Developer Guide

AWS Serverless Application Model

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AWS Serverless Application Model: Developer Guide

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

AWS Serverless Application Model (AWS SAM) is an open-source framework for building serverless applications using infrastructure as code (IaC). With AWS SAM's shorthand syntax, developers declare CloudFormation resources and specialized serverless resources that are transformed to infrastructure during deployment. When working with AWS SAM, you will interact with:

1. AWS SAM CLI - A command-line tool that helps you develop, locally test, and deploy your serverless applications.
2. AWS SAM Template - An extension of CloudFormation that provides simplified syntax for defining serverless resources.

When you use the **sam init** command, it creates a project directory, which we will refer to as the AWS SAM project, that typically includes your AWS SAM template, application code, and other configuration files.

When to use AWS SAM

AWS SAM is an ideal IaC solution for scenarios where you want simplified serverless development with the full power of CloudFormation. For example, you can use SAM for:

- **Serverless applications:** You can use SAM to quickly define AWS Lambda functions, Lambda durable functions, Amazon API Gateway APIs, Amazon DynamoDB tables, and other serverless resources with minimal code.
- **CloudFormation enhancement:** You can combine SAM with existing CloudFormation templates to add serverless components to traditional infrastructure. SAM resources work alongside standard CloudFormation resources in the same template.
- **Local development and testing:** You can use the SAM CLI to test Lambda functions locally, simulate API Gateway endpoints, and debug serverless applications on your development machine before deploying to AWS.
- **CI/CD for serverless:** You can build deployment pipelines using SAM templates that automatically generate the CloudFormation infrastructure needed for staging and production environments.

- **Migration from console-created resources:** You can convert Lambda functions and API Gateway resources created in the AWS Management Console into infrastructure as code using SAM templates.

Comparing AWS SAM with other IaC tools

- Use SAM instead of CloudFormation to simplify serverless resource definitions while maintaining template compatibility.
- Use SAM instead of AWS CDK if you prefer a declarative approach to describing your infrastructure rather than a programmatic one.
- Combine SAM with AWS CDK by using SAM CLI's local testing features to enhance your CDK applications.

Key features

AWS SAM offers a variety of benefits that improve the developer experience by allowing you to:

Define your application infrastructure code quickly, using less code

Author AWS SAM templates to define your serverless application infrastructure code. Deploy your templates directly to CloudFormation to provision your resources.

Manage your serverless applications through their entire development lifecycle

Use the AWS SAM CLI to manage your serverless application through the authoring, building, deploying, testing, and monitoring phases of your development lifecycle. For more information, see AWS SAM CLI.

Quickly provision permissions between resources with AWS SAM connectors

Use AWS SAM connectors in your AWS SAM templates to define permissions between your AWS resources. AWS SAM transforms your code into the IAM permissions required to facilitate your intent. For more information, see Managing resource permissions with AWS SAM connectors.

Continuously sync local changes to the cloud as you develop

Use the AWS SAM CLI **sam sync** command to automatically sync local changes to the cloud, speeding up your development and cloud testing workflows. For more information, see Introduction to using sam sync to sync to AWS Cloud.

Manage your Terraform serverless applications

Use the AWS SAM CLI to perform local debugging and testing of your Lambda functions and layers. For more information, see AWS SAM CLI Terraform support.

Related information

- For information on how AWS SAM works, see How AWS SAM works.
- To start using AWS SAM, see Getting started with AWS SAM.
- For an overview on how you can use AWS SAM to create a serverless application, see How to use AWS SAM.

How AWS SAM works

When working with AWS SAM to create your serverless application, you will interact with the following components:

1. **AWS SAM template** – An important file that defines your AWS resources. This template includes the **AWS SAM template specification** – the open-source framework that comes with a simplified short-hand syntax you use to define the functions, events, APIs, configurations, and permissions of your serverless application. This file is located in the AWS SAM project, which is the application folder that gets created when you run the **sam init** command.
2. **AWS SAM CLI** – A command line tool that you can use with your AWS SAM project and supported third-party integrations to build and run your serverless applications. The AWS SAM CLI is the tool you use to run commands on your AWS SAM project and eventually turn it into your serverless application.

To express resources, event source mappings, and other properties that define your serverless application, you define resources and develop your application in the AWS SAM template and other files in your AWS SAM project. You use the AWS SAM CLI to run commands on your AWS SAM project, which is how you initialize, build, test, and deploy your serverless application.

> **New to serverless?**
>
> We recommend you review Serverless concepts for AWS Serverless Application Model.

What is the AWS SAM template specification?

The AWS SAM template specification is an open-source framework that you can use to define and manage your serverless application infrastructure code. The AWS SAM template specification is:

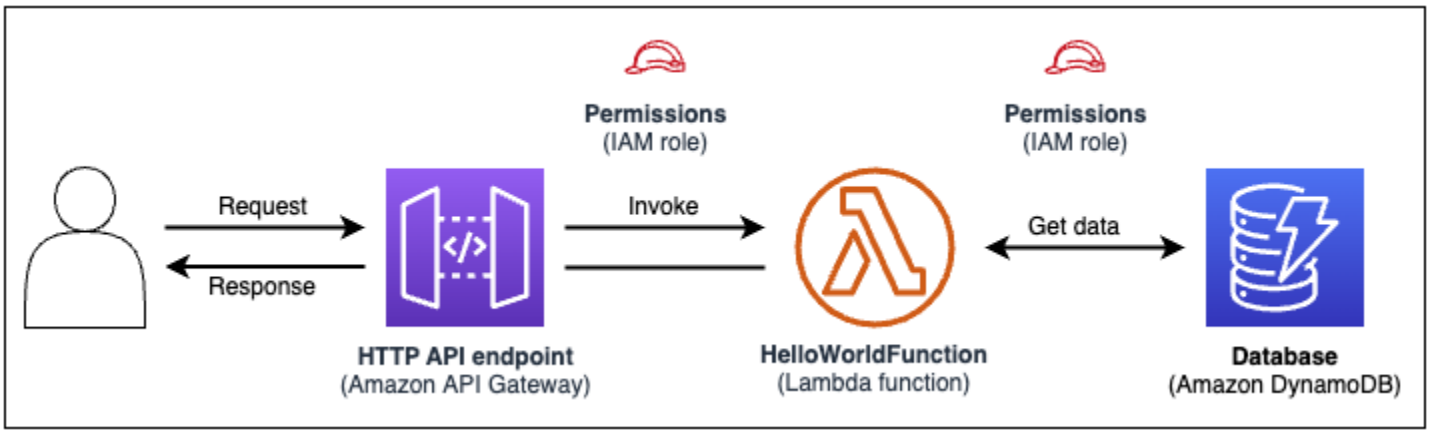
- **Built on AWS CloudFormation** – You use the CloudFormation syntax directly in your AWS SAM template, taking advantage of its extensive support of resource and property configurations. If you are already familiar with CloudFormation, you don't have to learn a new service to manage your application infrastructure code.
- **An extension of CloudFormation** – AWS SAM offers its own unique syntax that focuses specifically on speeding up serverless development. You can use both the CloudFormation and AWS SAM syntax within the same template.
- **An abstract, short-hand syntax** – Using the AWS SAM syntax, you can define your infrastructure quickly, in fewer lines of code, and with a lower chance of errors. Its syntax is especially curated to abstract away the complexity in defining your serverless application infrastructure.
- **Transformational** – AWS SAM does the complex work of transforming your template into the code necessary to provision your infrastructure through CloudFormation.

