable files, see Container environment variable file (p. 207).

Option	Description
	This option only applies if the `--use-container` option is specified, otherwise an error will result.
`--build-image TEXT`	The URI of the container image that you want to pull for the build. By default, AWS SAM pulls the container image from Amazon ECR Public. Use this option to pull the image from another location. You can specify this option multiple times. Each instance of this option can take either a string or a key-value pair. If you specify a string, it is the URI of the container image to use for all resources in your application. For example, `sam build --use-container --build-image amazon/aws-sam-cli-build-image-python3.8`. If you specify a key-value pair, the key is the resource name, and the value is the URI of the container image to use for that resource. For example `sam build --use-container --build-image Function1=amazon/aws-sam-cli-build-image-python3.8`. With key-value pairs, you can specify different container images for different resources. This option only applies if the `--use-container` option is specified, otherwise an error will result.
-m, `--manifest PATH`	The path to a custom dependency manifest file (for example, package.json) to use instead of the default.
`-t, --template-file, --template PATH`	The path and file name of AWS SAM template file `[default: template.[yaml|yml]]`.
`--parameter-overrides`	(Optional) A string that contains AWS CloudFormation parameter overrides encoded as key-value pairs. Uses the same format as the AWS Command Line Interface (AWS CLI). For example: '`ParameterKey=KeyPairName, ParameterValue=MyKey ParameterKey=InstanceType, ParameterValue=t1.micro`'.
`--skip-pull-image`	Specifies whether the command should skip pulling down the latest Docker image for the Lambda runtime.
`--docker-network TEXT`	Specifies the name or ID of an existing Docker network that Lambda Docker containers should connect to, along with the default bridge network. If not specified, the Lambda containers connect only to the default bridge Docker network.
`--parallel`	Enabled parallel builds. Use this option to build your AWS SAM template's functions and layers in parallel. By default, the functions and layers are built in sequence.
`--cached`	Enable cached builds. Use this option to reuse build artifacts that haven't changed from previous builds. AWS SAM evaluates whether you've changed any files in your project directory. **Note:** AWS SAM doesn't evaluate whether you've changed third-party modules that your project depends on, where you haven't provided a specific version. For example, if your Python function includes a `requirements.txt` file with the entry `requests=1.x`, and the latest request module version changes from `1.1` to `1.2`, then AWS SAM doesn't pull the latest version until you run a non-cached build.
`--cache-dir`	The directory where the cache artifacts are stored when `--cached` is specified. The default cache directory is `.aws-sam/cache`.

Option	Description
`--profile TEXT`	The specific profile from your credential file that gets AWS credentials.
`--region TEXT`	The AWS Region to deploy to. For example, us-east-1.
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is "`samconfig.toml`" in the root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is "default". For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--debug`	Turns on debug logging to print debug messages that the AWS SAM CLI generates, and to display timestamps.
`--help`	Shows this message and exits.

Examples

Building a resource using a Lambda runtime identifier

Here's an example AWS SAM template showing how to build a resource using a Lambda runtime identifier:

```
Resources:
  MyLayer:
    Type: AWS::Serverless::LayerVersion
    Properties:
      ContentUri: my_layer
      CompatibleRuntimes:
        - python3.6
    Metadata:
      BuildMethod: python3.6
```

With this template, the following command will build the `MyLayer` resource against the Python 3.6 runtime environment:

```
sam build MyLayer
```

Building a resource using the `makefile` identifier

Here's an example AWS SAM showing how to build a resource using the `makefile` identifier:

```
Resources:
  MyLayer:
    Type: AWS::Serverless::LayerVersion
    Properties:
      ContentUri: my_layer
      CompatibleRuntimes:
        - python3.8
    Metadata:
      BuildMethod: makefile
```

This is an example of an associated makefile. The file must be named `Makefile`, and include a build target with the commands you want to run:

```
build-MyLayer:
    mkdir -p "$(ARTIFACTS_DIR)/python"
    cp *.py "$(ARTIFACTS_DIR)/python"
    python -m pip install -r requirements.txt -t "$(ARTIFACTS_DIR)/python"
```

With this template and makefile, the following command will execute the commands for the `build-MyLayer` target:

```
sam build MyLayer
```

Passing environment variables to a build container

Here's an example showing how to pass environment variables to a build container using a file.

First, create a file named `env.json` with the following contents:

```
{
  "MyFunction1": {
    "GITHUB_TOKEN": "TOKEN1"
  },
  "MyFunction2": {
    "GITHUB_TOKEN": "TOKEN2"
  }
}
```

Then, run the following command:

```
sam build --use-container --container-env-var-file env.json
```

For more information about container environment variable files, see Container environment variable file (p. 207).

sam delete

Deletes an AWS SAM application by deleting the AWS CloudFormation stack, the artifacts that were packaged and deployed to Amazon S3 and Amazon ECR, and the AWS SAM template file.

Also checks whether there is an Amazon ECR companion stack deployed, and if so prompts the user about deleting that stack and Amazon ECR repositories. If `--no-prompts` is specified, then companion stacks and Amazon ECR reponsitories are deleted by default.

Usage:

```
sam delete [OPTIONS]
```

Options:

Option	Description
`--stack-name TEXT`	The name of the AWS CloudFormation stack that you want to delete.
`--no-prompts`	Specify this option to have AWS SAM operate in non-interactive mode. The stack name must be provided, either with the `--stack-name` option, or in the configuration `toml` file.

Option	Description
`--region TEXT`	The AWS Region to deploy to. For example, us-east-1.
`--profile TEXT`	The specific profile from your credential file that gets AWS credentials.
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is `samconfig.toml` in the root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is `default`. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--debug`	Turns on debug logging to print the debug message that the AWS SAM CLI generates and to display timestamps.
`--help`	Shows this message and exits.

sam deploy

Deploys an AWS SAM application.

By default when you use this command, the AWS SAM CLI assumes that your current working directory is your project's root directory. The AWS SAM CLI first tries to locate a template file built using the sam build (p. 252) command, located in the `.aws-sam` subfolder, and named `template.yaml`. Next, the AWS SAM CLI tries to locate a template file named `template.yaml` or `template.yml` in the current working directory. If you specify the `--template` option, AWS SAM CLI's default behavior is overridden, and will deploy just that AWS SAM template and the local resources it points to.

This command comes with a guided interactive mode, which you can enable by specifying the `--guided` option. The interactive mode walks you through the parameters required for deployment, provides default options, and optionally saves these options in a configuration file in your project directory. When you perform subsequent deployments of your application using `sam deploy`, the AWS SAM CLI retrieves the required parameters from the configuration file.

Objects declared in the `Parameters` section of the AWS SAM template file appear as additional interactive mode prompts. You're prompted to provide values for each parameter. For examples of these objects and the corresponding prompts, see the Examples section later in this topic.

Serverless applications that you configure with code signing generate more interactive mode prompts. You're asked whether you want your code to be signed, and if so, you're prompted to enter signing profile names and owners. For examples of these prompts, see the Examples section later in this topic.

For more information about settings that are optionally stored when specifying the `--guided` option, see AWS SAM CLI configuration file (p. 280).

Deploying AWS Lambda functions through AWS CloudFormation requires an Amazon Simple Storage Service (Amazon S3) bucket for the Lambda deployment package. The AWS SAM CLI creates and manages this Amazon S3 bucket for you. AWS SAM enables encryption for all files stored in Amazon S3.

If your application includes any function or layer resources declared with `PackageType: Image`, then you can instruct the AWS SAM CLI to automatically create the required Amazon ECR repositories for you, using either the `--resolve-images-repos` option, or the `--guided` option and responding to prompt "Create managed ERC respositories for all functions?" with `Y`.

Usage:

```
sam deploy [OPTIONS] [ARGS]...
```

Options:

Option	Description
`-g, --guided`	Specify this option to have AWS SAM use prompts to guide you through the deployment.
`-t, --template-file, --template PATH`	The path and file name where your AWS SAM template is located. **Note:** If you specify this option, AWS SAM deploys only the template and the local resources that it points to.
`--stack-name TEXT`	(Required) The name of the AWS CloudFormation stack that you're deploying to. If you specify an existing stack, the command updates the stack. If you specify a new stack, the command creates it.
`--s3-bucket TEXT`	The name of the Amazon S3 bucket where this command uploads your AWS CloudFormation template. If your template is larger than 51,200 bytes, then either the `--s3-bucket` or the `--resolve-s3` option is required. If you specify both the `--s3-bucket` and `--resolve-s3` options, then an error will result.
`--s3-prefix TEXT`	The prefix added to the names of the artifacts that are uploaded to the Amazon S3 bucket. The prefix name is a path name (folder name) for the Amazon S3 bucket.
`--image-repository TEXT`	The name of the Amazon Elastic Container Registry (Amazon ECR) repository where this command uploads your function's image. Required for functions declared with the `Image` package type.
`--signing-profiles LIST`	The list of signing profiles to sign your deployment packages with. This option takes a list of key-value pairs, where the key is the name of the function or layer to sign, and the value is the signing profile, with an optional profile owner delimited with `:`. For example, `FunctionNameToSign=SigningProfileName1 LayerNameToSign=SigningProfileName2:SigningProfileOwner`.
`--capabilities LIST`	A list of capabilities that you must specify to allow AWS CloudFormation to create certain stacks. Some stack templates might include resources that can affect permissions in your AWS account, for example, by creating new AWS Identity and Access Management (IAM) users. For those stacks, you must explicitly acknowledge their capabilities by specifying this option. The only valid values are `CAPABILITY_IAM` and `CAPABILITY_NAMED_IAM`. If you have IAM resources, you can specify either capability. If you have IAM resources with custom names, you must specify `CAPABILITY_NAMED_IAM`. If you don't specify this option, the operation returns an `InsufficientCapabilities` error.
`--region TEXT`	The AWS Region to deploy to. For example, us-east-1.
`--profile TEXT`	The specific profile from your credential file that gets AWS credentials.
`--kms-key-id TEXT`	The ID of an AWS Key Management Service (AWS KMS) key used to encrypt artifacts that are at rest in the Amazon S3 bucket. If this option is not specified, then AWS SAM uses Amazon S3-managed encryption keys.

Option	Description
`--force-upload`	Specify this option to upload artifacts even if they match existing artifacts in the Amazon S3 bucket. Matching artifacts are overwritten.
`--no-execute-changeset`	Indicates whether to execute the changeset. Specify this option if you want to view your stack changes before executing the changeset. This command creates an AWS CloudFormation changeset and then exits without executing the changeset. To execute the changeset, run the same command without this option.
`--role-arn TEXT`	The Amazon Resource Name (ARN) of an IAM role that AWS CloudFormation assumes when executing the changeset.
`--fail-on-empty-changeset | --no-fail-on-empty-changeset`	Specify whether to return a non-zero exit code if there are no changes to be made to the stack. The default behavior is to return a non-zero exit code.
`--confirm-changeset | --no-confirm-changeset`	Prompt to confirm whether the AWS SAM CLI deploys the computed changeset.
`--use-json`	Output JSON for the AWS CloudFormation template. The default output is YAML.
`--resolve-s3`	Automatically create an Amazon S3 bucket to use for packaging and deploying for non-guided deployments. If you specify the `--guided` option, then `--resolve-s3` is ignored. If you specify both the `--s3-bucket` and `--resolve-s3` options, then an error will result.
`--resolve-image-repos`	Automatically create Amazon ECR repositories to use for packaging and deploying for non-guided deployments. This option applies only to functions and layers with `PackageType: Image` specified. If you specify the `--guided` option, then --resolve-image-repos is ignored. **Note**: If AWS SAM automatically creates any Amazon ECR repositories for functions or layers with this option, and you later delete those functions or layers from your AWS SAM template, the corresponding Amazon ECR repositories will be automatically deleted.
`--metadata`	A map of metadata to attach to all artifacts that are referenced in your template.
`--notification-arns LIST`	A list of Amazon Simple Notification Service (Amazon SNS) topic ARNs that AWS CloudFormation associates with the stack.
`--tags LIST`	A list of tags to associate with the stack that is created or updated. AWS CloudFormation also propagates these tags to resources in the stack that support it.
`--parameter-overrides`	A string that contains AWS CloudFormation parameter overrides encoded as key-value pairs. Use the same format as the AWS Command Line Interface (AWS CLI). For example, `ParameterKey=ParameterValue InstanceType=t1.micro`.
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is `samconfig.toml` in the root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).

Option	Description
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is `default`. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--no-progressbar`	Do not display a progress bar when uploading artifacts to Amazon S3.
`--debug`	Turns on debug logging to print the debug message that the AWS SAM CLI generates and to display timestamps.
`--help`	Shows this message and exits.

Examples

Parameters

Here is an example object declared in the `Parameters` section, and the corresponding prompt that appears when using `sam deploy --guided`.

AWS SAM template:

```
Parameters:
  MyPar:
    Type: String
    Default: MyParVal
```

Corresponding `sam deploy --guided` prompt:

```
Parameter MyPar [MyParVal]:
```

Code signing

Here is an example function configured with code signing.

AWS SAM template:

```
Resources:
  HelloWorld:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: hello_world/
      Handler: app.lambda_handler
      Runtime: python3.7
      CodeSigningConfigArn: arn:aws:lambda:us-east-1:111122223333:code-signing-
config:csc-12e12345db1234567
```

Corresponding `sam deploy --guided` prompts:

```
#Found code signing configurations in your function definitions
Do you want to sign your code? [Y/n]:
#Please provide signing profile details for the following functions & layers
#Signing profile details for function 'HelloWorld'
Signing Profile Name:
Signing Profile Owner Account ID (optional):
```

```
#Signing profile details for layer 'MyLayer', which is used by functions {'HelloWorld'}
Signing Profile Name:
Signing Profile Owner Account ID (optional):
```

sam init

Initializes a serverless application with an AWS SAM template. The template provides a folder structure for your AWS Lambda functions, and is connected to event sources such as APIs, Amazon Simple Storage Service (Amazon S3) buckets, or Amazon DynamoDB tables. This application includes everything that you need to get started and to eventually extend it into a production-scale application.

For some sample applications, you can choose the package type of the application, either `Zip` or `Image`. For more information about Lambda package types, see Lambda deployment packages in the *AWS Lambda Developer Guide*.

Usage:

```
sam init [OPTIONS]
```

> **Note**
> With AWS SAM version 0.30.0 or later, you can initialize your application using one of two modes: 1) interactive workflow, or 2) providing all required parameters.
>
> - *Interactive workflow:* Through the interactive initialize workflow, you can input either 1) your project name, preferred runtime, and template file, or 2) the location of a custom template.
> - *Providing parameters:* Provide all required parameters.
>
> If you provide a subset of required parameters, you are prompted for the additional required information.

Examples:

```
Initializes a new SAM project with required parameters passed as parameters

sam init --runtime python3.7 --dependency-manager pip --app-template hello-world --name
 sam-app

Initializes a new SAM project using custom template in a Git/Mercurial repository

# gh being expanded to github url
sam init --location gh:aws-samples/cookiecutter-aws-sam-python

sam init --location git+ssh://git@github.com/aws-samples/cookiecutter-aws-sam-python.git

sam init --location hg+ssh://hg@bitbucket.org/repo/template-name

# Initializes a new SAM project using custom template in a Zipfile

sam init --location /path/to/template.zip

sam init --location https://example.com/path/to/template.zip

# Initializes a new SAM project using cookiecutter template in a local path

sam init --location /path/to/template/folder
```

Options:

Option	Description
`--no-interactive`	Disable interactive prompting for init parameters, and fail if any required values are missing.
`-l, --location TEXT`	The template or application location (Git, Mercurial, HTTP/HTTPS, .zip file, path). This parameter is required if `--no-interactive` is specified and `--runtime`, `--name`, and `--app-template` are not provided. For Git repositories, you must use the location of the root of the repository. For local paths, the template must be in either .zip file or Cookiecutter format.
`--package-type [Zip | Image]`	The package type of the example application. `Zip` creates a .zip file archive, and `Image` creates a container image.
`-r, --runtime [python2.7 | ruby2.5 | ruby2.7 | java8 | dotnetcore2.0 | nodejs10.x | nodejs12.x | nodejs14.x | dotnetcore2.1 | dotnetcore1.0 | python3.9 | python3.8 | python3.7 | python3.6 | go1.x]`	The Lambda runtime of your application. This option applies only when the package type is `Zip`. This parameter is required if `--no-interactive` is specified, `--image-type` is specified as `Zip`, and `--location` is not specified.
`-a, --architecture [x86_64 | arm64]`	The instruction set architecture for your application's Lambda functions. Specify one of `x86_64` or `arm64`.
`--base-image [amazon/nodejs14.x-base | amazon/nodejs12.x-base | amazon/nodejs10.x-base | amazon/python3.9-base | amazon/python3.8-base | amazon/python3.7-base | amazon/python3.6-base | amazon/python2.7-base | amazon/ruby2.7-base | amazon/ruby2.5-base | amazon/go1.x-base | amazon/java11-base | amazon/java8.al2-base | amazon/java8-base | amazon/dotnetcore3.1-base | amazon/dotnetcore2.1-base]`	The base image of your application. This option applies only when the package type is `Image`. This parameter is required if `--no-interactive` is specified, `--image-type` is specified as `Image`, and `--location` is not specified.