What is the AWS SAM project and AWS SAM template?

The AWS SAM project includes the AWS SAM template which contains the AWS SAM template specification. This specification is the open-source framework that you use to define your serverless application infrastructure on AWS, with some additional components that make them easier to work with. In this sense, AWS SAM templates are an extension of CloudFormation templates.

Here’s an example of a basic serverless application. This application processes requests to get all items from a database through an HTTP request. It consists of the following parts:

1. A function that contains the logic to process the request.
2. An HTTP API to serve as communication between the client (requestor) and the application.
3. A database to store items.
4. Permissions for the application to run securely.



This application's infrastructure code can be defined in the following AWS SAM template:

```
AWSTemplateFormatVersion: 2010-09-09
Transform: AWS::Serverless-2016-10-31
Resources:
  getAllItemsFunction:
    Type: AWS::Serverless::Function
    Properties:
      Handler: src/get-all-items.getAllItemsHandler
      Runtime: nodejs20.x
      Events:
        Api:
          Type: HttpApi
          Properties:
            Path: /
            Method: GET
    Connectors:
      MyConn:
        Properties:
          Destination:
            Id: SampleTable
          Permissions:
            - Read
  SampleTable:
    Type: AWS::Serverless::SimpleTable
```

In 23 lines of code, the following infrastructure is defined:

- A function using the AWS Lambda service.
- An HTTP API using the Amazon API Gateway service.

- A database using the Amazon DynamoDB service.
- The AWS Identity and Access Management (IAM) permissions necessary for these services to interact with one another.

To provision this infrastructure, the template is deployed to CloudFormation. During deployment, AWS SAM transforms the 23 lines of code into the CloudFormation syntax required to generate these resources in AWS. The transformed CloudFormation template contains over 200 lines of code!

Transformed CloudFormation template

```
{
  "AWSTemplateFormatVersion": "2010-09-09",
  "Resources": {
    "getAllItemsFunction": {
      "Type": "AWS::Lambda::Function",
      "Metadata": {
        "SamResourceId": "getAllItemsFunction"
      },
      "Properties": {
        "Code": {
          "S3Bucket": "amzn-s3-demo-source-bucket-1a4x26zbcdkqr",
          "S3Key": "what-is-app/a6f856abf1b2c4f7488c09b367540b5b"
        },
        "Handler": "src/get-all-items.getAllItemsHandler",
        "Role": {
          "Fn::GetAtt": [
            "getAllItemsFunctionRole",
            "Arn"
          ]
        },
        "Runtime": "nodejs12.x",
        "Tags": [
          {
            "Key": "lambda:createdBy",
            "Value": "SAM"
          }
        ]
      }
    },
    "getAllItemsFunctionRole": {
      "Type": "AWS::IAM::Role",
```

```
      "Properties": {
        "AssumeRolePolicyDocument": {
          "Version": "2012-10-17",
          "Statement": [
            {
              "Action": [
                "sts:AssumeRole"
              ],
              "Effect": "Allow",
              "Principal": {
                "Service": [
                  "lambda.amazonaws.com"
                ]
              }
            }
          ]
        },
        "ManagedPolicyArns": [
          "arn:aws:iam::aws:policy/service-role/AWSLambdaBasicExecutionRole"
        ],
        "Tags": [
          {
            "Key": "lambda:createdBy",
            "Value": "SAM"
          }
        ]
      }
    },
    "getAllItemsFunctionApiPermission": {
      "Type": "AWS::Lambda::Permission",
      "Properties": {
        "Action": "lambda:InvokeFunction",
        "FunctionName": {
          "Ref": "getAllItemsFunction"
        },
        "Principal": "apigateway.amazonaws.com",
        "SourceArn": {
          "Fn::Sub": [
            "arn:${AWS::Partition}:execute-api:${AWS::Region}:${AWS::AccountId}:
${__ApiId__}/${__Stage__}/GET/",
            {
              "__ApiId__": {
                "Ref": "ServerlessHttpApi"
              },
```

```
              "__Stage__": "*"
            }
          ]
        }
      }
    },
    "ServerlessHttpApi": {
      "Type": "AWS::ApiGatewayV2::Api",
      "Properties": {
        "Body": {
          "info": {
            "version": "1.0",
            "title": {
              "Ref": "AWS::StackName"
            }
          },
          "paths": {
            "/": {
              "get": {
                "x-amazon-apigateway-integration": {
                  "httpMethod": "POST",
                  "type": "aws_proxy",
                  "uri": {
                    "Fn::Sub": "arn:${AWS::Partition}:apigateway:
${AWS::Region}:lambda:path/2015-03-31/functions/${getAllItemsFunction.Arn}/invocations"
                  },
                  "payloadFormatVersion": "2.0"
                },
                "responses": {}
              }
            }
          },
          "openapi": "3.0.1",
          "tags": [
            {
              "name": "httpapi:createdBy",
              "x-amazon-apigateway-tag-value": "SAM"
            }
          ]
        }
      }
    },
    "ServerlessHttpApiApiGatewayDefaultStage": {
      "Type": "AWS::ApiGatewayV2::Stage",
```

```
      "Properties": {
        "ApiId": {
          "Ref": "ServerlessHttpApi"
        },
        "StageName": "$default",
        "Tags": {
          "httpapi:createdBy": "SAM"
        },
        "AutoDeploy": true
      }
    },
    "SampleTable": {
      "Type": "AWS::DynamoDB::Table",
      "Metadata": {
        "SamResourceId": "SampleTable"
      },
      "Properties": {
        "AttributeDefinitions": [
          {
            "AttributeName": "id",
            "AttributeType": "S"
          }
        ],
        "KeySchema": [
          {
            "AttributeName": "id",
            "KeyType": "HASH"
          }
        ],
        "BillingMode": "PAY_PER_REQUEST"
      }
    },
    "getAllItemsFunctionMyConnPolicy": {
      "Type": "AWS::IAM::ManagedPolicy",
      "Metadata": {
        "aws:sam:connectors": {
          "getAllItemsFunctionMyConn": {
            "Source": {
              "Type": "AWS::Serverless::Function"
            },
            "Destination": {
              "Type": "AWS::Serverless::SimpleTable"
            }
          }
```

```
        }
      },
      "Properties": {
        "PolicyDocument": {
          "Version": "2012-10-17",
          "Statement": [
            {
              "Effect": "Allow",
              "Action": [
                "dynamodb:GetItem",
                "dynamodb:Query",
                "dynamodb:Scan",
                "dynamodb:BatchGetItem",
                "dynamodb:ConditionCheckItem",
                "dynamodb:PartiQLSelect"
              ],
              "Resource": [
                {
                  "Fn::GetAtt": [
                    "SampleTable",
                    "Arn"
                  ]
                },
                {
                  "Fn::Sub": [
                    "${DestinationArn}/index/*",
                    {
                      "DestinationArn": {
                        "Fn::GetAtt": [
                          "SampleTable",
                          "Arn"
                        ]
                      }
                    }
                  ]
                }
              ]
            }
          ]
        },
        "Roles": [
          {
            "Ref": "getAllItemsFunctionRole"
          }
```

```
          ]
        }
      }
    }
  }
```

By using AWS SAM, you define 23 lines of infrastructure code. AWS SAM transforms your code into the 200+ lines of CloudFormation code necessary to provision your application.