Option	Description
`-d, --dependency-manager [gradle | mod | maven | bundler | npm | cli-package | pip]`	The dependency manager of your Lambda runtime.
`-o, --output-dir PATH`	The location where the initialized application is output.
`-n, --name TEXT`	The name of your project to be generated as a directory. This parameter is required if `--no-interactive` is specified and `--location` is not provided.
`--app-template TEXT`	The identifier of the managed application template that you want to use. If you're not sure, call `sam init` without options for an interactive workflow. This parameter is required if `--no-interactive` is specified and `--location` is not provided. This parameter is available only in AWS SAM CLI version 0.30.0 and later. Specifying this parameter with an earlier version results in an error.
`--no-input`	Disables Cookiecutter prompting and accepts the vcfdefault values that are defined in the template configuration.
`--extra-content`	Override any custom parameters in the template's `cookiecutter.json` configuration, for example, `{"customParam1": "customValue1", "customParam2":"customValue2"}`
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is "samconfig.toml" in the root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is "default". For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--debug`	Turns on debug logging to print debug messages that the AWS SAM CLI generates, and to display timestamps.
`-h, --help`	Shows this message and exits.

sam local generate-event

Generates sample payloads from different event sources, such as Amazon S3, Amazon API Gateway, and Amazon SNS. These payloads contain the information that the event sources send to your Lambda functions.

Usage:

```
sam local generate-event [OPTIONS] COMMAND [ARGS]...
```

Examples:

```
Generate the event that S3 sends to your Lambda function when a new object is uploaded
sam local generate-event s3 [put/delete]

# You can even customize the event by adding parameter flags. To find which flags apply to
 your command,
run:

sam local generate-event s3 [put/delete] --help

# Then you can add in those flags that you wish to customize using

sam local generate-event s3 [put/delete] --bucket <bucket> --key <key>

# After you generate a sample event, you can use it to test your Lambda function locally
sam local generate-event s3 [put/delete] --bucket <bucket> --key <key> | sam local invoke -
e - <function logical id>
```

Options:

Option	Description
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is "samconfig.toml" in the root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is "default". For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--help`	Shows this message and exits.

Commands:

- `alexa-skills-kit`
- `alexa-smart-home`
- `apigateway`
- `batch`
- `cloudformation`
- `cloudfront`
- `cloudwatch`
- `codecommit`
- `codepipeline`
- `cognito`
- `config`
- `dynamodb`
- `kinesis`
- `lex`
- `rekognition`
- `s3`
- `ses`
- `sns`

- sqs
- stepfunctions

sam local invoke

Invokes a local AWS Lambda function once and quits after invocation completes.

By default when you use this command, the AWS SAM CLI assumes that your current working directory is your project's root directory. The AWS SAM CLI first tries to locate a template file built using the sam build (p. 252) command, located in the .aws-sam subfolder, and named template.yaml or template.yml. Next, the AWS SAM CLI tries to locate a template file named template.yaml or template.yml in the current working directory. If you specify the --template option, AWS SAM CLI's default behavior is overridden, and will load just that AWS SAM template and the local resources it points to.

To invoke a function of a nested application or stack, you can provide the application or stack logical ID along with the function logical ID using the format StackLogicalId/FunctionLogicalId.

The sam local invoke command is useful for developing serverless functions that handle asynchronous events, such as Amazon Simple Storage Service (Amazon S3) or Amazon Kinesis events. It can also be useful if you want to compose a script of test cases. You can pass in the event body using the --event parameter. For more information about events, see Event in the *AWS Lambda Developer Guide*. For details about event message formats from different AWS services, see Working with other services in the *AWS Lambda Developer Guide*.

The runtime output (for example, logs) is output to stderr, and the Lambda function result is output to stdout.

> **Note**
> If there is more than one function defined in your AWS SAM template, you must provide the FUNCTION_LOGICAL_ID of the function you want to invoke.

Usage:

```
sam local invoke [OPTIONS] [FUNCTION_LOGICAL_ID]
```

Options:

Option	Description
-e, --event PATH	The JSON file that contains event data that's passed to the Lambda function when it's invoked. If you don't specify this option, no event is assumed. To input JSON from stdin, you must pass in the value '-'. For details about event message formats from different AWS services, see Working with other services in the *AWS Lambda Developer Guide*.
--no-event	Invokes the function with an empty event.
-t, --template PATH	The AWS SAM template file. **Note:** If you specify this option, AWS SAM loads only the template and the local resources that it points to.
-n, --env-vars PATH	The JSON file that contains values for the Lambda function's environment variables. For more information about environment variable files, see Environment variable file (p. 214).

Option	Description
`--parameter-overrides`	(Optional) A string that contains AWS CloudFormation parameter overrides encoded as key-value pairs. Uses the same format as the AWS Command Line Interface (AWS CLI). For example: '`ParameterKey=KeyPairName, ParameterValue=MyKey ParameterKey=InstanceType, ParameterValue=t1.micro`'.
`-d`, `--debug-port TEXT`	When specified, starts the Lambda function container in debug mode and exposes this port on the local host.
`--debugger-path TEXT`	The host path to a debugger that's mounted into the Lambda container.
`--debug-args TEXT`	Additional arguments to pass to the debugger.
`-v`, `--docker-volume-basedir TEXT`	The location of the base directory where the AWS SAM file exists. If Docker is running on a remote machine, you must mount the path where the AWS SAM file exists on the Docker machine and modify this value to match the remote machine.
`--docker-network TEXT`	The name or ID of an existing Docker network that Lambda Docker containers should connect to, along with the default bridge network. If this isn't specified, the Lambda containers connect only to the default bridge Docker network.
`--container-env-vars`	(Optional) Pass environment variables to the Lambda function image container when debugging locally.
`-l`, `--log-file TEXT`	The log file to send runtime logs to.
`--layer-cache-basedir DIRECTORY`	Specifies the location of the base directory where the layers that your template uses are downloaded to.
`--skip-pull-image`	Specifies whether the AWS SAM CLI should skip pulling down the latest Docker image for the Lambda runtime.
`--force-image-build`	Specifies whether the AWS SAM CLI should rebuild the image used for invoking Lambda functions with layers.
`--profile TEXT`	The specific profile from your credential file that gets AWS credentials.
`--region TEXT`	The AWS Region to deploy to. For example, us-east-1.
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is "`samconfig.toml`" in the root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is "default". For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--shutdown`	Emulates a shutdown event after the invoke completes, in order to test extension handling of shutdown behavior.

Option	Description
`--container-host TEXT`	Host of locally emulated Lambda container. The default value is `localhost`. If you want to run AWS SAM CLI in a Docker container on macOS, you can specify `host.docker.internal`. If you want to run the container on a different host than AWS SAM CLI, you can specify the IP address of the remote host.
`--container-host-interface TEXT`	The IP address of the host network interface that container ports should bind to. The default value is `127.0.0.1`. Use `0.0.0.0` to bind to all interfaces.
`--debug`	Turns on debug logging to print debug messages that the AWS SAM CLI generates, and to display timestamps.
`--help`	Shows this message and exits.

sam local start-api

Allows you to run your serverless application locally for quick development and testing. When you run this command in a directory that contains your serverless functions and your AWS SAM template, it creates a local HTTP server that hosts all of your functions.

By default when you use this command, the AWS SAM CLI assumes that your current working directory is your project's root directory. The AWS SAM CLI first tries to locate a template file built using the sam build (p. 252) command, located in the `.aws-sam` subfolder, and named `template.yaml` or `template.yml`. Next, the AWS SAM CLI tries to locate a template file named `template.yaml` or `template.yml` in the current working directory. If you specify the `--template` option, AWS SAM CLI's default behavior is overridden, and will load just that AWS SAM template and the local resources it points to.

When it's accessed (through a browser, CLI, and so on), it starts a Docker container locally to invoke the function. It reads the CodeUri property of the `AWS::Serverless::Function` resource to find the path in your file system that contains the Lambda function code. This could be the project's root directory for interpreted languages like Node.js and Python, or a build directory that stores your compiled artifacts or a Java Archive (JAR) file.

If you're using an interpreted language, local changes are available immediately in the Docker container on every invoke. For more compiled languages or projects that require complex packing support, we recommend that you run your own building solution, and point AWS SAM to the directory or file that contains the build artifacts.

To see an end-to-end example that uses this command, see Tutorial: Deploying a Hello World application (p. 16). The `sam local start-api` command is part of Step 4: (Optional) Test your application locally (p. 22).

Usage:

```
sam local start-api [OPTIONS]
```

Options:

Option	Description
`--host TEXT`	The local hostname or IP address to bind to (default: '127.0.0.1').
`-p, --port INTEGER`	The local port number to listen on (default: '3000').

Option	Description
`-s, --static-dir TEXT`	Any static asset (for example, CSS/JavaScript/HTML) files located in this directory are presented at /.
`-t, --template PATH`	The AWS SAM template file. **Note:** If you specify this option, AWS SAM loads only the template and the local resources that it points to.
`-n, --env-vars PATH`	The JSON file that contains values for the Lambda function's environment variables.
`--parameter-overrides`	Optional. A string that contains AWS CloudFormation parameter overrides encoded as key-value pairs. Use the same format as the AWS CLI—for example, 'ParameterKey=KeyPairName, ParameterValue=MyKey ParameterKey=InstanceType,ParameterValue=t1.micro'.
`-d, --debug-port TEXT`	When specified, starts the Lambda function container in debug mode and exposes this port on the local host.
`--debugger-path TEXT`	The host path to a debugger that will be mounted into the Lambda container.
`--debug-args TEXT`	Additional arguments to be passed to the debugger.
`--warm-containers [EAGER | LAZY]`	Optional. Specifies how AWS SAM CLI manages containers for each function. Two options are available: `EAGER`: Containers for all functions are loaded at startup and persist between invocations. `LAZY`: Containers are only loaded when each function is first invoked. Those containers persist for additional invocations.
`--debug-function`	Optional. Specifies the Lambda function to apply debug options to when `--warm-containers` is specified. This parameter applies to `--debug-port`, `--debugger-path`, and `--debug-args`.
`-v, --docker-volume-basedir TEXT`	The location of the base directory where the AWS SAM file exists. If Docker is running on a remote machine, you must mount the path where the AWS SAM file exists on the Docker machine, and modify this value to match the remote machine.
`--docker-network TEXT`	The name or ID of an existing Docker network that the Lambda Docker containers should connect to, along with the default bridge network. If this isn't specified, the Lambda containers only connect to the default bridge Docker network.
`--container-env-vars`	Optional. Pass environment variables to image container when locally debugging.
`-l, --log-file TEXT`	The log file to send runtime logs to.
`--layer-cache-basedir DIRECTORY`	Specifies the location basedir where the Layers your template uses are downloaded to.

Option	Description
`--skip-pull-image`	Specifies whether the CLI should skip pulling down the latest Docker image for the Lambda runtime.
`--force-image-build`	Specifies whether CLI should rebuild the image used for invoking functions with layers.
`--profile TEXT`	The specific profile from your credential file that gets AWS credentials.
`--region TEXT`	The AWS Region to deploy to. For example, us-east-1.
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is "samconfig.toml" in the root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is "default". For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--shutdown`	Emulates a shutdown event after the invoke completes, in order to test extension handling of shutdown behavior.
`--container-host TEXT`	Host of locally emulated Lambda container. The default value is `localhost`. If you want to run AWS SAM CLI in a Docker container on macOS, you can specify `host.docker.internal`. If you want to run the container on a different host than AWS SAM CLI, you can specify the IP address of the remote host.
`--container-host-interface TEXT`	The IP address of the host network interface that container ports should bind to. The default value is `127.0.0.1`. Use `0.0.0.0` to bind to all interfaces.
`--debug`	Turns on debug logging to print debug message generated by the AWS SAM CLI and display timestamps.
`--help`	Shows this message and exits.

sam local start-lambda

Enables you to programmatically invoke your Lambda function locally by using the AWS CLI or SDKs. This command starts a local endpoint that emulates AWS Lambda.

By default when you use this command, the AWS SAM CLI assumes that your current working directory is your project's root directory. The AWS SAM CLI first tries to locate a template file built using the sam build (p. 252) command, located in the `.aws-sam` subfolder, and named `template.yaml` or `template.yml`. Next, the AWS SAM CLI tries to locate a template file named `template.yaml` or `template.yml` in the current working directory. If you specify the `--template` option, AWS SAM CLI's default behavior is overridden, and will load just that AWS SAM template and the local resources it points to.

You can run your automated tests against this local Lambda endpoint. When you send an invoke to this endpoint using the AWS CLI or SDK, it locally executes the Lambda function that's specified in the request.

Usage:

```
sam local start-lambda [OPTIONS]
```

Examples:

```
# SETUP
# ------
# Start the local Lambda endpoint by running this command in the directory that contains
 your AWS SAM template.

sam local start-lambda

# USING AWS CLI
# -------------
# Then, you can invoke your Lambda function locally using the AWS CLI

aws lambda invoke --function-name "HelloWorldFunction" --endpoint-url
 "http://127.0.0.1:3001" --no-verify-ssl out.txt

# USING AWS SDK
# -------------
# You can also use the AWS SDK in your automated tests to invoke your functions
 programatically.
# Here is a Python example:
#
#     self.lambda_client = boto3.client('lambda',
#                                  endpoint_url="http://127.0.0.1:3001",
#                                  use_ssl=False,
#                                  verify=False,
#                                  config=Config(signature_version=UNSIGNED,
#                                                read_timeout=0,
#                                                retries={'max_attempts': 0}))
#    self.lambda_client.invoke(FunctionName="HelloWorldFunction")
```

Options:

Option	Description
`--host TEXT`	The local hostname or IP address to bind to (default: '127.0.0.1').
`-p, --port INTEGER`	The local port number to listen on (default: '3001').
`-t, --template PATH`	The AWS SAM template file. **Note:** If you specify this option, AWS SAM loads only the template and the local resources that it points to.
`-n, --env-vars PATH`	The JSON file that contains values for the Lambda function's environment variables.
`--parameter-overrides`	Optional. A string that contains AWS CloudFormation parameter overrides encoded as key-value pairs. Use the same format as the AWS CLI—for example, 'ParameterKey=KeyPairName, ParameterValue=MyKey ParameterKey=InstanceType,ParameterValue=t1.micro'.
`-d, --debug-port TEXT`	When specified, starts the Lambda function container in debug mode, and exposes this port on the local host.
`--debugger-path TEXT`	The host path to a debugger to be mounted into the Lambda container.
`--debug-args TEXT`	Additional arguments to be passed to the debugger.

Option	Description
`--warm-containers [EAGER | LAZY]`	Optional. Specifies how AWS SAM CLI manages containers for each function. Two options are available: `EAGER`: Containers for all functions are loaded at startup and persist between invocations. `LAZY`: Containers are only loaded when each function is first invoked. Those containers persist for additional invocations.
`--debug-function`	Optional. Specifies the Lambda function to apply debug options to when `--warm-containers` is specified. This parameter applies to `--debug-port`, `--debugger-path`, and `--debug-args`.
`-v, --docker-volume-basedir TEXT`	The location of the base directory where the AWS SAM file exists. If Docker is running on a remote machine, you must mount the path where the AWS SAM file exists on the Docker machine, and modify this value to match the remote machine.
`--docker-network TEXT`	The name or ID of an existing Docker network that Lambda Docker containers should connect to, along with the default bridge network. If this is specified, the Lambda containers only connect to the default bridge Docker network.
`--container-env-vars`	Optional. Pass environment variables to image container when locally debugging.
`-l, --log-file TEXT`	The log file to send runtime logs to.
`--layer-cache-basedir DIRECTORY`	Specifies the location basedir where the layers your template uses are downloaded to.
`--skip-pull-image`	Specifies whether the CLI should skip pulling down the latest Docker image for the Lambda runtime.
`--force-image-build`	Specify whether the CLI should rebuild the image used for invoking functions with layers.
`--profile TEXT`	The specific profile from your credential file that gets AWS credentials.
`--region TEXT`	The AWS Region to deploy to. For example, us-east-1.
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is "samconfig.toml" in the root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is "default". For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--shutdown`	Emulates a shutdown event after the invoke completes, in order to test extension handling of shutdown behavior.

Option	Description
`--container-host TEXT`	Host of locally emulated Lambda container. The default value is `localhost`. If you want to run AWS SAM CLI in a Docker container on macOS, you can specify `host.docker.internal`. If you want to run the container on a different host than AWS SAM CLI, you can specify the IP address of the remote host.
`--container-host-interface TEXT`	The IP address of the host network interface that container ports should bind to. The default value is `127.0.0.1`. Use `0.0.0.0` to bind to all interfaces.
`--debug`	Turns on debug logging to print debug message generated by the AWS SAM CLI and display timestamps.
`--help`	Shows this message and exits.

sam logs

Fetches logs that are generated by your Lambda function.

When your functions are a part of an AWS CloudFormation stack, you can fetch logs by using the function's logical ID when you specify the stack name.

Usage:

```
sam logs [OPTIONS]
```

Examples:

```
sam logs -n HelloWorldFunction --stack-name mystack

# Or, you can fetch logs using the function's name.
sam logs -n mystack-HelloWorldFunction-1FJ8PD36GML2Q

# You can view logs for a specific time range using the -s (--start-time) and -e (--end-
time) options
sam logs -n HelloWorldFunction --stack-name mystack -s '10min ago' -e '2min ago'

# You can also add the --tail option to wait for new logs and see them as they arrive.
sam logs -n HelloWorldFunction --stack-name mystack --tail

# Use the --filter option to quickly find logs that match terms, phrases or values in your
 log events.
sam logs -n HelloWorldFunction --stack-name mystack --filter "error"
```

Options:

Option	Description
`-n, --name TEXT`	The name of your Lambda function. If this function is part of an AWS CloudFormation stack, this can be the logical ID of the function resource in the AWS CloudFormation/AWS SAM template. [required]
`--stack-name TEXT`	The name of the AWS CloudFormation stack that the function is a part of.

Option	Description
`--filter TEXT`	Lets you specify an expression to quickly find logs that match terms, phrases, or values in your log events. This can be a simple keyword (for example, "error") or a pattern that's supported by Amazon CloudWatch Logs. For the syntax, see the Amazon CloudWatch Logs documentation.
`-s, --start-time TEXT`	Fetches logs starting at this time. The time can be relative values like '5mins ago', 'yesterday', or a formatted timestamp like '2018-01-01 10:10:10'. It defaults to '10mins ago'.
`-e, --end-time TEXT`	Fetches logs up to this time. The time can be relative values like '5mins ago', 'tomorrow', or a formatted timestamp like '2018-01-01 10:10:10'.
`-t, --tail`	Tails the log output. This ignores the end time argument and continues to fetch logs as they become available.
`--profile TEXT`	The specific profile from your credential file that gets AWS credentials.
`--region TEXT`	The AWS Region to deploy to. For example, us-east-1.
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is "samconfig.toml" in the root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is "default". For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--debug`	Turns on debug logging to print debug message generated by the AWS SAM CLI and display timestamps.
`--help`	Shows this message and exits.

sam package

Packages an AWS SAM application. This command creates a `.zip` file of your code and dependencies, and uploads the file to Amazon Simple Storage Service (Amazon S3). AWS SAM enables encryption for all files stored in Amazon S3. It then returns a copy of your AWS SAM template, replacing references to local artifacts with the Amazon S3 location where the command uploaded the artifacts.

By default when you use this command, the AWS SAM CLI assumes that your current working directory is your project's root directory. The AWS SAM CLI first tries to locate a template file built using the sam build (p. 252) command, located in the `.aws-sam` subfolder, and named `template.yaml`. Next, the AWS SAM CLI tries to locate a template file named `template.yaml` or `template.yml` in the current working directory. If you specify the `--template` option, AWS SAM CLI's default behavior is overridden, and will package just that AWS SAM template and the local resources it points to.

> **Note**
> sam deploy (p. 258) now implicitly performs the functionality of `sam package`. You can use the sam deploy (p. 258) command directly to package and deploy your application.

Usage:

```
sam package [OPTIONS] [ARGS]...
```

Options:

Option	Description
`-t, --template-file, --template PATH`	The path and file name where your AWS SAM template is located. **Note:** If you specify this option, AWS SAM packages only the template and the local resources that it points to.
`--s3-bucket TEXT`	The name of the Amazon S3 bucket where this command uploads your AWS CloudFormation template. If your template is larger than 51,200 bytes, then either the `--s3-bucket` or the `--resolve-s3` option is required. If you specify both the `--s3-bucket` and `--resolve-s3` options, then an error will result.
`--s3-prefix TEXT`	Prefix added to the artifacts name that are uploaded to the Amazon S3 bucket. The prefix name is a path name (folder name) for the Amazon S3 bucket. This only applies for functions declared with `Zip` package type.
`--image-repository TEXT`	The URI of the Amazon Elastic Container Registry (Amazon ECR) repository where this command uploads your function's image. Required for functions declared with the `Image` package type.
`--kms-key-id TEXT`	The ID of an AWS Key Management Service (AWS KMS) key used to encrypt artifacts that are at rest in the Amazon S3 bucket. If this option is not specified, then AWS SAM uses Amazon S3-managed encryption keys.
`--signing-profiles LIST`	(Optional) The list of signing profiles to sign your deployment packages with. This parameter takes a list of key-value pairs, where the key is the name of the function or layer to sign, and the value is the signing profile, with an optional profile owner delimited with `:`. For example, `FunctionNameToSign=SigningProfileName1 LayerNameToSign=SigningProfileName2:SigningProfileOwner`.
`--output-template-file PATH`	The path to the file where the command writes the packaged template. If you don't specify a path, the command writes the template to the standard output.
`--use-json`	Output JSON for the AWS CloudFormation template. YAML is used by default.
`--resolve-s3`	Automatically create an Amazon S3 bucket to use for packaging. If you specify both the `--s3-bucket` and `--resolve-s3` options, then an error will result.
`--force-upload`	Override existing files in the Amazon S3 bucket. Specify this flag to upload artifacts even if they match existing artifacts in the Amazon S3 bucket.
`--metadata`	(Optional) A map of metadata to attach to all artifacts that are referenced in your template.
`--profile TEXT`	The specific profile from your credential file that gets AWS credentials.
`--region TEXT`	The AWS Region to deploy to. For example, us-east-1.
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is "samconfig.toml" in the

Option	Description
	root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is "default". For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--no-progressbar`	Do not display a progress bar when uploading artifacts to Amazon S3.
`--debug`	Turns on debug logging to print debug message generated by the AWS SAM CLI and display timestamps.
`--help`	Shows this message and exits.

Note

If the AWS SAM template contains a `Metadata` section for ServerlessRepo, and the `LicenseUrl` or `ReadmeUrl` properties contain references to local files, you must update AWS CLI to version 1.16.77 or later. For more information about the `Metadata` section of AWS SAM templates and publishing applications with AWS SAM CLI, see Publishing serverless applications using the AWS SAM CLI (p. 233).

sam pipeline bootstrap

This command generates the required AWS infrastructure resources to connect to your CI/CD system. This step must be run for each deployment stage in your pipeline, prior to running the **sam pipeline init** command.

This command sets up the following AWS infrastructure resources:

- A pipeline IAM user with access key ID and secret key access credentials to be shared with the CI/CD system.
- A pipeline execution IAM role assumed by the pipeline user to obtain access to the AWS account.
- An AWS CloudFormation execution IAM role assumed by AWS CloudFormation to deploy the AWS SAM application.
- An Amazon S3 bucket to hold the AWS SAM artifacts.
- Optionally, an Amazon ECR image repository to hold container image Lambda deployment packages (if you have a resource that is of package type `Image`).

Usage:

```
sam pipeline bootstrap [OPTIONS]
```

Options:

Option	Description
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is "default". For more information about configuration files, see AWS SAM CLI configuration file (p. 280).

Option	Description
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is "samconfig.toml" in the root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--no-interactive`	Disable interactive prompting for bootstrap parameters, and fail if any required parameters are missing. For this command `--stage` is the only required parameter.
`--stage TEXT`	The name of the corresponding deployment stage. It is used as a suffix for the created AWS infrastructure resources.
`--pipeline-user TEXT`	The Amazon Resource Name (ARN) of the IAM user having its access key ID and secret access key shared with the CI/CD system. It is used to grant this IAM user permission to access the corresponding AWS account. If not provided, the command will create one along with the access key ID and secret access key credentials.
`--pipeline-execution-role TEXT`	The ARN of the IAM role to be assumed by the pipeline user to operate on this stage. Provide it only if you want to use your own role, otherwise this command will create one.
`--cloudformation-execution-role TEXT`	The ARN of the IAM role to be assumed by the AWS CloudFormation service while deploying the application's stack. Provide only if you want to use your own role, otherwise the command will create one.
`--bucket TEXT`	The ARN of the Amazon S3 bucket to hold the AWS SAM artifacts.
`--create-image-repository / --no-create-image-repository`	Specify whether to create an Amazon ECR image repository if none is provided. The Amazon ECR repository holds the container images of Lambda functions or layers having a package type of `Image`. The default is `--no-create-image-repository`.
`--image-repository TEXT`	The ARN of an Amazon ECR image repository to hold the container images of Lambda functions or layers that have a package type of `Image`. If provided, the `--create-image-repository` options is ignored. If not provided and `--create-image-repository` is specified, the command will create one.
`--confirm-changeset / --no-confirm-changeset`	Prompt to confirm if the resources are to be deployed.
`--profile TEXT`	The specific profile from your credential file that gets AWS credentials.
`--debug`	Turns on debug logging to print debug messages that the AWS SAM CLI generates, and to display timestamps.
`--region TEXT`	The AWS Region to deploy to. For example, `us-east-1`.
`-h, --help`	Shows this message and exits.

sam pipeline init

This command generates a pipeline configuration file that your CI/CD system can use to deploy serverless applications using AWS SAM.

Before using **sam pipeline init**, you must bootstrap the necessary resources for each stage in your pipeline. You can do this by running **sam pipeline init --bootstrap** to be guided through the setup and configuration file generation process, or refer to resources you have previously created with the **sam pipeline bootstrap** command.

Usage:

```
sam pipeline init [OPTIONS]
```

Options:

Option	Description
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is `default`. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-file TEXT`	The path and file name of the configuration file containing default parameter values to use. The default value is `samconfig.toml` in the project root directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--bootstrap`	Enable interactive mode that walks the user through creating necessary AWS infrastructure resources.
`--debug`	Turns on debug logging to print debug messages that the AWS SAM CLI generates, and to display timestamps.
`-h, --help`	Shows this message and exits.

sam publish

Publish an AWS SAM application to the AWS Serverless Application Repository. Takes a packaged AWS SAM template and publishes the application to the specified AWS Region.

The `sam publish` command expects the AWS SAM template to include a `Metadata` section that contains application metadata required for publishing. In the `Metadata` section, the `LicenseUrl` and `ReadmeUrl` properties must refer to Amazon Simple Storage Service (Amazon S3) buckets, not local files. For more information about the `Metadata` section of the AWS SAM template, see Publishing serverless applications using the AWS SAM CLI (p. 233).

By default, `sam publish` creates the application as private. Before other AWS accounts are allowed to view and deploy your application, you must share it. For information on sharing applications, see AWS Serverless Application Repository Resource-Based Policy Examples in the *AWS Serverless Application Repository Developer Guide*.

> **Note**
> Currently `sam publish` doesn't support publishing nested applications that are specified locally. If your application contains nested applications, you must publish them separately to the AWS Serverless Application Repository before publishing your parent application.

Usage:

```
sam publish [OPTIONS]
```

Examples:

```
# To publish an application
sam publish --template packaged.yaml --region us-east-1
```

Options:

Option	Description
`-t, --template PATH`	The path of AWS SAM template file `[default: template.[yaml|yml]]`.
`--semantic-version TEXT`	(Optional) Use this option to provide a semantic version of your application that overrides the `SemanticVersion` property in the `Metadata` section of the template file. For more information about semantic versioning, see the Semantic Versioning specification.
`--profile TEXT`	The specific profile from your credential file that gets AWS credentials.
`--region TEXT`	The AWS Region to deploy to. For example, us-east-1.
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is "`samconfig.toml`" in the root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is "default". For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--debug`	Turns on debug logging to print debug messages that the AWS SAM CLI generates, and to display timestamps.
`--help`	Shows this message and exits.

sam validate

Verifies whether an AWS SAM template file is valid.

Usage:

```
sam validate [OPTIONS]
```

Options:

Option	Description
`-t, --template, --template-file PATH`	The AWS SAM template file [default: template.[yaml|yml]].
`--profile TEXT`	The specific profile from your credential file that gets AWS credentials.
`--region TEXT`	The AWS Region to deploy to. For example, us-east-1.
`--config-file PATH`	The path and file name of the configuration file containing default parameter values to use. The default value is "samconfig.toml" in the

Option	Description
	root of the project directory. For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--config-env TEXT`	The environment name specifying the default parameter values in the configuration file to use. The default value is "default". For more information about configuration files, see AWS SAM CLI configuration file (p. 280).
`--debug`	Turns on debug logging to print debug message generated by the AWS SAM CLI and display timestamps.

AWS SAM CLI configuration file

The AWS SAM CLI supports a project-level configuration file that stores default parameters for its commands. This configuration file is in the TOML file format, and the default file name is `samconfig.toml`. The file's default location is your project's root directory, which contains your project's AWS SAM template file.

You can manually edit this file to set default parameters for any AWS SAM CLI command. In addition, the `sam deploy --guided` command writes a subset of parameters to your configuration file. For more information about this command, see Writing configurations with `sam deploy --guided` (p. 282) later in this topic.

Example

Here's an example configuration file that contains three sets of parameters for the `default` environment. One set is for all commands, one is for the `deploy` command, and one is for the `build` command.

```
version=0.1
[default.global.parameters]
stack_name = "common-stack"

[default.deploy.parameters]
stack_name = "my-app-stack"
s3_bucket = "my-source-bucket"
s3_prefix = "my-s3-prefix"
image_repositories = ["my-function-1=image-repo-1", "my-function-2=image-repo-2"]
region = "us-west-2"
confirm_changeset = true
capabilities = "CAPABILITY_IAM"
tags = "project=\"my-application\" stage=\"production\""

[default.build.parameters]
container_env_var = ["Function1.GITHUB_TOKEN=TOKEN1", "Function2.GITHUB_TOKEN=TOKEN2"]
container_env_var_file = "env.json"
```

Configuration file rules

The AWS SAM CLI applies the following rules to configuration files:

File name and location

- The default configuration file is named `samconfig.toml` and is located in your project's root directory.

- You can override the default file name and location using the `--config-file` parameter.

Tables

- The AWS SAM CLI uses TOML tables to group configuration entries by environment and command. A single configuration file can contain tables for multiple environments, commands, and subcommands.
- The default environment name is named `default`. You can override the default environment name using the `--config-env` parameter.
- For commands, the format of the table header is `[environment.command.parameters]`. For example, for the `sam deploy` command for the `default` environment, the configuration table header is `[default.deploy.parameters]`.
- For subcommands, the format of the table header is `[environment.command_subcommand.parameters]`. That is, delimit the command and subcommand with _ (underscore). For example, for the `sam local invoke` command for the `default` environment, the configuration table header is `[default.local_invoke.parameters]`.
- If any command or subcommand contains a - (hyphen) character, replace it with _ (underscore). For example, for the `sam local start-api` command, the configuration table header is `[default.local_start_api.parameters]`.
- To specify parameters for all commands, use the `global` keyword as the command in the table header (`[environment.global.parameters]`). For example, the global table header for the `default` environment is `[default.global.parameters]`.

Configuration entries

- Each configuration entry is a TOML key-value pair.
- The configuration key is the long-form parameter name with the - (hyphen) character replaced with _ (underscore). For the list of available parameters for each command, see the AWS SAM CLI command reference (p. 252), or run `sam command --help`.
- The configuration value can take the following forms:
  - For toggle parameters, the value can be `true` or `false` (no quotation marks). For example, `confirm_changeset = true`.
  - For parameters that take a single argument, the value is the argument surrounded by `" "` (quotation marks). For example, `region = "us-west-2"`.
  - For parameters that take a list of arguments, the arguments are space-delimited within `" "` (quotation marks). For example, `capabilities = "CAPABILITY_IAM CAPABILITY_NAMED_IAM"`.
    - To specify a list of key-value pairs, the pairs are space-delimited, and the value of each pair is surrounded by encoded `" "` (quotation marks). For example, `tags = "project=\"my-application\" stage=\"production\""`.
  - For parameters that you can specify multiple times, the value is an array of arguments. For example, `image_repositories = ["my-function-1=image-repo-1", "my-function-2=image-repo-2"]`.