What is the AWS SAM CLI?

The AWS SAM CLI is a command line tool that you can use with AWS SAM templates and supported third-party integrations to build and run your serverless applications. Use the AWS SAM CLI to:

- Quickly initialize a new application project.
- Build your application for deployment.
- Perform local debugging and testing.
- Deploy your application.
- Configure CI/CD deployment pipelines.
- Monitor and troubleshoot your application in the cloud.
- Sync local changes to the cloud as you develop.
- And more!

The AWS SAM CLI is best utilized when used with AWS SAM and CloudFormation templates. It also works with third-party products such as Terraform.

Initialize a new project

Select from starter templates or choose a custom template location to begin a new project.

Here, we use the **sam init** command to initialize a new application project. We select the **Hello World Example** project to start with. The AWS SAM CLI downloads a starter template and creates our project folder directory structure.

```
→  what-is sam init

You can preselect a particular runtime or package type when using the `sam init` experience.
Call `sam init --help` to learn more.

Which template source would you like to use?
        1 - AWS Quick Start Templates
        2 - Custom Template Location
Choice: 1

Choose an AWS Quick Start application template
        1 - Hello World Example
        2 - Multi-step workflow
        3 - Serverless API
        4 - Scheduled task
        5 - Standalone function
        6 - Data processing
        7 - Infrastructure event management
        8 - Serverless Connector Hello World Example
        9 - Multi-step workflow with Connectors
        10 - Lambda EFS example
        11 - Machine Learning
Template: 1

Use the most popular runtime and package type? (Python and zip) [y/N]:
```

For more details, see Create your application in AWS SAM.

Build your application for deployment

Package your function dependencies and organize your project code and folder structure to prepare for deployment.

Here, we use the **sam build** command to prepare our application for deployment. The AWS SAM CLI creates a `.aws-sam`directory and organizes our application dependencies and files there for deployment.

```
➜  sam-app sam build
Building codeuri: /Users/evzz/Demo/what-is/sam-app/hello_world runtime: python3.9 metadata: {} archit
ecture: x86_64 functions: HelloWorldFunction
Running PythonPipBuilder:ResolveDependencies
Running PythonPipBuilder:CopySource

Build Succeeded

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

Commands you can use next
=========================
[*] Validate SAM template: sam validate
[*] Invoke Function: sam local invoke
[*] Test Function in the Cloud: sam sync --stack-name {{stack-name}} --watch
[*] Deploy: sam deploy --guided
➜  sam-app cd .aws-sam
➜  .aws-sam ls
build      build.toml
➜  .aws-sam
```

For more details, see Build your application.

Perform local debugging and testing

On your local machine, simulate events, test APIs, invoke functions, and more to debug and test your application.

Here, we use the **sam local invoke** command to invoke our `HelloWorldFunction` locally. To accomplish this, the AWS SAM CLI creates a local container, builds our function, invokes it, and outputs the results. You can use an application like Docker to run containers on your machine.

```
➜  sam-app sam local invoke HelloWorldFunction
Invoking app.lambda_handler (python3.9)
Local image was not found.
Removing rapid images for repo public.ecr.aws/sam/emulation-python3.9
Building image.....................................................................................
.....................................................................................................
.............................................................
Using local image: public.ecr.aws/lambda/python:3.9-rapid-x86_64.

Mounting /Users/evzz/Demo/what-is/sam-app/.aws-sam/build/HelloWorldFunction as /var/task:ro,delegated
 inside runtime container
START RequestId: 6f8347ce-6b04-4246-a0de-6dc37f0eef51 Version: $LATEST
END RequestId: 6f8347ce-6b04-4246-a0de-6dc37f0eef51
REPORT RequestId: 6f8347ce-6b04-4246-a0de-6dc37f0eef51  Init Duration: 1.23 ms  Duration: 639.26 ms B
illed Duration: 640 ms  Memory Size: 128 MB     Max Memory Used: 128 MB
{"statusCode": 200, "body": "{\"message\": \"hello world\"}"}
```

For more details, see Test your application and Debug your application.

Deploy your application

Configure your application's deployment settings and deploy to the AWS Cloud to provision your resources.

Here, we use the **sam deploy --guided** command to deploy our application through an interactive flow. The AWS SAM CLI guides us through configuring our application's deployment settings, transforms our template into CloudFormation, and deploys to CloudFormation to create our resources.

```
➜  sam-app sam deploy --guided

Configuring SAM deploy
======================

        Looking for config file [samconfig.toml] :  Not found

        Setting default arguments for 'sam deploy'
        =========================================
        Stack Name [sam-app]:
        AWS Region [us-west-2]:
        #Shows you resources changes to be deployed and require a 'Y' to initiate deploy
        Confirm changes before deploy [y/N]:
        #SAM needs permission to be able to create roles to connect to the resources in your template
        Allow SAM CLI IAM role creation [Y/n]:
        #Preserves the state of previously provisioned resources when an operation fails
        Disable rollback [y/N]:
        HelloWorldFunction may not have authorization defined, Is this okay? [y/N]: y
        Save arguments to configuration file [Y/n]:
        SAM configuration file [samconfig.toml]:
        SAM configuration environment [default]:

        Looking for resources needed for deployment:
         Managed S3 bucket: aws-sam-cli-managed-default-samclisourcebucket-1a4x26zbcdkqr
         A different default S3 bucket can be set in samconfig.toml
```

For more details, see Deploy your application and resources.

Configure CI/CD deployment pipelines

Create secure *continuous integration and delivery (CI/CD)* pipelines, using a supported CI/CD system.

Here, we use the **sam pipeline init --bootstrap** command to configure a CI/CD deployment pipeline for our application. The AWS SAM CLI guides us through our options and generates the AWS resources and configuration file to use with our CI/CD system.

```
[3] Reference application build resources
Enter the pipeline execution role ARN if you have previously created one, or we will create one for y
ou []:
Enter the CloudFormation execution role ARN if you have previously created one, or we will create one
 for you []:
Please enter the artifact bucket ARN for your Lambda function. If you do not have a bucket, we will c
reate one for you []:
Does your application contain any IMAGE type Lambda functions? [y/N]: n

[4] Summary
Below is the summary of the answers:
        1 - Account: 513423067560
        2 - Stage configuration name: dev
        3 - Region: us-west-2
        4 - Pipeline user: [to be created]
        5 - Pipeline execution role: [to be created]
        6 - CloudFormation execution role: [to be created]
        7 - Artifacts bucket: [to be created]
        8 - ECR image repository: [skipped]
Press enter to confirm the values above, or select an item to edit the value:

This will create the following required resources for the 'dev' configuration:
        - Pipeline IAM user
        - Pipeline execution role
        - CloudFormation execution role
        - Artifact bucket
Should we proceed with the creation? [y/N]:
```

For more details, see Deploy with CI/CD systems and pipelines.