Precedence

- Parameter values that you provide on the command line take precedence over corresponding entries in the configuration file. For example, if your configuration file contains the entry `stack_name = "DefaultStack"` and you run the command `sam deploy --stack-name MyCustomStack`, then the deployed stack name is `MyCustomStack`.

- For the parameter_overrides entry, both the parameter values that you provide on the command line and entries in the configuration file take precedence over corresponding objects declared in the Parameters section of the template file.
- Entries that you provide in a specific command table take precedence over entries in a global command section. For example, suppose that your configuration file contains the following tables and entries:

```
[default.global.parameters]
stack_name = "common-stack"

[default.deploy.parameters]
stack_name = "my-app-stack"
```

In this case, the sam deploy command uses the stack name my-app-stack, and any other command (for example, sam logs) uses the stack name common-stack.

Writing configurations with sam deploy --guided

When you run the sam deploy --guided command, the AWS SAM CLI guides you through the deployment with a series of prompts.

These prompts include the question "Save arguments to samconfig.toml [Y/n]:". If you respond **Y** to this prompt, the AWS SAM CLI updates the configuration file with values for the deploy command. For example, for the default environment, AWS SAM updates the [default.deploy.parameters] table.

The list of entries in the deploy command table that AWS SAM can update include the following:

- stack_name
- s3_bucket
- s3_prefix
- image_repository
- region
- confirm_changeset
- capabilities
- signing_profiles
- parameter_overrides

Note

There's a special case for a configuration file that contains entries for the same parameter in both the deploy and global command tables. In this case, if you run sam deploy --guided and provide the same value for that parameter as the global command table entry, then the deploy command table entry is removed.

By specifying at the sam deploy --guided prompt the same value that's already specified in the global command table, AWS SAM assumes that you want to default to the value in the global command table.

Rules for guided prompt default values

To control the default values for the prompts that the AWS SAM CLI displays when you run sam deploy --guided, you can specify parameters on the command line, or entries in an existing configuration file.

The rules for these prompts are as follows:

- If you specify values on the command line, the AWS SAM CLI uses those command line values as the defaults for the corresponding prompts.
- If there's an existing configuration file, the AWS SAM CLI uses entries from the matching table in that file as the default values for the corresponding prompts.

The precedence rules between the command line and configuration file are the same as stated in the **Precedence** section earlier in this topic.

AWS SAM policy templates

AWS SAM allows you to choose from a list of policy templates to scope the permissions of your Lambda functions to the resources that are used by your application.

AWS SAM applications in the AWS Serverless Application Repository that use policy templates don't require any special customer acknowledgments to deploy the application from the AWS Serverless Application Repository.

If you want to request a new policy template to be added, do the following:

1. Submit a pull request against the policy_templates.json source file in the `develop` branch of the AWS SAM GitHub project. You can find the source file in policy_templates.json on the GitHub website.
2. Submit an issue in the AWS SAM GitHub project that includes the reasons for your pull request and a link to the request. Use this link to submit a new issue: AWS Serverless Application Model: Issues.

Syntax

For every policy template you specify in your AWS SAM template file, you must always specify an object containing the policy template's placeholder values. If a policy template does not require any placeholder values, you must specify an empty object.

YAML

```
MyFunction:
  Type: AWS::Serverless::Function
  Properties:
    Policies:
      - PolicyTemplateName1:        # Policy template with placeholder value
          Key1: Value1
      - PolicyTemplateName2: {}     # Policy template with no placeholder value
```

Examples

Example 1: Policy template with placeholder values

The following example shows that the SQSPollerPolicy (p. 289) policy template expects a `QueueName` as a resource. The AWS SAM template retrieves the name of the "`MyQueue`" Amazon SQS queue, which you can create in the same application or requested as a parameter to the application.

```
MyFunction:
  Type: 'AWS::Serverless::Function'
  Properties:
    CodeUri: ${codeuri}
```

```
      Handler: hello.handler
      Runtime: python2.7
      Policies:
        - SQSPollerPolicy:
            QueueName:
              !GetAtt MyQueue.QueueName
```

Example 2: Policy template with no placeholder values

The following example contains the CloudWatchPutMetricPolicy (p. 290) policy template, which has no placeholder values.

> **Note**
> Even though there are no placeholder values, you must specify an empty object, otherwise an error will result.

```
MyFunction:
  Type: 'AWS::Serverless::Function'
  Properties:
    CodeUri: ${codeuri}
    Handler: hello.handler
    Runtime: python2.7
    Policies:
      - CloudWatchPutMetricPolicy: {}
```

Policy template table

The following is a table of the available policy templates.

Policy Template	Description		
SQSPollerPolicy (p. 289)	Gives permission to poll an Amazon Simple Queue Service (Amazon SQS) queue.		
LambdaInvokePolicy (p. 289)	Gives permission to invoke an AWS Lambda function, alias, or version.		
CloudWatchDescribeAlarmHistoryPolicy (p. 290)	Gives permission to describe CloudWatch alarm history.		
CloudWatchPutMetricPolicy (p. 290)	Gives permission to send metrics to CloudWatch.		
EC2DescribePolicy (p. 290)	Gives permission to describe Amazon Elastic Compute Cloud (Amazon EC2) instances.		
DynamoDBCrudPolicy (p. 290)	Gives create, read, update, and delete permissions to an Amazon DynamoDB table.		
DynamoDBReadPolicy (p. 291)	Gives read-only permission to a DynamoDB table.		
DynamoDBWritePolicy (p. 292)	Gives write-only permission to a DynamoDB table.		
DynamoDBReconfigurePolicy (p. 292)	Gives permission to reconfigure a DynamoDB table.		

Policy Template	Description		
SESSendBouncePolicy (p. 293)	Gives SendBounce permission to an Amazon Simple Email Service (Amazon SES) identity.		
ElasticsearchHttpPostPolicy (p. 293)	Gives POST permission to Amazon OpenSearch Service.		
S3ReadPolicy (p. 294)	Gives read-only permission to read objects in an Amazon Simple Storage Service (Amazon S3) bucket.		
S3WritePolicy (p. 294)	Gives write permission to write objects into an Amazon S3 bucket.		
S3CrudPolicy (p. 295)	Gives create, read, update, and delete permission to act on the objects in an Amazon S3 bucket.		
AMIDescribePolicy (p. 296)	Gives permission to describe Amazon Machine Images (AMIs).		
CloudFormationDescribeStacksPolicy (p. 296)	Gives permission to describe AWS CloudFormation stacks.		
RekognitionDetectOnlyPolicy (p. 296)	Gives permission to detect faces, labels, and text.		
RekognitionNoDataAccessPolicy (p. 297)	Gives permission to compare and detect faces and labels.		
RekognitionReadPolicy (p. 297)	Gives permission to list and search faces.		
RekognitionWriteOnlyAccessPolicy (p. 298)	Gives permission to create collection and index faces.		
SQSSendMessagePolicy (p. 298)	Gives permission to send message to an Amazon SQS queue.		
SNSPublishMessagePolicy (p. 298)	Gives permission to publish a message to an Amazon Simple Notification Service (Amazon SNS) topic.		
VPCAccessPolicy (p. 299)	Gives access to create, delete, describe, and detach elastic network interfaces.		
DynamoDBStreamReadPolicy (p. 299)	Gives permission to describe and read DynamoDB streams and records.		
KinesisStreamReadPolicy (p. 300)	Gives permission to list and read an Amazon Kinesis stream.		
SESCrudPolicy (p. 301)	Gives permission to send email and verify identity.		
SNSCrudPolicy (p. 301)	Gives permission to create, publish, and subscribe to Amazon SNS topics.		
KinesisCrudPolicy (p. 302)	Gives permission to create, publish, and delete an Amazon Kinesis stream.		

Policy Template	Description		
KMSDecryptPolicy (p. 302)	Gives permission to decrypt with an AWS Key Management Service (AWS KMS) key.		
KMSEncryptPolicy (p. 303)	Gives permission to encrypt with an AWS Key Management Service (AWS KMS) key.		
PollyFullAccessPolicy (p. 303)	Gives full access permission to Amazon Polly lexicon resources.		
S3FullAccessPolicy (p. 304)	Gives full access permission to act on the objects in an Amazon S3 bucket.		
CodePipelineLambdaExecutionPolicy (p. 305)	Gives permission for a Lambda function invoked by CodePipeline to report the status of the job.		
ServerlessRepoReadWriteAccessPolicy (p. 305)	Gives permission to create and list applications in the AWS Serverless Application Repository service.		
EC2CopyImagePolicy (p. 305)	Gives permission to copy Amazon EC2 images.		
AWSSecretsManagerRotationPolicy (p. 306)	Gives permission to rotate a secret in AWS Secrets Manager.		
AWSSecretsManagerGetSecretValuePolicy (p. 306)	Gives permission to get the secret value for the specified AWS Secrets Manager secret.		
CodePipelineReadOnlyPolicy (p. 307)	Gives read permission to get details about a CodePipeline pipeline.		
CloudWatchDashboardPolicy (p. 307)	Gives permissions to put metrics to operate on CloudWatch dashboards.		
RekognitionFacesManagementPolicy (p. 308)	Gives permission to add, delete, and search faces in an Amazon Rekognition collection.		
RekognitionFacesPolicy (p. 308)	Gives permission to compare and detect faces and labels.		
RekognitionLabelsPolicy (p. 308)	Gives permission to detect object and moderation labels.		
DynamoDBBackupFullAccessPolicy (p. 309)	Gives read and write permission to DynamoDB on-demand backups for a table.		
DynamoDBRestoreFromBackupPolicy (p. 309)	Gives permission to restore a DynamoDB table from backup.		
ComprehendBasicAccessPolicy (p. 310)	Gives permission for detecting entities, key phrases, languages, and sentiments.		
MobileAnalyticsWriteOnlyAccessPolicy (p. 310)	Gives write-only permission to put event data for all application resources.		

Policy Template	Description		
PinpointEndpointAccessPolicy (p. 311)	Gives permission to get and update endpoints for an Amazon Pinpoint application.		
FirehoseWritePolicy (p. 311)	Gives permission to write to a Kinesis Data Firehose delivery stream.		
FirehoseCrudPolicy (p. 312)	Gives permission to create, write, update, and delete a Kinesis Data Firehose delivery stream.		
EKSDescribePolicy (p. 312)	Gives permission to describe or list Amazon EKS clusters.		
CostExplorerReadOnlyPolicy (p. 312)	Gives read-only permission to the read-only Cost Explorer APIs for billing history.		
OrganizationsListAccountsPolicy (p. 313)	Gives read-only permission to list child account names and IDs.		
SESBulkTemplatedCrudPolicy (p. 313)	Gives permission to send email, templated email, templated bulk emails and verify identity.		
SESEmailTemplateCrudPolicy (p. 313)	Gives permission to create, get, list, update and delete Amazon SES email templates.		
FilterLogEventsPolicy (p. 314)	Gives permission to filter CloudWatch Logs events from a specified log group.		
SSMParameterReadPolicy (p. 314)	Gives permission to access a parameters from an Amazon EC2 Systems Manager (SSM) parameter store to load secrets in this account.		
StepFunctionsExecutionPolicy (p. 315)	Gives permission to start a Step Functions state machine execution.		
CodeCommitCrudPolicy (p. 315)	Gives permissions to create/read/update/delete objects within a specific CodeCommit repository.		
CodeCommitReadPolicy (p. 317)	Gives permissions to read objects within a specific CodeCommit repository.		
AthenaQueryPolicy (p. 317)	Gives permissions to execute Athena queries.		
TextractPolicy (p. 318)	Gives full access to Amazon Textract.		
TextractDetectAnalyzePolicy (p. 319)	Gives access to detect and analyze documents with Amazon Textract.		
TextractGetResultPolicy (p. 319)	Gives access to get detected and analyzed documents from Amazon Textract.		
EventBridgePutEventsPolicy (p. 319)	Gives permissions to send events to EventBridge.		

Policy Template	Description		
ElasticMapReduceModifyInstanceFleetPolicy (p. 320)	Gives permission to list details and modify capacities for instance fleets within a cluster.		
ElasticMapReduceSetTerminationProtectionPolicy (p. 320)	Gives permission to set termination protection for a cluster.		
ElasticMapReduceModifyInstanceGroupsPolicy (p. 320)	Gives permission to list details and modify settings for instance groups within a cluster.		
ElasticMapReduceCancelStepsPolicy (p. 321)	Gives permission to cancel a pending step or steps in a running cluster.		
ElasticMapReduceTerminateJobFlowsPolicy (p. 321)	Gives permission to shut down a cluster.		
ElasticMapReduceAddJobFlowStepsPolicy (p. 322)	Gives permission to add new steps to a running cluster.		
SageMakerCreateEndpointPolicy (p. 322)	Gives permission to create an endpoint in SageMaker.		
SageMakerCreateEndpointConfigPolicy (p. 322)	Gives permission to create an endpoint configuration in SageMaker.		
EcsRunTaskPolicy (p. 323)	Gives permission to start a new task for a task definition.		
EFSWriteAccessPolicy (p. 323)	Gives permission to mount an Amazon EFS file system with write access.		
Route53ChangeResourceRecordSetsPolicy (p. 324)	Gives permission to change resource record sets in Route 53.		

Troubleshooting

SAM CLI error: "Must specify valid parameter values for policy template '<policy-template-name>'"

When executing `sam build`, you see the following error:

```
"Must specify valid parameter values for policy template '<policy-template-name>'"
```

This means that you did not pass an empty object when declaring a policy template that does not have any placeholder values.

To fix this, declare the policy like the following example for CloudWatchPutMetricPolicy (p. 290).

```
MyFunction:
  Policies:
    - CloudWatchPutMetricPolicy: {}
```

Policy template list

The following are the available policy templates, along with the permissions that are applied to each one. AWS Serverless Application Model (AWS SAM) automatically populates the placeholder items (such as AWS Region and account ID) with the appropriate information.