Monitor and troubleshoot your application in the cloud

View important information about your deployed resources, gather logs, and utilize built-in monitoring tools such as AWS X-Ray.

Here, we use the **sam list** command to view our deployed resources. We get our API endpoint and invoke it, which triggers our function. Then, we use **sam logs** to view our function's logs.

```
➜  sam-app sam logs --stack-name sam-app
2023/03/13/[$LATEST]0a433e844dd445bd82d0d78cd55e0cdc 2023-03-13T21:06:42.075000 INIT_START Runtime Ve
rsion: python:3.9.v16   Runtime Version ARN: arn:aws:lambda:us-west-2::runtime:07a48df201798d627f2b95
0f03bb227aab4a655a1d019c3296406f95937e2525
2023/03/13/[$LATEST]0a433e844dd445bd82d0d78cd55e0cdc 2023-03-13T21:06:42.180000 START RequestId: 778e
4226-0a80-435f-929b-5b19292ed9a7 Version: $LATEST
2023/03/13/[$LATEST]0a433e844dd445bd82d0d78cd55e0cdc 2023-03-13T21:06:42.181000 END RequestId: 778e42
26-0a80-435f-929b-5b19292ed9a7
2023/03/13/[$LATEST]0a433e844dd445bd82d0d78cd55e0cdc 2023-03-13T21:06:42.182000 REPORT RequestId: 778
e4226-0a80-435f-929b-5b19292ed9a7       Duration: 1.69 ms       Billed Duration: 2 ms   Memory Size:
128 MB  Max Memory Used: 36 MB  Init Duration: 104.13 ms
```

For more details, see Monitor your application.

Sync local changes to the cloud as you develop

As you develop on your local machine, automatically sync changes to the cloud. Quickly see your changes and perform testing and validation in the cloud.

Here, we use the **sam sync --watch** command to have the AWS SAM CLI watch for local changes. We modify our `HelloWorldFunction` code and the AWS SAM CLI automatically detects the change and deploys our updates to the cloud.

```
-----------------------------------------------------------------------------------------------
Key                 HelloWorldFunctionIamRole
Description         Implicit IAM Role created for Hello World function
Value               arn:aws:iam::513423067560:role/sam-app-HelloWorldFunctionRole-15GLOUR9LMT1W

Key                 HelloWorldApi
Description         API Gateway endpoint URL for Prod stage for Hello World function
Value               https://ets1gv8lxi.execute-api.us-west-2.amazonaws.com/Prod/hello/

Key                 HelloWorldFunction
Description         Hello World Lambda Function ARN
Value               arn:aws:lambda:us-west-2:513423067560:function:sam-app-HelloWorldFunction-
yQDNe17r9maD
-----------------------------------------------------------------------------------------------

Stack update succeeded. Sync infra completed.

Infra sync completed.
CodeTrigger not created as CodeUri or DefinitionUri is missing for ServerlessRestApi.
Syncing Lambda Function HelloWorldFunction...
Manifest is not changed for (HelloWorldFunction), running incremental build
Building codeuri: /Users/evzz/Demo/what-is/sam-app/hello_world runtime: python3.9 metadata: {} archit
ecture: x86_64 functions: HelloWorldFunction
Running PythonPipBuilder:CopySource
Finished syncing Lambda Function HelloWorldFunction.
```

Test supported resources in the cloud

Invoke and pass events to supported resources in the cloud.

Here, we use the **sam remote invoke** command to test a deployed Lambda function in the cloud. We invoke our Lambda function and receive its logs and response. With our Lambda function configured to stream responses, the AWS SAM CLI streams its response back in real time.

```
→ lambda-streaming-app sam remote invoke StreamingFunction --stack-name lambda-streaming-app
```

Learn more

To continue learning about AWS SAM, see the following resources:

- **The Complete AWS SAM Workshop** – A workshop designed to teach you many of the major features that AWS SAM provides.
- **Sessions with SAM** – Video series created by our AWS Serverless Developer Advocate team on using AWS SAM.
- **Serverless Land** – Site that brings together the latest information, blogs, videos, code, and learning resources for AWS serverless.

Next steps

If this is your first time using AWS SAM, see Getting started with AWS SAM.

Serverless concepts for AWS Serverless Application Model

Learn about basic serverless concepts before using the AWS Serverless Application Model (AWS SAM).

Serverless concepts

Event-driven architecture

A serverless application consists of individual AWS services, such as AWS Lambda for compute and Amazon DynamoDB for database management, that each perform a specialized role. These services are then loosely integrated with each other through an event-driven architecture. To learn more about event-driven architecture, see What is an Event-Driven Architecture?.

Infrastructure as Code (IaC)

Infrastructure as Code (IaC) is a way of treating infrastructure in the same way that developers treat code, applying the same rigor of application code development to infrastructure provisioning. You define your infrastructure in a template file, deploy it to AWS, and AWS creates the resources for you. With IaC, you define in code what you want AWS to provision. For a comparison of IaC tools available for AWS, see Infrastructure as Code (IaC).

Serverless technologies

With AWS serverless technologies, you can build and run applications without having to manage your own servers. All server management is done by AWS, providing many benefits such as automatic scaling and built-in high availability, letting you take your idea to production quickly. Using serverless technologies, you can focus on the core of your product without having to worry about managing and operating servers. To learn more about serverless, see the following:

- Serverless on AWS
- Serverless Developer Guide – Provides a conceptual overview of serverless development in the AWS Cloud.

For a basic introduction to the core AWS serverless services, see Serverless 101: Understanding the serverless services at *Serverless Land*.

Serverless Application

When you use AWS SAM, you manage related resources in an application, which consists of your AWS SAM project and template. All the resources in your application are defined or referred to in your AWS SAM template. When AWS SAM processes your template, it creates CloudFormation resources. In CloudFormation, resources are managed in a single unit called a stack, and all the resources in a stack are defined by the stack's CloudFormation template.

Infrastructure as Code (IaC)

With Infrastructure as Code (IaC), you can automate the deployment and management of your AWS resources, including serverless applications. IaC allows you to define your infrastructure using code, making it easier to version, share, and replicate your deployments. This approach helps you:

- Speed up your development cycle
- Simplify configuration management
- Improve reliability and consistency of your deployments

IaC tools for AWS serverless applications

AWS offers several IaC tools to help you build, deploy, and manage your cloud resources. This section explains how AWS SAM fits within this ecosystem and works with other AWS IaC tools.

AWS CloudFormation

Using CloudFormation, you can model and provision your entire AWS infrastructure with YAML or JSON templates. CloudFormation handles resource creation, updates, and deletion automatically. When you deploy AWS SAM applications, CloudFormation processes the transformed templates to create and manage your resources.