SQSPollerPolicy

Gives permission to poll an Amazon Simple Queue Service (Amazon SQS) queue.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "sqs:ChangeMessageVisibility",
              "sqs:ChangeMessageVisibilityBatch",
              "sqs:DeleteMessage",
              "sqs:DeleteMessageBatch",
              "sqs:GetQueueAttributes",
              "sqs:ReceiveMessage"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:sqs:${AWS::Region}:${AWS::AccountId}:${queueName}",
                {
                  "queueName": {
                    "Ref": "QueueName"
                  }
                }
              ]
            }
          }
        ]
```

LambdaInvokePolicy

Gives permission to invoke an AWS Lambda function, alias, or version.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "lambda:InvokeFunction"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:lambda:${AWS::Region}:${AWS::AccountId}:function:
${functionName}*",
                {
                  "functionName": {
                    "Ref": "FunctionName"
                  }
                }
              ]
            }
          }
        ]
```

CloudWatchDescribeAlarmHistoryPolicy

Gives permission to describe Amazon CloudWatch alarm history.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "cloudwatch:DescribeAlarmHistory"
    ],
    "Resource": "*"
  }
]
```

CloudWatchPutMetricPolicy

Gives permission to send metrics to CloudWatch.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "cloudwatch:PutMetricData"
    ],
    "Resource": "*"
  }
]
```

EC2DescribePolicy

Gives permission to describe Amazon Elastic Compute Cloud (Amazon EC2) instances.

```
 "Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "ec2:DescribeRegions",
      "ec2:DescribeInstances"
    ],
    "Resource": "*"
  }
]
```

DynamoDBCrudPolicy

Gives create, read, update, and delete permissions to an Amazon DynamoDB table.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
              "dynamodb:GetItem",
              "dynamodb:DeleteItem",
              "dynamodb:PutItem",
              "dynamodb:Scan",
              "dynamodb:Query",
              "dynamodb:UpdateItem",
              "dynamodb:BatchWriteItem",
              "dynamodb:BatchGetItem",
              "dynamodb:DescribeTable",
              "dynamodb:ConditionCheckItem"
            ],
            "Resource": [
              {
                "Fn::Sub": [
                  "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}",
                  {
                    "tableName": {
                      "Ref": "TableName"
                    }
                  }
                ]
              },
              {
                "Fn::Sub": [
                  "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}/index/*",
                  {
                    "tableName": {
                      "Ref": "TableName"
                    }
                  }
                ]
              }
            ]
          }
        ]
```

DynamoDBReadPolicy

Gives read-only permission to a DynamoDB table.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "dynamodb:GetItem",
              "dynamodb:Scan",
              "dynamodb:Query",
              "dynamodb:BatchGetItem",
              "dynamodb:DescribeTable"
            ],
            "Resource": [
              {
                "Fn::Sub": [
                  "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}",
                  {
                    "tableName": {
                      "Ref": "TableName"
                    }
                  }
                ]
              },
              {
                "Fn::Sub": [
                  "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}/index/*",
                  {
                    "tableName": {
                      "Ref": "TableName"
                    }
                  }
                ]
              }
            ]
          }
        ]
```

DynamoDBWritePolicy

Gives write-only permission to a DynamoDB table.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "dynamodb:PutItem",
              "dynamodb:UpdateItem",
              "dynamodb:BatchWriteItem"
            ],
            "Resource": [
              {
                "Fn::Sub": [
                  "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}",
                  {
                    "tableName": {
                      "Ref": "TableName"
                    }
                  }
                ]
              },
              {
                "Fn::Sub": [
                  "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}/index/*",
                  {
                    "tableName": {
                      "Ref": "TableName"
                    }
                  }
                ]
              }
            ]
          }
        ]
```

DynamoDBReconfigurePolicy

Gives permission to reconfigure a DynamoDB table.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "dynamodb:UpdateTable"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}",
                {
                  "tableName": {
                    "Ref": "TableName"
                  }
                }
              ]
            }
          }
        ]
```

SESSendBouncePolicy

Gives SendBounce permission to an Amazon Simple Email Service (Amazon SES) identity.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "ses:SendBounce"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:ses:${AWS::Region}:${AWS::AccountId}:identity/
${identityName}",
                {
                  "identityName": {
                    "Ref": "IdentityName"
                  }
                }
              ]
            }
          }
        ]
```

ElasticsearchHttpPostPolicy

Gives POST and PUT permission to Amazon OpenSearch Service.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "es:ESHttpPost",
              "es:ESHttpPut"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:es:${AWS::Region}:${AWS::AccountId}:domain/
${domainName}/*",
                {
                  "domainName": {
                    "Ref": "DomainName"
                  }
                }
              ]
            }
          }
        ]
```

S3ReadPolicy

Gives read-only permission to read objects in an Amazon Simple Storage Service (Amazon S3) bucket.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "s3:GetObject",
              "s3:ListBucket",
              "s3:GetBucketLocation",
              "s3:GetObjectVersion",
              "s3:GetLifecycleConfiguration"
            ],
            "Resource": [
              {
                "Fn::Sub": [
                  "arn:${AWS::Partition}:s3:::${bucketName}",
                  {
                    "bucketName": {
                      "Ref": "BucketName"
                    }
                  }
                ]
              },
              {
                "Fn::Sub": [
                  "arn:${AWS::Partition}:s3:::${bucketName}/*",
                  {
                    "bucketName": {
                      "Ref": "BucketName"
                    }
                  }
                ]
              }
            ]
          }
        ]
```

S3WritePolicy

Gives write permission to write objects into an Amazon S3 bucket.

```
        "Statement": [
          {
```

```
    "Effect": "Allow",
    "Action": [
      "s3:PutObject",
      "s3:PutObjectAcl",
      "s3:PutLifecycleConfiguration"
    ],
    "Resource": [
      {
        "Fn::Sub": [
          "arn:${AWS::Partition}:s3:::${bucketName}",
          {
            "bucketName": {
              "Ref": "BucketName"
            }
          }
        ]
      },
      {
        "Fn::Sub": [
          "arn:${AWS::Partition}:s3:::${bucketName}/*",
          {
            "bucketName": {
              "Ref": "BucketName"
            }
          }
        ]
      }
    ]
  }
]
```

S3CrudPolicy

Gives create, read, update, and delete permission to act on the objects in an Amazon S3 bucket.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "s3:GetObject",
      "s3:ListBucket",
      "s3:GetBucketLocation",
      "s3:GetObjectVersion",
      "s3:PutObject",
      "s3:PutObjectAcl",
      "s3:GetLifecycleConfiguration",
      "s3:PutLifecycleConfiguration",
      "s3:DeleteObject"
    ],
    "Resource": [
      {
        "Fn::Sub": [
          "arn:${AWS::Partition}:s3:::${bucketName}",
          {
            "bucketName": {
              "Ref": "BucketName"
            }
          }
        ]
      },
      {
        "Fn::Sub": [
          "arn:${AWS::Partition}:s3:::${bucketName}/*",
          {
            "bucketName": {
              "Ref": "BucketName"
            }
          }
        ]
      }
    ]
  }
]
```

AMIDescribePolicy

Gives permission to describe Amazon Machine Images (AMIs).

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "ec2:DescribeImages"
            ],
            "Resource": {
              "*"
            }
          }
        ]
```

CloudFormationDescribeStacksPolicy

Gives permission to describe AWS CloudFormation stacks.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "cloudformation:DescribeStacks"
            ],
            "Resource": {
              "Fn::Sub": "arn:${AWS::Partition}:cloudformation:${AWS::Region}:
${AWS::AccountId}:stack/*"
            }
          }
        ]
```

RekognitionDetectOnlyPolicy

Gives permission to detect faces, labels, and text.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "rekognition:DetectFaces",
              "rekognition:DetectLabels",
              "rekognition:DetectModerationLabels",
              "rekognition:DetectText"
            ],
            "Resource": "*"
          }
        ]
```

RekognitionNoDataAccessPolicy

Gives permission to compare and detect faces and labels.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "rekognition:CompareFaces",
              "rekognition:DetectFaces",
              "rekognition:DetectLabels",
              "rekognition:DetectModerationLabels"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:rekognition:${AWS::Region}:
${AWS::AccountId}:collection/${collectionId}",
                {
                  "collectionId": {
                    "Ref": "CollectionId"
                  }
                }
              ]
            }
          }
        ]
```

RekognitionReadPolicy

Gives permission to list and search faces.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "rekognition:ListCollections",
              "rekognition:ListFaces",
              "rekognition:SearchFaces",
              "rekognition:SearchFacesByImage"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:rekognition:${AWS::Region}:
${AWS::AccountId}:collection/${collectionId}",
                {
                  "collectionId": {
                    "Ref": "CollectionId"
                  }
                }
              ]
          }
        }
      ]
```

RekognitionWriteOnlyAccessPolicy

Gives permission to create collection and index faces.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "rekognition:CreateCollection",
              "rekognition:IndexFaces"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:rekognition:${AWS::Region}:
${AWS::AccountId}:collection/${collectionId}",
                {
                  "collectionId": {
                    "Ref": "CollectionId"
                  }
                }
              ]
            }
          }
        ]
```

SQSSendMessagePolicy

Gives permission to send message to an Amazon SQS queue.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "sqs:SendMessage*"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:sqs:${AWS::Region}:${AWS::AccountId}:${queueName}",
                {
                  "queueName": {
                    "Ref": "QueueName"
                  }
                }
              ]
            }
          }
        ]
```

SNSPublishMessagePolicy

Gives permission to publish a message to an Amazon Simple Notification Service (Amazon SNS) topic.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "sns:Publish"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:sns:${AWS::Region}:${AWS::AccountId}:${topicName}",
                {
                  "topicName": {
                    "Ref": "TopicName"
                  }
                }
              ]
            }
          }
        ]
```

VPCAccessPolicy

Gives access to create, delete, describe, and detach elastic network interfaces.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "ec2:CreateNetworkInterface",
              "ec2:DeleteNetworkInterface",
              "ec2:DescribeNetworkInterfaces",
              "ec2:DetachNetworkInterface"
            ],
            "Resource": "*"
          }
        ]
```

DynamoDBStreamReadPolicy

Gives permission to describe and read DynamoDB streams and records.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "dynamodb:DescribeStream",
              "dynamodb:GetRecords",
              "dynamodb:GetShardIterator"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}/stream/${streamName}",
                {
                  "tableName": {
                    "Ref": "TableName"
                  },
                  "streamName": {
                    "Ref": "StreamName"
                  }
                }
              ]
            }
          },
         {
            "Effect": "Allow",
            "Action": [
              "dynamodb:ListStreams"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}/stream/*",
                {
                  "tableName": {
                    "Ref": "TableName"
                  }
                }
              ]
            }
          }
        ]
```

KinesisStreamReadPolicy

Gives permission to list and read an Amazon Kinesis stream.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "kinesis:ListStreams",
              "kinesis:DescribeLimits"
            ],
            "Resource": {
              "Fn::Sub": "arn:${AWS::Partition}:kinesis:${AWS::Region}:
${AWS::AccountId}:stream/*"
            }
          },
          {
            "Effect": "Allow",
            "Action": [
              "kinesis:DescribeStream",
              "kinesis:DescribeStreamSummary",
              "kinesis:GetRecords",
              "kinesis:GetShardIterator"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:kinesis:${AWS::Region}:${AWS::AccountId}:stream/
${streamName}",
                {
                  "streamName": {
                    "Ref": "StreamName"
                  }
                }
              ]
            }
          }
        ]
```

SESCrudPolicy

Gives permission to send email and verify identity.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "ses:GetIdentityVerificationAttributes",
              "ses:SendEmail",
              "ses:SendRawEmail",
              "ses:VerifyEmailIdentity"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:ses:${AWS::Region}:${AWS::AccountId}:identity/
${identityName}",
                {
                  "identityName": {
                    "Ref": "IdentityName"
                  }
                }
              ]
            }
          }
        ]
```

SNSCrudPolicy

Gives permission to create, publish, and subscribe to Amazon SNS topics.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "sns:ListSubscriptionsByTopic",
              "sns:CreateTopic",
              "sns:SetTopicAttributes",
              "sns:Subscribe",
              "sns:Publish"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:sns:${AWS::Region}:${AWS::AccountId}:${topicName}*",
                {
                  "topicName": {
                    "Ref": "TopicName"
                  }
                }
              ]
            }
          }
        ]
```

KinesisCrudPolicy

Gives permission to create, publish, and delete an Amazon Kinesis stream.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "kinesis:AddTagsToStream",
              "kinesis:CreateStream",
              "kinesis:DecreaseStreamRetentionPeriod",
              "kinesis:DeleteStream",
              "kinesis:DescribeStream",
              "kinesis:DescribeStreamSummary",
              "kinesis:GetShardIterator",
              "kinesis:IncreaseStreamRetentionPeriod",
              "kinesis:ListTagsForStream",
              "kinesis:MergeShards",
              "kinesis:PutRecord",
              "kinesis:PutRecords",
              "kinesis:SplitShard",
              "kinesis:RemoveTagsFromStream"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:kinesis:${AWS::Region}:${AWS::AccountId}:stream/
${streamName}",
                {
                  "streamName": {
                    "Ref": "StreamName"
                  }
                }
              ]
            }
          }
        ]
```

KMSDecryptPolicy

Gives permission to decrypt with an AWS Key Management Service (AWS KMS) key. Note that `keyId` must be an AWS KMS key ID, and not a key alias.

```
        "Statement": [
          {
            "Action": "kms:Decrypt",
            "Effect": "Allow",
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:kms:${AWS::Region}:${AWS::AccountId}:key/${keyId}",
                {
                  "keyId": {
                    "Ref": "KeyId"
                  }
                }
              ]
            }
          }
        ]
```

KMSEncryptPolicy

Gives permission to encrypt with an AWS KMS key. Note that keyId must be an AWS KMS key ID, and not a key alias.

```
        "Statement": [
          {
            "Action": "kms:Encrypt",
            "Effect": "Allow",
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:kms:${AWS::Region}:${AWS::AccountId}:key/${keyId}",
                {
                  "keyId": {
                    "Ref": "KeyId"
                  }
                }
              ]
            }
          }
        ]
```

PollyFullAccessPolicy

Gives full access permission to Amazon Polly lexicon resources.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "polly:GetLexicon",
              "polly:DeleteLexicon"
            ],
            "Resource": [
              {
                "Fn::Sub": [
                  "arn:${AWS::Partition}:polly:${AWS::Region}:${AWS::AccountId}:lexicon/
${lexiconName}",
                  {
                    "lexiconName": {
                      "Ref": "LexiconName"
                    }
                  }
                ]
              }
            ]
          },
          {
            "Effect": "Allow",
            "Action": [
              "polly:DescribeVoices",
              "polly:ListLexicons",
              "polly:PutLexicon",
              "polly:SynthesizeSpeech"
            ],
            "Resource": [
              {
                "Fn::Sub": "arn:${AWS::Partition}:polly:${AWS::Region}:
${AWS::AccountId}:lexicon/*"
              }
            ]
          }
        ]
```

S3FullAccessPolicy

Gives full access permission to act on the objects in an Amazon S3 bucket.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "s3:GetObject",
              "s3:GetObjectAcl",
              "s3:GetObjectVersion",
              "s3:PutObject",
              "s3:PutObjectAcl",
              "s3:DeleteObject",
              "s3:DeleteObjectTagging",
              "s3:DeleteObjectVersionTagging",
              "s3:GetObjectTagging",
              "s3:GetObjectVersionTagging",
              "s3:PutObjectTagging",
              "s3:PutObjectVersionTagging"
            ],
            "Resource": [
              {
                "Fn::Sub": [
                  "arn:${AWS::Partition}:s3:::${bucketName}/*",
                  {
                    "bucketName": {
                      "Ref": "BucketName"
                    }
                  }
                ]
              }
            ]
          },
          {
            "Effect": "Allow",
            "Action": [
              "s3:ListBucket",
              "s3:GetBucketLocation",
              "s3:GetLifecycleConfiguration",
              "s3:PutLifecycleConfiguration"
            ],
            "Resource": [
              {
                "Fn::Sub": [
                  "arn:${AWS::Partition}:s3:::${bucketName}",
                  {
                    "bucketName": {
                      "Ref": "BucketName"
                    }
                  }
                ]
              }
            ]
          }
        ]
```

CodePipelineLambdaExecutionPolicy

Gives permission for a Lambda function invoked by AWS CodePipeline to report the status of the job.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "codepipeline:PutJobSuccessResult",
              "codepipeline:PutJobFailureResult"
            ],
            "Resource": "*"
          }
        ]
```

ServerlessRepoReadWriteAccessPolicy

Gives permission to create and list applications in the AWS Serverless Application Repository (AWS SAM) service.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "serverlessrepo:CreateApplication",
              "serverlessrepo:CreateApplicationVersion",
              "serverlessrepo:GetApplication",
              "serverlessrepo:ListApplications",
              "serverlessrepo:ListApplicationVersions"
            ],
            "Resource": [
              {
                "Fn::Sub": "arn:${AWS::Partition}:serverlessrepo:${AWS::Region}:
${AWS::AccountId}:applications/*"
              }
            ]
          }
        ]
```

EC2CopyImagePolicy

Gives permission to copy Amazon EC2 images.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "ec2:CopyImage"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:ec2:${AWS::Region}:${AWS::AccountId}:image/
${imageId}",
                {
                  "imageId": {
```

```
          "Ref": "ImageId"
         }
        }
       ]
      }
     }
    ]
```

AWSSecretsManagerRotationPolicy

Gives permission to rotate a secret in AWS Secrets Manager.

```
    "Statement": [
     {
      "Effect": "Allow",
      "Action": [
       "secretsmanager:DescribeSecret",
       "secretsmanager:GetSecretValue",
       "secretsmanager:PutSecretValue",
       "secretsmanager:UpdateSecretVersionStage"
      ],
      "Resource": {
       "Fn::Sub": "arn:${AWS::Partition}:secretsmanager:${AWS::Region}:
${AWS::AccountId}:secret:*"
      },
      "Condition": {
       "StringEquals": {
        "secretsmanager:resource/AllowRotationLambdaArn": {
         "Fn::Sub": [
          "arn:${AWS::Partition}:lambda:${AWS::Region}:
${AWS::AccountId}:function:${functionName}",
          {
           "functionName": {
            "Ref": "FunctionName"
           }
          }
         ]
        }
       }
      }
     },
     {
      "Effect": "Allow",
      "Action": [
       "secretsmanager:GetRandomPassword"
      ],
      "Resource": "*"
     }
    ]
```

AWSSecretsManagerGetSecretValuePolicy

Gives permission to get the secret value for the specified AWS Secrets Manager secret.