AWS Serverless Application Model (AWS SAM)

AWS SAM helps you build serverless applications with simplified syntax for defining serverless resources. You can use AWS SAM templates to provision Lambda functions, APIs, databases, and event sources using concise YAML syntax. AWS SAM transforms these templates into CloudFormation templates during deployment.

> **Note**
>
> While AWS SAM specializes in serverless applications, you can use any CloudFormation resource types in your AWS SAM templates. This gives you the flexibility to include non-serverless resources when needed.

AWS Cloud Development Kit (AWS CDK)

With AWS CDK, you can define your serverless infrastructure using familiar programming languages like TypeScript, Python, Java, C#/.Net, or Go. You can use programming constructs such as loops and conditions to define your infrastructure, and AWS CDK generates CloudFormation templates for deployment. You can use the AWS SAM CLI to locally test and debug applications created with AWS CDK. To learn more, see Testing CDK applications locally.

Comparing IaC tools for Serverless Applications

When choosing an IaC tool for your serverless applications, consider your team's preferences, project requirements, and existing workflows. The following table compares the key characteristics of AWS IaC tools for serverless development:

Tool	Primary use	Best for	Works with AWS SAM	When to choose
CloudFormation	Managing complex AWS infrastructure	Applications requiring detailed control of AWS resources	AWS SAM templates transform into CloudFormation templates during deployment	For fine-grained control over non-serverless resources
AWS SAM	Serverless application development	Teams building serverless applications using Lambda	Native functionality	When focusing primarily on serverless architectures with Lambda functions, API Gateway APIs, and other serverless resources
AWS CDK	Infrastructure definition using programming languages	Teams preferring typed languages and code-first approach	Generate AWS SAM templates and use AWS	When you need programmatic infrastructure definition or

Tool	Primary use	Best for	Works with AWS SAM	When to choose
			SAM CLI for testing	complex resource configuration logic

> **Note**
>
> While this guide focuses on AWS-native IaC tools, Terraform is another popular IaC solution that can be used to define serverless applications. The AWS SAM CLI supports local testing of Lambda functions defined in Terraform. For more information, see AWS SAM CLI Terraform support.

Learn more

- To learn more about DevOps practices on AWS, see Introduction to DevOps on AWS
- For information about using Lambda with different IaC tools, see Using Lambda with infrastructure as code (IaC)

Getting started with AWS SAM

Get started with AWS SAM by reviewing and completing the topics in this section. AWS SAM prerequisites provides detailed instructions on setting up an AWS account, creating IAM users, creating key access, and installing and configuring the AWS SAM CLI. After completing the prerequisites, you can choose your development approach:

- Install the AWS SAM CLI, which you can do on Linux, Windows, and macOS operating systems.
- Getting started with AWS SAM using VS Code Toolkit for a visual development experience with integrated debugging and testing capabilities.

After installation is complete, you can optionally walk through the AWS SAM Hello World tutorial. Following this tutorial will walk you through the process of creating a basic serverless application with AWS SAM. After completing the tutorial, you'll be ready to review the concepts detailed in How to use AWS Serverless Application Model (AWS SAM).

Topics

- AWS SAM prerequisites
- Install the AWS SAM CLI
- Tutorial: Deploy a Hello World application with AWS SAM
- Converting Lambda Functions to AWS SAM Applications

AWS SAM prerequisites

Complete the following prerequisites before installing and using the AWS Serverless Application Model Command Line Interface (AWS SAM CLI).

To use the AWS SAM CLI, you need the following:

- An AWS account, AWS Identity and Access Management (IAM) credentials, and an IAM access key pair.
- The AWS Command Line Interface (AWS CLI) to configure AWS credentials.

Topics

- Step 1: Sign up for an AWS account
- Step 2: Create an IAM user account
- Step 3: Create an access key ID and secret access key
- Step 4: Install the AWS CLI
- Step 5: Use the AWS CLI to configure AWS credentials
- Step 6: (Optional) Install AWS Toolkit for VS Code
- Next steps

Step 1: Sign up for an AWS account

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

To sign up for an AWS account

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

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

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

Step 2: Create an IAM user account

To create an administrator user, choose one of the following options.

Choose one way to manage your administrator	To	By	You can also
In IAM Identity Center (Recommended)	Use short-term credentials to access AWS. This aligns with the security best practices. For information about best practices, see Security best practices in IAM in the *IAM User Guide*.	Following the instructions in Getting started in the *AWS IAM Identity Center User Guide*.	Configure programmatic access by Configuring the AWS CLI to use AWS IAM Identity Center in the *AWS Command Line Interface User Guide*.
In IAM (Not recommended)	Use long-term credentials to access AWS.	Following the instructions in Create an IAM user for emergency access in the *IAM User Guide*.	Configure programmatic access by Manage access keys for IAM users in the *IAM User Guide*.

Step 3: Create an access key ID and secret access key

For CLI access, you need an access key ID and a secret access key. Use temporary credentials instead of long-term access keys when possible. Temporary credentials include an access key ID, a secret access key, and a security token that indicates when the credentials expire. For more information, see Using temporary credentials with AWS resources in the *IAM User Guide*.

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

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

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

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

Step 4: Install the AWS CLI

The AWS CLI is an open source tool that enables you to interact with AWS services using commands in your command-line shell. The AWS SAM CLI requires the AWS CLI for activities such as configuring credentials. To learn more about the AWS CLI, see What is the AWS Command Line Interface? in the *AWS Command Line Interface User Guide*.

To install the AWS CLI, see Installing or updating the latest version of the AWS CLI in the *AWS Command Line Interface User Guide*.

Step 5: Use the AWS CLI to configure AWS credentials

To configure credentials with IAM Identity Center

- To configure credentials with IAM Identity Center, see Configure your profile with the AWS configure sso wizard.

To configure credentials with the AWS CLI

1. Run the `aws configure` command from the command line.
2. Configure the following. Select each link to learn more:

   a. Access key ID

   b. Secret access key

   c. AWS Region

   d. Output format

   The following example shows sample values.

```
$ aws configure
AWS Access Key ID [None]: AKIAIOSFODNN7EXAMPLE
AWS Secret Access Key [None]: wJalrXUtnFEMI/K7MDENG/bPxRfiCYEXAMPLEKEY
Default region name [None]: us-west-2
Default output format [None]: json
```

The AWS CLI stores this information in a *profile* (a collection of settings) named `default` in the `credentials` and `config` files. These files are located in the `.aws` file in your home directory. By default, the information in this profile is used when you run an AWS CLI command that doesn't explicitly specify a profile to use. For more information on the `credentials` file, see Configuration and credential file settings in the *AWS Command Line Interface User Guide*.

For more information on configuring credentials, such as using an existing configuration and credentials file, see Quick setup in the *AWS Command Line Interface User Guide*.

Step 6: (Optional) Install AWS Toolkit for VS Code

For developers who prefer an integrated development environment, the AWS Toolkit for VS Code provides powerful features for serverless development including visual debugging, CodeLens integration, and streamlined deployment workflows.

Prerequisites for VS Code development

- Visual Studio Code (version 1.73.0 or a later version) installed on your system
- YAML language support extension for VS Code

To install the AWS Toolkit for VS Code

1. Open Visual Studio Code
2. Open the Extensions view (Ctrl+Shift+X or Cmd+Shift+X)
3. Search for "AWS Toolkit"
4. Install the "AWS Toolkit" extension by Amazon Web Services
5. Install the "YAML" extension by Red Hat (required for SAM template CodeLens features)

Benefits of using VS Code with AWS SAM

- Visual debugging: Set breakpoints and step through your Lambda functions locally
- CodeLens integration: Build, deploy, and invoke functions directly from your SAM template
- Integrated terminal: Access AWS SAM AWS CLI commands without leaving your editor
- Template validation: Real-time validation and IntelliSense for SAM templates

For information about configuring your AWS credentials in VS Code, see Setting up credentials in the AWS Toolkit for VS Code User Guide.

Next steps

- You are now ready to install the AWS SAM CLI and start using AWS SAM. To install the AWS SAM CLI, see Install the AWS SAM CLI.
- To set up Visual Studio Code for serverless development, see Setting up the AWS Toolkit for VS Code.

Install the AWS SAM CLI

Install the latest release of the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) on supported operating systems by following instructions in Step 4: Install the AWS CLI.

For information on managing a currently installed version of the AWS SAM CLI, including how to upgrade, uninstall, or manage nightly builds, see Managing AWS SAM CLI versions.

Is this your first time installing the AWS SAM CLI?

Complete all prerequisites in the previous section before moving forward. This includes:

1. Signing up for an AWS account.
2. Setting up secure access to AWS.
3. Creating an access key ID and secret access key.
4. Installing the AWS CLI.
5. Configuring AWS credentials.

Topics

- Installing the AWS SAM CLI
- Troubleshooting installation errors
- Next steps
- Optional: Verify the integrity of the AWS SAM CLI installer

Installing the AWS SAM CLI

Note

Starting September 2023, AWS will no longer maintain the AWS managed Homebrew installer for the AWS SAM CLI (`aws/tap/aws-sam-cli`). If you use Homebrew to install and manage the AWS SAM CLI, see the following options:

- To continue using Homebrew, you can use the community managed installer. For more information, see Managing the AWS SAM CLI with Homebrew.

- We recommend using one of the first party installation methods that are documented on this page. Before using one of these methods, see Switch from Homebrew.
- For additional details, refer to Release version: 1.121.0.

To install the AWS SAM CLI, follow the instructions for your operating system.

Linux

x86_64 - command line installer

1. Download the AWS SAM CLI .zip file to a directory of your choice.
2. **(Optional)** You can verify the integrity of the installer before installation. For instructions, see Optional: Verify the integrity of the AWS SAM CLI installer.
3. Unzip the installation files into a directory of your choice. The following is an example, using the `sam-installation` subdirectory.

   > **Note**
   >
   > If your operating system doesn't have the built-in **unzip** command, use an equivalent.

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

4. Install the AWS SAM CLI by running the `install` executable. This executable is located in the directory used in the previous step. The following is an example, using the `sam-installation` subdirectory:

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

5. Verify the installation.

   ```
   $ sam --version
   ```

   To confirm a successful installation, you should see an output that replaces the following bracketed text with the latest available version:

```
SAM CLI, <latest version>
```

arm64 - command line installer

1. Download the AWS SAM CLI .zip file to a directory of your choice.
2. **(Optional)** You can verify the integrity of the installer before installation. For instructions, see Optional: Verify the integrity of the AWS SAM CLI installer.
3. Unzip the installation files into a directory of your choice. The following is an example, using the `sam-installation` subdirectory.

   > **Note**
   >
   > If your operating system doesn't have the built-in **unzip** command, use an equivalent.

   ```
   $ unzip aws-sam-cli-linux-arm64.zip -d sam-installation
   ```

4. Install the AWS SAM CLI by running the `install` executable. This executable is located in the directory used in the previous step. The following is an example, using the `sam-installation` subdirectory:

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

5. Verify the installation.

   ```
   $ sam --version
   ```

   To confirm a successful installation, you should see an output like the following but that replaces the bracketed text with the latest SAM CLI version:

   ```
   SAM CLI, <latest version>
   ```

macOS

Installation steps

Use the package installer to install the AWS SAM CLI. Additionally, the package installer has two installation methods that you can choose from: **GUI** and **Command line**. You can install for **all users** or just your **current user**. To install for all users, superuser authorization is required.

> **Note**
> AWS SAM CLI doesn't support MacOS versions older than MacOS 13.x. Upgrade to a supported version of MacOS or install AWS SAM CLI with Homebrew.

GUI - All users

To download the package installer and install the AWS SAM CLI

> **Note**
> If you previously installed the AWS SAM CLI through Homebrew or pip, you need to uninstall it first. For instructions, see Uninstalling the AWS SAM CLI.

1. Download the macOS pkg to a directory of your choice:
   - **For Macs running Intel processors, choose x86_64** – aws-sam-cli-macos-x86_64.pkg
   - **For Macs running Apple silicon, choose arm64** – aws-sam-cli-macos-arm64.pkg

   > **Note**
   > You have the option of verifying the integrity of the installer before installation. For instructions, see Optional: Verify the integrity of the AWS SAM CLI installer.

2. Run your downloaded file and follow the on-screen instructions to continue through the **Introduction**, **Read Me**, and **License** steps.
3. For **Destination Select**, select **Install for all users of this computer**.

4. For **Installation Type**, choose where the AWS SAM CLI will be installed and press **Install**. The recommended default location is `/usr/local/aws-sam-cli`.

> **Note**
>
> To invoke the AWS SAM CLI with the **sam** command, the installer automatically creates a symlink between `/usr/local/bin/sam` and either `/usr/local/aws-sam-cli/sam` or the installation folder you chose.

5. The AWS SAM CLI will install and **The installation was successful** message will display. Press **Close**.

To verify a successful installation

- Verify that the AWS SAM CLI has properly installed and that your symlink is configured by running:

```
$ which sam
/usr/local/bin/sam
$ sam --version
SAM CLI, <latest version>
```

GUI - Current user

To download and install the AWS SAM CLI

> **Note**
>
> If you previously installed the AWS SAM CLI through Homebrew or pip, you need to uninstall it first. For instructions, see Uninstalling the AWS SAM CLI.

1. Download the macOS pkg to a directory of your choice:

   - **For Macs running Intel processors, choose x86_64** – aws-sam-cli-macos-x86_64.pkg
   - **For Macs running Apple silicon, choose arm64** – aws-sam-cli-macos-arm64.pkg

> **Note**
>
> You have the option of verifying the integrity of the installer before installation. For instructions, see Optional: Verify the integrity of the AWS SAM CLI installer.

2. Run your downloaded file and follow the on-screen instructions to continue through the **Introduction**, **Read Me**, and **License** steps.
3. For **Destination Select**, select **Install for me only**. If you don't see this option, go to the next step.
4. For **Installation Type**, do the following:
   1. Choose where the AWS SAM CLI will be installed. The default location is `/usr/local/aws-sam-cli`. Select a location that you have write permissions for. To change the installation location, select **local** and choose your location. Press **Continue** when done.
   2. If you didn't get the option to choose **Install for me only** in the previous step, select **Change Install Location** > **Install for me only** and press **Continue**.
   3. Press **Install**.
5. The AWS SAM CLI will install and **The installation was successful** message will display. Press **Close**.