```
    "Statement": [
     {
      "Effect": "Allow",
            "Action": [
              "secretsmanager:GetSecretValue"
            ],
            "Resource": {
              "Fn::Sub": [
                "${secretArn}",
                {
                  "secretArn": {
                    "Ref": "SecretArn"
                  }
                }
              ]
            }
          }
        ]
```

CodePipelineReadOnlyPolicy

Gives read permission to get details about a CodePipeline pipeline.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "codepipeline:ListPipelineExecutions"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:codepipeline:${AWS::Region}:${AWS::AccountId}:
${pipelinename}",
                {
                  "pipelinename": {
                    "Ref": "PipelineName"
                  }
                }
              ]
            }
          }
        ]
```

CloudWatchDashboardPolicy

Gives permissions to put metrics to operate on CloudWatch dashboards.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "cloudwatch:GetDashboard",
              "cloudwatch:ListDashboards",
              "cloudwatch:PutDashboard",
              "cloudwatch:ListMetrics"
            ],
            "Resource": "*"
          }
        ]
```

RekognitionFacesManagementPolicy

Gives permission to add, delete, and search faces in an Amazon Rekognition collection.

```
        "Statement": [{
          "Effect": "Allow",
          "Action": [
            "rekognition:IndexFaces",
            "rekognition:DeleteFaces",
            "rekognition:SearchFaces",
            "rekognition:SearchFacesByImage",
            "rekognition:ListFaces"
          ],
          "Resource": {
            "Fn::Sub": [
              "arn:${AWS::Partition}:rekognition:${AWS::Region}:
${AWS::AccountId}:collection/${collectionId}",
              {
                "collectionId": {
                  "Ref": "CollectionId"
                }
              }
            ]
          }
        ]
```

RekognitionFacesPolicy

Gives permission to compare and detect faces and labels.

```
        "Statement": [{
          "Effect": "Allow",
          "Action": [
            "rekognition:CompareFaces",
            "rekognition:DetectFaces"
          ],
          "Resource": "*"
          }
        ]
```

RekognitionLabelsPolicy

Gives permission to detect object and moderation labels.

```
        "Statement": [{
          "Effect": "Allow",
          "Action": [
            "rekognition:DetectLabels",
            "rekognition:DetectModerationLabels"
          ],
          "Resource": "*"
         }
        ]
```

DynamoDBBackupFullAccessPolicy

Gives read and write permission to DynamoDB on-demand backups for a table.

```
        "Statement": [{
          "Effect": "Allow",
          "Action": [
            "dynamodb:CreateBackup",
            "dynamodb:DescribeContinuousBackups"
          ],
          "Resource": {
            "Fn::Sub": [
              "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}",
              {
                "tableName": {
                  "Ref": "TableName"
                }
              }
            ]
          }
        },
          {
            "Effect": "Allow",
            "Action": [
              "dynamodb:DeleteBackup",
              "dynamodb:DescribeBackup",
              "dynamodb:ListBackups"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}/backup/*",
                {
                  "tableName": {
                    "Ref": "TableName"
                  }
                }
              ]
            }
          }
        ]
```

DynamoDBRestoreFromBackupPolicy

Gives permission to restore a DynamoDB table from backup.

```
        "Statement": [{
          "Effect": "Allow",
          "Action": [
            "dynamodb:RestoreTableFromBackup"
          ],
          "Resource": {
            "Fn::Sub": [
              "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}/backup/*",
              {
                "tableName": {
                  "Ref": "TableName"
        }
       }
      ]
     }
    },
     {
      "Effect": "Allow",
      "Action": [
       "dynamodb:PutItem",
       "dynamodb:UpdateItem",
       "dynamodb:DeleteItem",
       "dynamodb:GetItem",
       "dynamodb:Query",
       "dynamodb:Scan",
       "dynamodb:BatchWriteItem"
      ],
      "Resource": {
       "Fn::Sub": [
        "arn:${AWS::Partition}:dynamodb:${AWS::Region}:${AWS::AccountId}:table/
${tableName}",
        {
         "tableName": {
          "Ref": "TableName"
         }
        }
       ]
      }
     }
    ]
```

ComprehendBasicAccessPolicy

Gives permission for detecting entities, key phrases, languages, and sentiments.

```
    "Statement": [{
     "Effect": "Allow",
     "Action": [
      "comprehend:BatchDetectKeyPhrases",
      "comprehend:DetectDominantLanguage",
      "comprehend:DetectEntities",
      "comprehend:BatchDetectEntities",
      "comprehend:DetectKeyPhrases",
      "comprehend:DetectSentiment",
      "comprehend:BatchDetectDominantLanguage",
      "comprehend:BatchDetectSentiment"
     ],
     "Resource": "*"
     }
    ]
```

MobileAnalyticsWriteOnlyAccessPolicy

Gives write-only permission to put event data for all application resources.

```
    "Statement": [
     {
      "Effect": "Allow",
      "Action": [
              "mobileanalytics:PutEvents"
            ],
            "Resource": "*"
          }
        ]
```

PinpointEndpointAccessPolicy

Gives permission to get and update endpoints for an Amazon Pinpoint application.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "mobiletargeting:GetEndpoint",
              "mobiletargeting:UpdateEndpoint",
              "mobiletargeting:UpdateEndpointsBatch"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:mobiletargeting:${AWS::Region}:
${AWS::AccountId}:apps/${pinpointApplicationId}/endpoints/*",
                {
                  "pinpointApplicationId": {
                    "Ref": "PinpointApplicationId"
                  }
                }
              ]
            }
          }
        ]
```

FirehoseWritePolicy

Gives permission to write to a Kinesis Data Firehose delivery stream.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "firehose:PutRecord",
              "firehose:PutRecordBatch"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:firehose:${AWS::Region}:
${AWS::AccountId}:deliverystream/${deliveryStreamName}",
                {
                  "deliveryStreamName": {
                    "Ref": "DeliveryStreamName"
                  }
                }
              ]
            }
          }
        ]
```

FirehoseCrudPolicy

Gives permission to create, write, update, and delete a Kinesis Data Firehose delivery stream.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "firehose:CreateDeliveryStream",
              "firehose:DeleteDeliveryStream",
              "firehose:DescribeDeliveryStream",
              "firehose:PutRecord",
              "firehose:PutRecordBatch",
              "firehose:UpdateDestination"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:firehose:${AWS::Region}:
${AWS::AccountId}:deliverystream/${deliveryStreamName}",
                {
                  "deliveryStreamName": {
                    "Ref": "DeliveryStreamName"
                  }
                }
              ]
            }
          }
        ]
```

EKSDescribePolicy

Gives permission to describe or list Amazon Elastic Kubernetes Service (Amazon EKS) clusters.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "eks:DescribeCluster",
              "eks:ListClusters"
            ],
            "Resource": "*"
          }
        ]
```

CostExplorerReadOnlyPolicy

Gives read-only permission to the read-only AWS Cost Explorer (Cost Explorer) APIs for billing history.

```
        "Statement": [{
          "Effect": "Allow",
          "Action": [
            "ce:GetCostAndUsage",
            "ce:GetDimensionValues",
            "ce:GetReservationCoverage",
            "ce:GetReservationPurchaseRecommendation",
            "ce:GetReservationUtilization",
            "ce:GetTags"
          ],
          "Resource": "*"
        }]
```

OrganizationsListAccountsPolicy

Gives read-only permission to list child account names and IDs.

```
        "Statement": [{
          "Effect": "Allow",
          "Action": [
            "organizations:ListAccounts"
          ],
          "Resource": "*"
        }]
```

SESBulkTemplatedCrudPolicy

Gives permission to send Amazon SES email, templated email, and templated bulk emails and to verify identity.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "ses:GetIdentityVerificationAttributes",
              "ses:SendEmail",
              "ses:SendRawEmail",
              "ses:SendTemplatedEmail",
              "ses:SendBulkTemplatedEmail",
              "ses:VerifyEmailIdentity"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:ses:${AWS::Region}:${AWS::AccountId}:identity/
${identityName}",
                {
                  "identityName": {
                    "Ref": "IdentityName"
                  }
                }
              ]
            }
          }
       ]
```

SESEmailTemplateCrudPolicy

Gives permission to create, get, list, update, and delete Amazon SES email templates.

```
        "Statement": [{
          "Effect": "Allow",
          "Action": [
            "ses:CreateTemplate",
            "ses:GetTemplate",
            "ses:ListTemplates",
            "ses:UpdateTemplate",
            "ses:DeleteTemplate",
            "ses:TestRenderTemplate"
          ],
          "Resource": "*"
        }]
```

FilterLogEventsPolicy

Gives permission to filter CloudWatch Logs events from a specified log group.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "logs:FilterLogEvents"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:logs:${AWS::Region}:${AWS::AccountId}:log-group:
${logGroupName}:log-stream:*",
                {
                  "logGroupName": {
                    "Ref": "LogGroupName"
                  }
                }
              ]
            }
          }
        ]
```

SSMParameterReadPolicy

Gives permission to access a parameters from an Amazon EC2 Systems Manager (SSM) parameter store to load secrets in this account.

> **Note**
> If you are not using default key, you will also need the `KMSDecryptPolicy` policy.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "ssm:DescribeParameters"
            ],
            "Resource": "*"
          },
          {
            "Effect": "Allow",
            "Action": [
              "ssm:GetParameters",
              "ssm:GetParameter",
       "ssm:GetParametersByPath"
      ],
      "Resource": {
       "Fn::Sub": [
        "arn:${AWS::Partition}:ssm:${AWS::Region}:${AWS::AccountId}:parameter/
${parameterName}",
        {
         "parameterName": {
          "Ref": "ParameterName"
         }
        }
       ]
      }
     }
    ]
```

StepFunctionsExecutionPolicy

Gives permission to start a Step Functions state machine execution.

```
    "Statement": [
     {
      "Effect": "Allow",
      "Action": [
       "states:StartExecution"
      ],
      "Resource": {
       "Fn::Sub": [
        "arn:${AWS::Partition}:states:${AWS::Region}:
${AWS::AccountId}:stateMachine:${stateMachineName}",
        {
         "stateMachineName": {
          "Ref": "StateMachineName"
         }
        }
       ]
      }
     }
    ]
```

CodeCommitCrudPolicy

Gives permissions to create, read, update, and delete objects within a specific CodeCommit repository.

```
    "Statement": [
     {
      "Effect": "Allow",
      "Action": [
       "codecommit:GitPull",
       "codecommit:GitPush",
       "codecommit:CreateBranch",
       "codecommit:DeleteBranch",
       "codecommit:GetBranch",
       "codecommit:ListBranches",
       "codecommit:MergeBranchesByFastForward",
       "codecommit:MergeBranchesBySquash",
       "codecommit:MergeBranchesByThreeWay",
       "codecommit:UpdateDefaultBranch",
              "codecommit:BatchDescribeMergeConflicts",
              "codecommit:CreateUnreferencedMergeCommit",
              "codecommit:DescribeMergeConflicts",
              "codecommit:GetMergeCommit",
              "codecommit:GetMergeOptions",
              "codecommit:BatchGetPullRequests",
              "codecommit:CreatePullRequest",
              "codecommit:DescribePullRequestEvents",
              "codecommit:GetCommentsForPullRequest",
              "codecommit:GetCommitsFromMergeBase",
              "codecommit:GetMergeConflicts",
              "codecommit:GetPullRequest",
              "codecommit:ListPullRequests",
              "codecommit:MergePullRequestByFastForward",
              "codecommit:MergePullRequestBySquash",
              "codecommit:MergePullRequestByThreeWay",
              "codecommit:PostCommentForPullRequest",
              "codecommit:UpdatePullRequestDescription",
              "codecommit:UpdatePullRequestStatus",
              "codecommit:UpdatePullRequestTitle",
              "codecommit:DeleteFile",
              "codecommit:GetBlob",
              "codecommit:GetFile",
              "codecommit:GetFolder",
              "codecommit:PutFile",
              "codecommit:DeleteCommentContent",
              "codecommit:GetComment",
              "codecommit:GetCommentsForComparedCommit",
              "codecommit:PostCommentForComparedCommit",
              "codecommit:PostCommentReply",
              "codecommit:UpdateComment",
              "codecommit:BatchGetCommits",
              "codecommit:CreateCommit",
              "codecommit:GetCommit",
              "codecommit:GetCommitHistory",
              "codecommit:GetDifferences",
              "codecommit:GetObjectIdentifier",
              "codecommit:GetReferences",
              "codecommit:GetTree",
              "codecommit:GetRepository",
              "codecommit:UpdateRepositoryDescription",
              "codecommit:ListTagsForResource",
              "codecommit:TagResource",
              "codecommit:UntagResource",
              "codecommit:GetRepositoryTriggers",
              "codecommit:PutRepositoryTriggers",
              "codecommit:TestRepositoryTriggers",
              "codecommit:GetBranch",
              "codecommit:GetCommit",
              "codecommit:UploadArchive",
              "codecommit:GetUploadArchiveStatus",
              "codecommit:CancelUploadArchive"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:codecommit:${AWS::Region}:${AWS::AccountId}:
${repositoryName}",
                {
                  "repositoryName": {
                    "Ref": "RepositoryName"
                  }
                }
              ]
            }
          }
        ]
```

CodeCommitReadPolicy

Gives permissions to read objects within a specific CodeCommit repository.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "codecommit:GitPull",
              "codecommit:GetBranch",
              "codecommit:ListBranches",
              "codecommit:BatchDescribeMergeConflicts",
              "codecommit:DescribeMergeConflicts",
              "codecommit:GetMergeCommit",
              "codecommit:GetMergeOptions",
              "codecommit:BatchGetPullRequests",
              "codecommit:DescribePullRequestEvents",
              "codecommit:GetCommentsForPullRequest",
              "codecommit:GetCommitsFromMergeBase",
              "codecommit:GetMergeConflicts",
              "codecommit:GetPullRequest",
              "codecommit:ListPullRequests",
              "codecommit:GetBlob",
              "codecommit:GetFile",
              "codecommit:GetFolder",
              "codecommit:GetComment",
              "codecommit:GetCommentsForComparedCommit",
              "codecommit:BatchGetCommits",
              "codecommit:GetCommit",
              "codecommit:GetCommitHistory",
              "codecommit:GetDifferences",
              "codecommit:GetObjectIdentifier",
              "codecommit:GetReferences",
              "codecommit:GetTree",
              "codecommit:GetRepository",
              "codecommit:ListTagsForResource",
              "codecommit:GetRepositoryTriggers",
              "codecommit:TestRepositoryTriggers",
              "codecommit:GetBranch",
              "codecommit:GetCommit",
              "codecommit:GetUploadArchiveStatus"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:codecommit:${AWS::Region}:${AWS::AccountId}:
${repositoryName}",
                {
                  "repositoryName": {
                    "Ref": "RepositoryName"
                  }
                }
              ]
            }
          }
        ]
```

AthenaQueryPolicy

Gives permissions to execute Athena queries.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "athena:ListWorkGroups",
              "athena:GetExecutionEngine",
              "athena:GetExecutionEngines",
              "athena:GetNamespace",
              "athena:GetCatalogs",
              "athena:GetNamespaces",
              "athena:GetTables",
              "athena:GetTable"
            ],
            "Resource": "*"
          },
          {
            "Effect": "Allow",
            "Action": [
              "athena:StartQueryExecution",
              "athena:GetQueryResults",
              "athena:DeleteNamedQuery",
              "athena:GetNamedQuery",
              "athena:ListQueryExecutions",
              "athena:StopQueryExecution",
              "athena:GetQueryResultsStream",
              "athena:ListNamedQueries",
              "athena:CreateNamedQuery",
              "athena:GetQueryExecution",
              "athena:BatchGetNamedQuery",
              "athena:BatchGetQueryExecution",
              "athena:GetWorkGroup"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:athena:${AWS::Region}:${AWS::AccountId}:workgroup/
${workgroupName}",
                {
                  "workgroupName": {
                    "Ref": "WorkGroupName"
                  }
                }
              ]
            }
          }
        ]
```

TextractPolicy

Gives full access to Amazon Textract.

```
        "Statement": [
         {
            "Effect": "Allow",
            "Action": [
              "textract:*"
            ],
            "Resource": "*"
          }
        ]
```

TextractDetectAnalyzePolicy

Gives access to detect and analyze documents with Amazon Textract.

```
    "Statement": [
     {
      "Effect": "Allow",
      "Action": [
       "textract:DetectDocumentText",
       "textract:StartDocumentTextDetection",
       "textract:StartDocumentAnalysis",
       "textract:AnalyzeDocument"
      ],
      "Resource": "*"
     }
    ]
```

TextractGetResultPolicy

Gives access to get detected and analyzed documents from Amazon Textract.

```
    "Statement": [
     {
      "Effect": "Allow",
      "Action": [
       "textract:GetDocumentTextDetection",
       "textract:GetDocumentAnalysis"
      ],
      "Resource": "*"
     }
    ]
```

EventBridgePutEventsPolicy

Gives permissions to send events to Amazon EventBridge.

```
    "Statement": [
     {
      "Effect": "Allow",
      "Action": "events:PutEvents",
      "Resource": {
       "Fn::Sub": [
        "arn:${AWS::Partition}:events:${AWS::Region}:${AWS::AccountId}:event-bus/
${eventBusName}",
        {
         "eventBusName": {
          "Ref": "EventBusName"
         }
        }
       ]
      }
     }
    ]
```

ElasticMapReduceModifyInstanceFleetPolicy

Gives permission to list details and modify capacities for instance fleets within a cluster.

```
        "Statement": [
          {
            "Action": [
              "elasticmapreduce:ModifyInstanceFleet",
              "elasticmapreduce:ListInstanceFleets"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:elasticmapreduce:${AWS::Region}:
${AWS::AccountId}:cluster/${clusterId}",
                {
                  "clusterId": {
                    "Ref": "ClusterId"
                  }
                }
              ]
            },
            "Effect": "Allow"
          }
        ]
```

ElasticMapReduceSetTerminationProtectionPolicy

Gives permission to set termination protection for a cluster.

```
        "Statement": [
          {
            "Action": "elasticmapreduce:SetTerminationProtection",
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:elasticmapreduce:${AWS::Region}:
${AWS::AccountId}:cluster/${clusterId}",
                {
                  "clusterId": {
                    "Ref": "ClusterId"
                  }
                }
              ]
            },
            "Effect": "Allow"
          }
        ]
```

ElasticMapReduceModifyInstanceGroupsPolicy

Gives permission to list details and modify settings for instance groups within a cluster.

```
        "Statement": [
          {
            "Action": [
              "elasticmapreduce:ModifyInstanceGroups",
              "elasticmapreduce:ListInstanceGroups"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:elasticmapreduce:${AWS::Region}:
${AWS::AccountId}:cluster/${clusterId}",
                {
                  "clusterId": {
                    "Ref": "ClusterId"
                  }
                }
              ]
            },
            "Effect": "Allow"
          }
        ]
```

ElasticMapReduceCancelStepsPolicy

Gives permission to cancel a pending step or steps in a running cluster.

```
        "Statement": [
          {
            "Action": "elasticmapreduce:CancelSteps",
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:elasticmapreduce:${AWS::Region}:
${AWS::AccountId}:cluster/${clusterId}",
                {
                  "clusterId": {
                    "Ref": "ClusterId"
                  }
                }
              ]
            },
            "Effect": "Allow"
          }
        ]
```

ElasticMapReduceTerminateJobFlowsPolicy

Gives permission to shut down a cluster.

```
        "Statement": [
          {
            "Action": "elasticmapreduce:TerminateJobFlows",
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:elasticmapreduce:${AWS::Region}:
${AWS::AccountId}:cluster/${clusterId}",
                {
                  "clusterId": {
                    "Ref": "ClusterId"
                  }
                }
              ]
            },
            "Effect": "Allow"
          }
        ]
```

ElasticMapReduceAddJobFlowStepsPolicy

Gives permission to add new steps to a running cluster.

```
        "Statement": [
          {
            "Action": "elasticmapreduce:AddJobFlowSteps",
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:elasticmapreduce:${AWS::Region}:
${AWS::AccountId}:cluster/${clusterId}",
                {
                  "clusterId": {
                    "Ref": "ClusterId"
                  }
                }
              ]
            },
            "Effect": "Allow"
          }
        ]
```

SageMakerCreateEndpointPolicy

Gives permission to create an endpoint in SageMaker.

```
        "Statement": [
          {
            "Action": [
              "sagemaker:CreateEndpoint"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:sagemaker:${AWS::Region}:${AWS::AccountId}:endpoint/
${endpointName}",
                {
                  "endpointName": {
                    "Ref": "EndpointName"
                  }
                }
              ]
            },
            "Effect": "Allow"
          }
        ]
```

SageMakerCreateEndpointConfigPolicy

Gives permission to create an endpoint configuration in SageMaker.

```
        "Statement": [
          {
            "Action": [
              "sagemaker:CreateEndpointConfig"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:sagemaker:${AWS::Region}:${AWS::AccountId}:endpoint-
config/${endpointConfigName}",
                {
                  "endpointConfigName": {
                    "Ref": "EndpointConfigName"
                  }
                }
              ]
            },
            "Effect": "Allow"
          }
        ]
```

EcsRunTaskPolicy

Gives permission to start a new task for a task definition.

```
        "Statement": [
          {
            "Action": [
              "ecs:RunTask"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:ecs:${AWS::Region}:${AWS::AccountId}:task-
definition/${taskDefinition}",
                {
                  "taskDefinition": {
                    "Ref": "TaskDefinition"
                  }
                }
              ]
            },
            "Effect": "Allow"
          }
        ]
```

EFSWriteAccessPolicy

Gives permission to mount an Amazon EFS file system with write access.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "elasticfilesystem:ClientMount",
              "elasticfilesystem:ClientWrite"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:elasticfilesystem:${AWS::Region}:
${AWS::AccountId}:file-system/${FileSystem}",
                {
                  "FileSystem": {
                    "Ref": "FileSystem"
                  }
                }
              ]
            },
            "Condition": {
              "StringEquals": {
                "elasticfilesystem:AccessPointArn": {
                  "Fn::Sub": [
                    "arn:${AWS::Partition}:elasticfilesystem:${AWS::Region}:
${AWS::AccountId}:access-point/${AccessPoint}",
                    {
                      "AccessPoint": {
                        "Ref": "AccessPoint"
                      }
                    }
                  ]
                }
              }
            }
          }
        ]
```

Route53ChangeResourceRecordSetsPolicy

Gives permission to change resource record sets in Route 53.

```
        "Statement": [
          {
            "Effect": "Allow",
            "Action": [
              "route53:ChangeResourceRecordSets"
            ],
            "Resource": {
              "Fn::Sub": [
                "arn:${AWS::Partition}:route53:::hostedzone/${HostedZoneId}",
                {
                  "HostedZoneId": {
                    "Ref": "HostedZoneId"
                  }
                }
              ]
            }
          }
        ]
```

Image repositories

AWS SAM simplifies continuous integration and continuous deployment (CI/CD) tasks for serverless applications with the help of build container images. The images that AWS SAM provides include the AWS SAM command line interface (CLI) and build tools for a number of supported AWS Lambda runtimes. This make it easier to build and package serverless applications using the AWS SAM CLI. You can use these images with CI/CD systems to automate the building and deployment of AWS SAM applications. For examples, see Deploying using CI/CD systems (p. 221).

AWS SAM build container image URIs are tagged with the version of the AWS SAM CLI included in that image. If you specify the untagged URI, then the latest version is used. For example, `public.ecr.aws/`

`sam/build-nodejs14.x` uses the latest image. However, `public.ecr.aws/sam/build-nodejs14.x:1.24.1` uses the the image containing AWS SAM CLI version 1.24.1.

Starting with version 1.33.0 of the AWS SAM CLI, both `x86_64` and `arm64` container images are available for supported runtimes. For more information, see Lambda runtimes in the *AWS Lambda Developer Guide*.

> **Note**
> Prior to version 1.22.0 of the AWS SAM CLI, DockerHub was the default repository that the AWS SAM CLI pulled the container image from. Starting with version 1.22.0, the default repository changed to Amazon Elastic Container Registry Public (Amazon ECR Public). To pull a container image from a repository other than the current default, you can use the **sam build (p. 252)** command with the **--build-image** option. The examples at the end of this topic show how to build applications using DockerHub repository images.

Image repository URIs

The following table lists the URIs of Amazon ECR Public build container images that you can use to build and package serverless applications with AWS SAM.

Runtime	Amazon ECR Public (default starting with version 1.22.0)	DockerHub (default prior to version 1.22.0)
Node.js 14	public.ecr.aws/sam/build-nodejs14.x	amazon/aws-sam-cli-build-image-nodejs14.x
Node.js 12	public.ecr.aws/sam/build-nodejs12.x	amazon/aws-sam-cli-build-image-nodejs12.x
Node.js 10	public.ecr.aws/sam/build-nodejs10.x	amazon/aws-sam-cli-build-image-nodejs10.x
Python 3.9	public.ecr.aws/sam/build-python3.9	Not supported
Python 3.8	public.ecr.aws/sam/build-python3.8	amazon/aws-sam-cli-build-image-python3.8
Python 3.7	public.ecr.aws/sam/build-python3.7	amazon/aws-sam-cli-build-image-python3.7
Python 3.6	public.ecr.aws/sam/build-python3.6	amazon/aws-sam-cli-build-image-python3.6
Python 2.7	public.ecr.aws/sam/build-python2.7	amazon/aws-sam-cli-build-image-python2.7
Ruby 2.7	public.ecr.aws/sam/build-ruby2.7	amazon/aws-sam-cli-build-image-ruby2.7
Ruby 2.5	public.ecr.aws/sam/build-ruby2.5	amazon/aws-sam-cli-build-image-ruby2.5
Java 11	public.ecr.aws/sam/build-java11	amazon/aws-sam-cli-build-image-java11
Java 8 (AL2)	public.ecr.aws/sam/build-java8.al2	amazon/aws-sam-cli-build-image-java8.al2

Runtime	Amazon ECR Public (default starting with version 1.22.0)	DockerHub (default prior to version 1.22.0)
Java 8	public.ecr.aws/sam/build-java8	amazon/aws-sam-cli-build-image-java8
Go 1.x	public.ecr.aws/sam/build-go1.x	amazon/aws-sam-cli-build-image-go1.x
Custom runtime (AL2)	public.ecr.aws/sam/build-provided.al2	amazon/aws-sam-cli-build-image-provided.al2
Custom runtime	public.ecr.aws/sam/build-provided	amazon/aws-sam-cli-build-image-provided

Examples

The following two example commands build applications using container images from the DockerHub repository:

```
# Build a Node.js 12 application using a container image pulled from DockerHub
sam build --use-container --build-image amazon/aws-sam-cli-build-image-nodejs12.x

# Build a function resource using the Python 3.8 container image pulled from DockerHub
sam build --use-container --build-image Function1=amazon/aws-sam-cli-build-image-python3.8
```

Deploying serverless applications gradually

If you use AWS SAM to create your serverless application, it comes built-in with CodeDeploy to provide gradual Lambda deployments. With just a few lines of configuration, AWS SAM does the following for you:

- Deploys new versions of your Lambda function, and automatically creates aliases that point to the new version.
- Gradually shifts customer traffic to the new version until you're satisfied that it's working as expected, or you roll back the update.
- Defines pre-traffic and post-traffic test functions to verify that the newly deployed code is configured correctly and your application operates as expected.
- Rolls back the deployment if CloudWatch alarms are triggered.

Note
If you enable gradual deployments through your AWS SAM template, a CodeDeploy resource is automatically created for you. You can view the CodeDeploy resource directly through the AWS Management Console.

Example

The following example demonstrates a simple version of using CodeDeploy to gradually shift customers to your newly deployed version:

```
Resources:
```

```
MyLambdaFunction:
  Type: AWS::Serverless::Function
  Properties:
    Handler: index.handler
    Runtime: nodejs12.x
    CodeUri: s3://bucket/code.zip

    AutoPublishAlias: live

    DeploymentPreference:
      Type: Canary10Percent10Minutes
      Alarms:
        # A list of alarms that you want to monitor
        - !Ref AliasErrorMetricGreaterThanZeroAlarm
        - !Ref LatestVersionErrorMetricGreaterThanZeroAlarm
      Hooks:
        # Validation Lambda functions that are run before & after traffic shifting
        PreTraffic: !Ref PreTrafficLambdaFunction
        PostTraffic: !Ref PostTrafficLambdaFunction
```

These revisions to the AWS SAM template do the following:

- **AutoPublishAlias**: By adding this property and specifying an alias name, AWS SAM:
  - Detects when new code is being deployed, based on changes to the Lambda function's Amazon S3 URI.
  - Creates and publishes an updated version of that function with the latest code.
  - Creates an alias with a name that you provide (unless an alias already exists), and points to the updated version of the Lambda function. Function invocations should use the alias qualifier to take advantage of this. If you aren't familiar with Lambda function versioning and aliases, see AWS Lambda Function Versioning and Aliases .
- **Deployment Preference Type**: In the previous example, 10 percent of your customer traffic is immediately shifted to your new version. After 10 minutes, all traffic is shifted to the new version. However, if your pre-hook/post-hook tests fail, or if a CloudWatch alarm is triggered, CodeDeploy rolls back your deployment. The following table outlines other traffic-shifting options that are available beyond the one used earlier. Note the following:
  - **Canary**: Traffic is shifted in two increments. You can choose from predefined canary options. The options specify the percentage of traffic that's shifted to your updated Lambda function version in the first increment, and the interval, in minutes, before the remaining traffic is shifted in the second increment.
  - **Linear**: Traffic is shifted in equal increments with an equal number of minutes between each increment. You can choose from predefined linear options that specify the percentage of traffic that's shifted in each increment and the number of minutes between each increment.
  - **All-at-once**: All traffic is shifted from the original Lambda function to the updated Lambda function version at once.

Deployment Preference Type
Canary10Percent30Minutes
Canary10Percent5Minutes
Canary10Percent10Minutes
Canary10Percent15Minutes
Linear10PercentEvery10Minutes
Linear10PercentEvery1Minute

Deployment Preference Type
Linear10PercentEvery2Minutes
Linear10PercentEvery3Minutes
AllAtOnce

- **Alarms**: These are CloudWatch alarms that are triggered by any errors raised by the deployment. They automatically roll back your deployment. An example is if the updated code you're deploying is creating errors within the application. Another example is if any AWS Lambda or custom CloudWatch metrics that you specified have breached the alarm threshold.
- **Hooks**: These are pre-traffic and post-traffic test functions that run sanity checks before traffic shifting starts to the new version, and after traffic shifting completes.
  - **PreTraffic**: Before traffic shifting starts, CodeDeploy invokes the pre-traffic hook Lambda function. This Lambda function must call back to CodeDeploy and indicate success or failure. If the function fails, it aborts and reports a failure back to AWS CloudFormation. If the function succeeds, CodeDeploy proceeds to traffic shifting.
  - **PostTraffic**: After traffic shifting completes, CodeDeploy invokes the post-traffic hook Lambda function. This is similar to the pre-traffic hook, where the function must call back to CodeDeploy to report a success or failure. Use post-traffic hooks to run integration tests or other validation actions.

For more information, see SAM Reference to Safe Deployments.

Telemetry in the AWS SAM CLI

At AWS, we develop and launch services based on what we learn from interactions with customers. We use customer feedback to iterate on our product. Telemetry is additional information that helps us to better understand our customers' needs, diagnose issues, and deliver features that improve the customer experience.

The AWS SAM CLI collects telemetry, such as generic usage metrics, system and environment information, and errors. For details of the types of telemetry collected, see Types of information collected (p. 329).

The AWS SAM CLI does **not** collect personal information, such as usernames or email addresses. It also does not extract sensitive project-level information.

Customers control whether telemetry is enabled, and can change their settings at any point of time. If telemetry remains enabled, the AWS SAM CLI sends telemetry data in the background without requiring any additional customer interaction.

Disabling telemetry for a session

In macOS and Linux operating systems, you can disable telemetry for a single session. To disable telemetry for your current session, run the following command to set the environment variable `SAM_CLI_TELEMETRY` to `false`. You must repeat the command for each new terminal or session.