To create a symlink

- To invoke the AWS SAM CLI with the **sam** command, you must manually create a symlink between the AWS SAM CLI program and your `$PATH`. Create your symlink by modifying and running the following command:

```
$ sudo ln -s /path-to/aws-sam-cli/sam /path-to-symlink-directory/sam
```

  - *`sudo`* – If your user has write permissions to `$PATH`, **sudo** is not required. Otherwise, **sudo** is required.
  - *`path-to`* – Path to where you installed the AWS SAM CLI program. For example, `/Users/myUser/Desktop`.
  - *`path-to-symlink-directory`* – Your `$PATH` environment variable. The default location is `/usr/local/bin`.

To verify a successful installation

- Verify that the AWS SAM CLI has properly installed and that your symlink is configured by running:

```
$ which sam
/usr/local/bin/sam
$ sam --version
SAM CLI, <latest version>
```

Command line - All users

To download and install the AWS SAM CLI

> **Note**
>
> If you previously installed the AWS SAM CLI through Homebrew or pip, you need to uninstall it first. For instructions, see Uninstalling the AWS SAM CLI.

1. Download the macOS pkg to a directory of your choice:

   - **For Macs running Intel processors, choose x86_64** – aws-sam-cli-macos-x86_64.pkg
   - **For Macs running Apple silicon, choose arm64** – aws-sam-cli-macos-arm64.pkg

   > **Note**
   >
   > You have the option of verifying the integrity of the installer before installation. For instructions, see Optional: Verify the integrity of the AWS SAM CLI installer.

2. Modify and run the installation script:

```
$ sudo installer -pkg path-to-pkg-installer/name-of-pkg-installer -target /
installer: Package name is AWS SAM CLI
installer: Upgrading at base path /
installer: The upgrade was successful.
```

> **Note**
>
> To invoke the AWS SAM CLI with the **sam** command, the installer automatically creates a symlink between `/usr/local/bin/sam` and `/usr/local/aws-sam-cli/sam`.

To verify a successful installation

- Verify that the AWS SAM CLI has properly installed and that your symlink is configured by running:

```
$ which sam
/usr/local/bin/sam
$ sam --version
SAM CLI, <latest version>
```

Command line - Current user

To download and install the AWS SAM CLI

> **Note**
>
> If you previously installed the AWS SAM CLI through Homebrew or pip, you need to uninstall it first. For instructions, see Uninstalling the AWS SAM CLI.

1. Download the macOS pkg to a directory of your choice:

   - **For Macs running Intel processors, choose x86_64** – aws-sam-cli-macos-x86_64.pkg
   - **For Macs running Apple silicon, choose arm64** – aws-sam-cli-macos-arm64.pkg

   > **Note**
   >
   > You have the option of verifying the integrity of the installer before installation. For instructions, see Optional: Verify the integrity of the AWS SAM CLI installer.

2. Determine an installation directory that you have write permissions to. Then, create an `xml` file using the template and modify it to reflect your installation directory. The directory must already exist.

   For example, if you replace *`path-to-my-directory`* with `/Users/myUser/Desktop`, the `aws-sam-cli` program folder will be installed there.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple//DTD PLIST 1.0//EN" "http://www.apple.com/DTDs/
PropertyList-1.0.dtd">
<plist version="1.0">
  <array>
    <dict>
      <key>choiceAttribute</key>
      <string>customLocation</string>
      <key>attributeSetting</key>
      <string>path-to-my-directory</string>
      <key>choiceIdentifier</key>
      <string>default</string>
    </dict>
  </array>
</plist>
```

3. Save the `xml` file and verify that its valid by running the following:

```
$ installer -pkg path-to-pkg-installer \
-target CurrentUserHomeDirectory \
-showChoicesAfterApplyingChangesXML path-to-your-xml-file
```

   The output should display the preferences that will be applied to the AWS SAM CLI program.

4. Run the following to install the AWS SAM CLI:

```
$ installer -pkg path-to-pkg-installer \
-target CurrentUserHomeDirectory \
-applyChoiceChangesXML path-to-your-xml-file

# Example output
installer: Package name is AWS SAM CLI
installer: choices changes file 'path-to-your-xml-file' applied
installer: Upgrading at base path base-path-of-xml-file
```

```
installer: The upgrade was successful.
```

To create a symlink

- To invoke the AWS SAM CLI with the **sam** command, you must manually create a symlink between the AWS SAM CLI program and your $PATH. Create your symlink by modifying and running the following command:

```
$ sudo ln -s /path-to/aws-sam-cli/sam /path-to-symlink-directory/sam
```

  - *sudo* – If your user has write permissions to $PATH, **sudo** is not required. Otherwise, **sudo** is required.
  - *path-to* – Path to where you installed the AWS SAM CLI program. For example, `/Users/myUser/Desktop`.
  - *path-to-symlink-directory* – Your $PATH environment variable. The default location is `/usr/local/bin`.

To verify a successful installation

- Verify that the AWS SAM CLI has properly installed and that your symlink is configured by running:

```
$ which sam
/usr/local/bin/sam
$ sam --version
SAM CLI, <latest version>
```

Windows

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. Download the AWS SAM CLI 64-bit.
2. **(Optional)** You can verify the integrity of the installer before installation. For instructions, see Optional: Verify the integrity of the AWS SAM CLI installer.

3. 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
   ```

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

   ```
   SAM CLI, <latest version>
   ```

4. Enable long paths (Windows 10 and newer only).

   > **Important**
   >
   > The AWS SAM CLI might interact with filepaths that exceed the Windows max path limitation. This may cause errors when running `sam init` due to Windows 10 **MAX_PATH** limitations. To resolve this issue, the new long paths behavior must be configured.

   To enable long paths, see Enable Long Paths in Windows 10, Version 1607, and Later in the *Microsoft Windows App Development Documentation*.

5. Install Git.

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

Troubleshooting installation errors

Linux

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.