```
export SAM_CLI_TELEMETRY=0
```

Disabling telemetry for your profile in all sessions

Run the following commands to disable telemetry for all sessions when you're running the AWS SAM CLI on your operating system.

To disable telemetry in Linux

1. Run:

```
echo "export SAM_CLI_TELEMETRY=0" >>~/.profile
```

2. Run:

```
source ~/.profile
```

To disable telemetry in macOS

1. Run:

```
echo "export SAM_CLI_TELEMETRY=0" >>~/.profile
```

2. Run:

```
source ~/.profile
```

To disable telemetry in Windows

1. Run:

```
setx SAM_CLI_TELEMETRY 0
```

2. Run:

```
refreshenv
```

Types of information collected

- **Usage information** – The generic commands and subcommands that are run.
- **Errors and diagnostic information** – The status and duration of commands that are run, including exit codes, internal exception names, and failures when connecting to Docker.
- **System and environment information** – The Python version, operating system (Windows, Linux, or macOS), and environment in which the AWS SAM CLI is executed (for example, AWS CodeBuild, an AWS IDE toolkit, or a terminal).

Learn more

The telemetry data that's collected adheres to the AWS data privacy policies. For more information, see the following:

- AWS Service Terms
- Data Privacy

Permissions

To control access to AWS resources, AWS SAM uses the same mechanisms as AWS CloudFormation. For more information, see Controlling access with AWS Identity and Access Management in the *AWS CloudFormation User Guide*.

There are three main options for granting a user permission to manage serverless applications. Each option provides users with different levels of access control.

- Grant administrator permissions.
- Attach necessary AWS managed policies.
- Grant specific AWS Identity and Access Management (IAM) permissions.

Depending on which option you choose, users can manage only serverless applications containing AWS resources that they have permission to access.

The following sections describe each option in more detail.

Grant administrator permissions

If you grant administrator permissions to a user, they can manage serverless applications that contain any combination of AWS resources. This is the simplest option, but it also grants users the broadest set of permissions, which therefore enables them to perform actions with the highest impact.

For more information about granting administrator permissions to a user, see Creating your first IAM admin user and group in the *IAM User Guide*.

Attach necessary AWS managed policies

You can grant users a subset of permissions using AWS managed policies, rather than granting full administrator permissions. If you use this option, make sure that the set of AWS managed policies covers all of the actions and resources required for the serverless applications that the users manage.

For example, the following AWS managed policies are sufficient to deploy the sample Hello World application (p. 16):

- AWSCloudFormationFullAccess
- IAMFullAccess
- AWSLambda_FullAccess
- AmazonAPIGatewayAdministrator
- AmazonS3FullAccess
- AmazonEC2ContainerRegistryFullAccess

For information about attaching policies to an IAM user, see Changing permissions for an IAM user in the *IAM User Guide*.

Grant specific IAM permissions

For the most granular level of access control, you can grant specific IAM permissions to users using policy statements. If you use this option, make sure that the policy statement includes all of the actions and resources required for the serverless applications that the users manage.

The best practice with this option is to deny users the permission to create roles, including Lambda execution roles, so they can't grant themselves escalated permissions. So, you as the administrator must first create a Lambda execution role that will be specified in the serverless applications that users will manage. For information about creating Lambda execution roles, see Creating an execution role in the IAM console.

For the sample Hello World application (p. 16) the **AWSLambdaBasicExecutionRole** is sufficient to run the application. After you've created a Lambda execution role, modify the AWS SAM template file of the sample Hello World application to add the following property to the `AWS::Serverless::Function` resource:

```
Role: lambda-execution-role-arn
```

With the modified Hello World application in place, the following policy statement grants sufficient permissions for users to deploy, update, and delete the application:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "CloudFormationTemplate",
            "Effect": "Allow",
            "Action": [
                "cloudformation:CreateChangeSet"
            ],
            "Resource": [
                "arn:aws:cloudformation:*:aws:transform/Serverless-2016-10-31"
            ]
        },
        {
            "Sid": "CloudFormationStack",
            "Effect": "Allow",
            "Action": [
                "cloudformation:CreateChangeSet",
                "cloudformation:CreateStack",
                "cloudformation:DeleteStack",
                "cloudformation:DescribeChangeSet",
                "cloudformation:DescribeStackEvents",
                "cloudformation:DescribeStacks",
                "cloudformation:ExecuteChangeSet",
                "cloudformation:GetTemplateSummary",
                "cloudformation:ListStackResources",
                "cloudformation:UpdateStack"
            ],
            "Resource": [
                "arn:aws:cloudformation:*:111122223333:stack/*"
            ]
        },
        {
            "Sid": "S3",
            "Effect": "Allow",
            "Action": [
                "s3:CreateBucket",
                "s3:GetObject",
                "s3:PutObject"
            ],
            "Resource": [
                "arn:aws:s3:::*/*"
            ]
        },
        {
            "Sid": "ECRRepository",
            "Effect": "Allow",
            "Action": [
                "ecr:BatchCheckLayerAvailability",
                "ecr:BatchGetImage",
                "ecr:CompleteLayerUpload",
                "ecr:CreateRepository",
                "ecr:DeleteRepository",
                "ecr:DescribeImages",
                "ecr:DescribeRepositories",
                "ecr:GetDownloadUrlForLayer",
                "ecr:GetRepositoryPolicy",
                "ecr:InitiateLayerUpload",
                "ecr:ListImages",
                "ecr:PutImage",
                "ecr:SetRepositoryPolicy",
                "ecr:UploadLayerPart"
            ],
            "Resource": [
                "arn:aws:ecr:*:111122223333:repository/*"
            ]
        },
        {
            "Sid": "ECRAuthToken",
            "Effect": "Allow",
            "Action": [
                "ecr:GetAuthorizationToken"
            ],
            "Resource": [
                "*"
            ]
        },
        {
            "Sid": "Lambda",
            "Effect": "Allow",
            "Action": [
                "lambda:AddPermission",
                "lambda:CreateFunction",
                "lambda:DeleteFunction",
                "lambda:GetFunction",
                "lambda:GetFunctionConfiguration",
                "lambda:ListTags",
                "lambda:RemovePermission",
                "lambda:TagResource",
                "lambda:UntagResource",
                "lambda:UpdateFunctionCode",
                "lambda:UpdateFunctionConfiguration"
            ],
            "Resource": [
                "arn:aws:lambda:*:111122223333:function:*"
            ]
        },
        {
            "Sid": "IAM",
            "Effect": "Allow",
            "Action": [
                "iam:AttachRolePolicy",
                "iam:DeleteRole",
                "iam:DetachRolePolicy",
                "iam:GetRole",
                "iam:PassRole",
                "iam:TagRole"
            ],
            "Resource": [
                "arn:aws:iam::111122223333:role/*"
            ]
        },
        {
            "Sid": "APIGateway",
            "Effect": "Allow",
            "Action": [
                "apigateway:DELETE",
                "apigateway:GET",
                "apigateway:PATCH",
                "apigateway:POST",
                "apigateway:PUT"
            ],
            "Resource": [
                "arn:aws:apigateway:*::*"
            ]
        }
    ]
}
```

For more information about IAM policies, see Managing IAM policies in the *IAM User Guide*.

Important notes

This section contains important notes and known issues for AWS Serverless Application Model.

Installing AWS SAM CLI on 32-bit Windows

Support for AWS SAM CLI on 32-bit Windows will soon be deprecated. If you operate on a 32-bit system, we recommend that you upgrade to a 64-bit system and follow the instructions found in Installing the AWS SAM CLI on Windows (p. 10).

If you cannot upgrade to a 64-bit system, you can use the Legacy Docker Toolbox with AWS SAM CLI on a 32-bit system. However, this will cause you to encounter certain limitations with the AWS SAM CLI. For example, you cannot run 64-bit Docker containers on a 32-bit system. So, if your Lambda function depends on a 64-bit natively compiled container, you will not be able to test it locally on a 32-bit system.

To install AWS SAM CLI on a 32-bit system, execute the following command:

```
pip install aws-sam-cli
```

> **Important**
> Although the `pip install aws-sam-cli` command also works on 64-bit Windows, we recommend that you use the 64-bit MSI to install AWS SAM CLI on 64-bit systems.

Document history for AWS SAM

The following table describes the important changes in each release of the *AWS Serverless Application Model Developer Guide*. For notifications about updates to this documentation, you can subscribe to an RSS feed.

- **Latest documentation update:** October 1, 2021

update-history-change	update-history-description	update-history-date
Support for Lambda instruction set architectures (p. 334)	Use the AWS SAM CLI to build Lambda functions and Lambda layers for `x86_64` or `arm64` instruction set architectures. For more information, see the Architectures property of the `AWS::Serverless::Function` resource type and the CompatibleArchitectures property of the `AWS::Serverless::LayerVersion` resource type.	October 1, 2021
Generating example pipeline configurations (p. 334)	Use the AWS SAM CLI to generate example pipelines for multiple CI/CD systems, using the new `sam pipeline bootstrap` and `sam pipeline init` commands. For more information, see Generating example CI/CD pipelines.	July 21, 2021
AWS SAM CLI AWS CDK integration (preview, phase 2) (p. 334)	With phase 2 of the public preview release, you can now use the AWS SAM CLI to package and deploy AWS CDK applications. You can also download a sample AWS CDK application directly using the AWS SAM CLI. For more information, see AWS Cloud Development Kit (CDK) (Preview).	July 13, 2021
Support for RabbitMQ as an event source for functions (p. 334)	Added support for RabbitMQ as an event source for serverless functions. For more information, see the `SourceAccessConfigurations` property of the `MQ` event source of the `AWS::Serverless::Function` resource type.	July 7, 2021

Deploying serverless applications using Amazon ECR build container images (p. 334)	Use Amazon ECR build container images to deploy serverless applications with common CI/CD systems such as AWS CodePipeline, Jenkins, GitLab CI/CD, and GitHub Actions. For more information, see Deploying serverless applications.	June 24, 2021
Debugging AWS SAM applications with AWS Toolkits (p. 334)	AWS Toolkits now supports step-through debugging with more combinations of integrated development environments (IDEs) and runtimes. For more information, see Using AWS Toolkits.	May 20, 2021
AWS SAM CLI AWS CDK integration (preview) (p. 334)	You can now use the AWS SAM CLI to locally test and build AWS CDK applications. This is a public preview release. For more information, see AWS Cloud Development Kit (CDK) (Preview).	April 29, 2021
Default container image repository changed to Amazon ECR Public (p. 334)	The default container image repository changed from DockerHub to Amazon ECR Public. For more information, see Image repositories.	April 6, 2021
Nightly AWS SAM CLI builds (p. 334)	You can now install a pre-release version of the AWS SAM CLI, which is built nightly. For more information, see the **Nightly build** section of the OS subtopic of your choice under Installing the AWS SAM CLI.	March 25, 2021
Build container environment variables support (p. 334)	You can now pass environment variables to build containers. For more information, see the `--container-env-var` and `--container-env-var-file` options in `sam build`.	March 4, 2021
New Linux installation process (p. 334)	You can now install the AWS SAM CLI using a native Linux installer. For more information, see Installing the AWS SAM CLI on Linux.	February 10, 2021

Support for dead-letter queues for EventBridge (p. 334)	Added support for dead-letter queues for EventBridge and `Schedule` event sources for serverless functions and state machines. For more information, see the `DeadLetterConfig` property of the `EventBridgeRule` and `Schedule` event sources, for both the `AWS::Serverless::Function` and `AWS::Serverless::StateMachine` resource types.	January 29, 2021
Support for custom checkpoints (p. 334)	Added support for custom checkpoints for DynamoDB and Kinesis event sources for serverless functions. For more information, see the `FunctionResponseTypes` property of the `Kinesis` and `DynamoDB` data types of the `AWS::Serverless::Function` resource type.	January 29, 2021
Support for tumbling windows (p. 334)	Added support for tumbling windows for DynamoDB and Kinesis event sources for serverless functions. For more information, see the `TumblingWindowInSeconds` property of the `Kinesis` and `DynamoDB` data types of the `AWS::Serverless::Function` resource type.	December 17, 2020
Support for warm containers (p. 334)	Added support for warm containers when testing locally using the AWS SAM CLI commands `sam local start-api` and `sam local start-lambda`. For more information, see the `--warm-containers` option for those commands.	December 16, 2020
Support for Lambda container images (p. 334)	Added support for Lambda container images. For more information, see Building applications.	December 1, 2020
Support for code signing (p. 334)	Added support for code signing and trusted deployments of serverless application code. For more information, see Configuring code signing for AWS SAM applications.	November 23, 2020

Support for parallel and cached builds (p. 334)	Improved performance of serverless application builds by adding two options to the `sam build` command: `--parallel`, which builds functions and layers in parallel rather than sequentially, and `--cached`, which uses build artifacts from previous builds when no changes have been made that requires a rebuild.	November 10, 2020
Support for Amazon MQ, and mutual TLS authentication (p. 334)	Added support for Amazon MQ as an event source for serverless functions. For more information, see the `EventSource` and `MQ` data types of the `AWS::Serverless::Function` resource type. Also added support for mutual Transport Layer Security (TLS) authentication for API Gateway APIs and HTTP APIs. For more information, see the `DomainConfiguration` data type of the `AWS::Serverless::Api` resource type, or the `HttpApiDomainConfiguration` data type of the `AWS::Serverless::HttpApi` resource type.	November 5, 2020
Support for Lambda authorizers for HTTP APIs (p. 334)	Added support for Lambda authorizers for the `AWS::Serverless::HttpApi` resource type. For more information, see Lambda authorizer example (`AWS::Serverless::HttpApi`).	October 27, 2020
Support for multiple configuration files and environments (p. 334)	Added support for multiple configuration files and environments to store default parameter values for AWS SAM CLI commands. For more information, see AWS SAM CLI configuration file.	September 24, 2020

Support for X-Ray with Step Functions, and references when controlling access to APIs (p. 334)	Added support for X-Ray as an event source for serverless state machines. For more information, see the `Tracing` property of the `AWS::Serverless::StateMachine` resource type. Also added support for references when controlling access to APIs. For more information, see the `ResourcePolicyStatement` data type.	September 17, 2020
Support for Amazon MSK (p. 334)	Added support for Amazon MSK as an event source for serverless functions. This allows records in an Amazon MSK topic to trigger your Lambda function. For more information, see the `EventSource` and `MSK` data types of the `AWS::Serverless::Function` resource type.	August 13, 2020
Support for Amazon EFS (p. 334)	Added support for mounting Amazon EFS file systems to local directories. This allows your Lambda function code to access and modify shared resources. For more information, see the `FileSystemConfigs` property of the `AWS::Serverless::Function` resource type.	June 16, 2020
Orchestrating serverless applications (p. 334)	Added support for orchestrating applications by creating Step Functions state machines using AWS SAM. For more information, see Orchestrating AWS resources with AWS Step Functions and the `AWS::Serverless::StateMachine` resource type.	May 27, 2020
Building custom runtimes (p. 334)	Added the ability to build custom runtimes. For more information, see Building custom runtimes.	May 21, 2020
Building layers (p. 334)	Added the ability to build individual `LayerVersion` resources. For more information, see Building layers.	May 19, 2020

Generated AWS CloudFormation resources (p. 334)	Provided details about the AWS CloudFormation resources that AWS SAM generates and how to reference them. For more information, see Generated AWS CloudFormation resources.	April 8, 2020
Setting up AWS credentials (p. 334)	Added instructions for setting up AWS credentials in case you haven't already set them to use with other AWS tools, such as one of the AWS SDKs or the AWS CLI. For more information, see Setting up AWS credentials.	January 17, 2020
AWS SAM specification and AWS SAM CLI updates (p. 334)	Migrated the AWS SAM specification from GitHub. For more information, see AWS SAM specification. Also updated the deployment workflow with changes to the `sam deploy` command.	November 25, 2019
New options for controlling access to API Gateway APIs and policy template updates (p. 334)	Added new options for controlling access to API Gateway APIs: IAM permissions, API keys, and resource policies. For more information, see Controlling access to API Gateway APIs. Also updated two policy templates: RekognitionFacesPolicy and ElasticsearchHttpPostPolicy. For more information, see AWS SAM policy templates.	August 29, 2019
Getting started updates (p. 334)	Updated the getting started chapter with improved installation instructions for the AWS SAM CLI and the Hello World tutorial. For more information, see Getting started with AWS SAM.	July 25, 2019
Controlling access to API Gateway APIs (p. 334)	Added support for controlling access to API Gateway APIs. For more information, see Controlling access to API Gateway APIs.	March 21, 2019

Added `sam publish` to the AWS SAM CLI (p. 334)	The new `sam publish` command in the AWS SAM CLI simplifies the process for publishing serverless applications in the AWS Serverless Application Repository. For more information, see Publishing serverless applications using the AWS SAM CLI.	December 21, 2018
Nested applications and layers support (p. 334)	Added support for nested applications and layers. For more information, see Using nested applications and Working with layers.	November 29, 2018
Added `sam build` to the AWS SAM CLI (p. 334)	The new `sam build` command in the AWS SAM CLI simplifies the process for compiling serverless applications with dependencies so that you can locally test and deploy these applications. For more information, see Building applications.	November 19, 2018
Added new installation options for the AWS SAM CLI (p. 334)	Added Linuxbrew (Linux), MSI (Windows), and Homebrew (macOS) installation options for the AWS SAM CLI. For more information, see Installing the AWS SAM CLI.	November 7, 2018
New guide (p. 334)	This is the first release of the *AWS Serverless Application Model Developer Guide*.	October 17, 2018