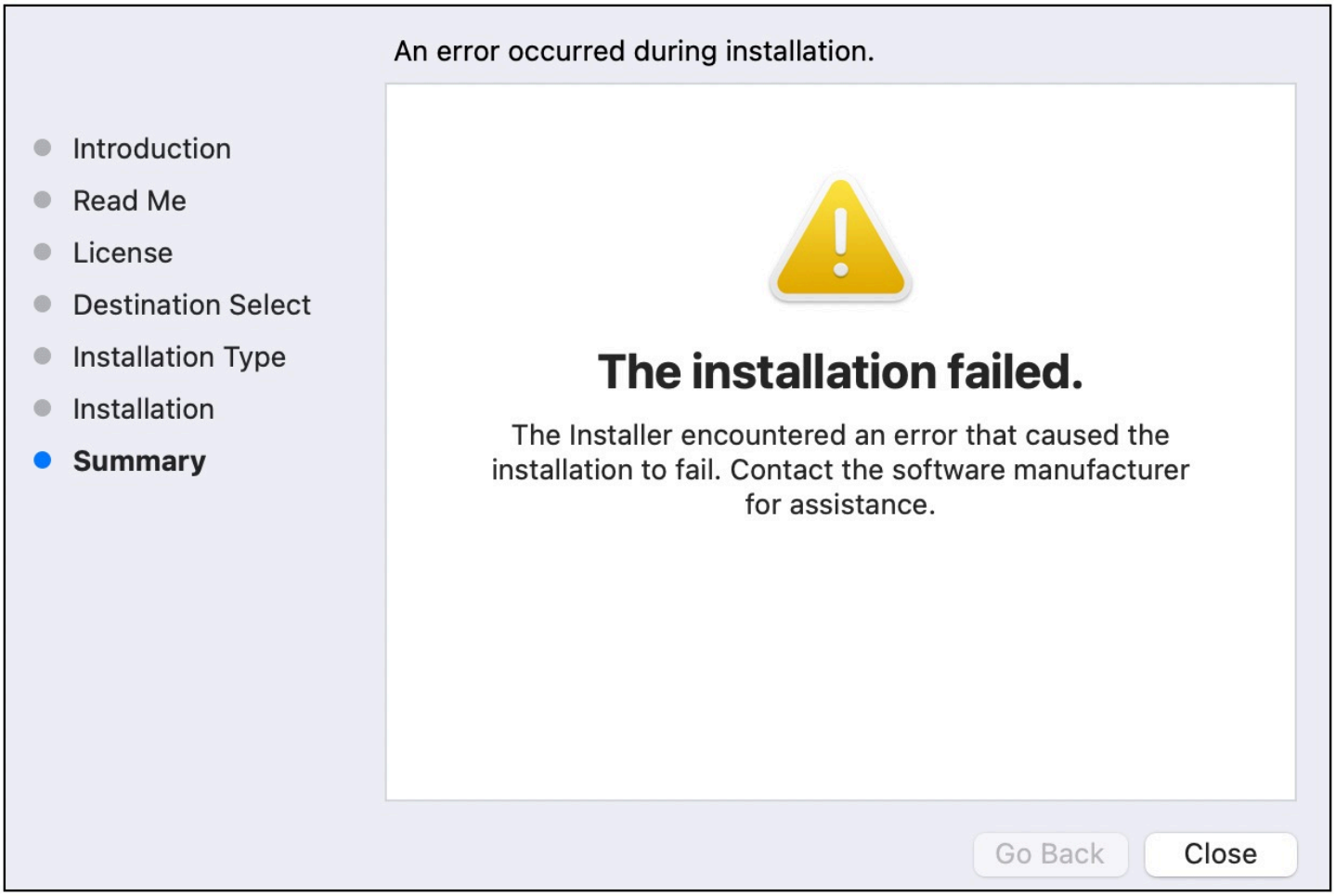
AWS SAM CLI error: "/lib64/libc.so.6: version `GLIBC_2.14' not found (required by /usr/local/aws-sam-cli/dist/libz.so.1)"

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 Install the AWS SAM CLI.

macOS

The installation failed



If you are installing the AWS SAM CLI for your user and selected an installation directory that you don't have write permissions for, this error could occur. Try either of the following:

1. Select a different installation directory that you have write permissions for.
2. Delete the installer. Then, download and run it again.

Next steps

To learn more about the AWS SAM CLI and to begin building your own serverless applications, see the following:

- Tutorial: Deploy a Hello World application with AWS SAM – Step-by-step instructions to download, build, and deploy a basic serverless application.

- The Complete AWS SAM Workshop – A workshop designed to teach you many of the major features that AWS SAM provides.
- AWS SAM example applications and patterns – Sample applications and patterns from community authors that you can further experiment with.

Optional: Verify the integrity of the AWS SAM CLI installer

When installing the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) using a package installer, you can verify its integrity before installation. This is an optional, but highly recommended step.

The two options of verification available to you are:

- Verify the package installer signature file.
- Verify the package installer hash value.

When available for your platform, we recommend verifying the signature file option. This option offers an extra layer of security since the key values are published here and managed separately from our GitHub repository.

Topics

- Verify the installer signature file
- Verify the hash value

Verify the installer signature file

Linux

arm64 - command line installer

AWS SAM uses GnuPG to sign the AWS SAM CLI .zip installer. Verification is performed in the following steps:

1. Use the primary public key to verify the signer public key.
2. Use the signer public key to verify the AWS SAM CLI package installer.

To verify the integrity of the signer public key

1. Copy the primary public key and save it to your local machine as a `.txt` file. For example, *`primary-public-key.txt`*.

```
-----BEGIN PGP PUBLIC KEY BLOCK-----
Version: GnuPG v2.0.22 (GNU/Linux)

mQINBGRuSzMBEADsqiwOy78w7F4+sshaMFRIwRGNRm94p5Qey2KMZBxekFtoryVD
D9jEOnvupx4tvhfBHz5EcUHCEOdl4MTqdBy6vVAshozgxVb9RE8JpECn5lw7XC69
4Y7Gy1TKKQMEWtDXElkGxIFdUWvWjSnPlzfnoXwQYGeE93CUS3h5dImP22Yk1Ct6
eGGhlcbg1X4L8EpFMj7GvcsU8f7ziVI/PyC1Xwy39Q8/I67ip5eU5ddxO/xHqrbL
YC7+8pJPbRMej2twT2LrcpWWYAbprMtRoa6WfE0/thoo3xhHpIMHdPfAA86ZNGIN
kRLjGUg7jnPTRW4Oin3pCc8nT4Tfc1QERkHm641gTC/jUvpmQsM6h/FUVP2i5iE/
JHpJcMuL2Mg6zDo3x+3gTCf+Wqz3rZzxB+wQT3yryZs6efcQy7nROiRxYBxCSXX0
2cNYzsYLb/bYaW8yqWIHD5IqKhw269gp2E5Khs60zgS3CorMb5/xHgXjUCVgcu8a
a8ncdf9fjl3WS5p0ohetPbO2ZjWv+MaqrZOmUIgKbA4RpWZ/fU97P5BW9ylwmIDB
sWy0cMxg8MlvSdLytPieogaM0qMg3u5qXRGBr6Wmevkty0qgnmpGGc5zPiUbtOE8
CnFFqyxBpj5IOnG0KZGVihvn+iRxrv6GO7WWO92+Dc6m94U0EEiBR7QiOwARAQAB
tDRBV1MgU0FNIENMSSBQcmltYXJ5IDxhd3Mtc2FtLWNsaS1wcmltYXJ5QGFtYXpv
bi5jb20+iQI/BBMBCQApBQJkbkszAhsvBQkHhM4ABwsJCAcDAgEGFQgCCQoLBBYC
AwECHgECF4AACgkQQv1fenOtiFqTuhAAzi5+ju5UVOWqHKevOJSO08T4QB8HcqAE
SVO3mY6/j29knkcL8ubZP/DbpV7QpHPI2PB5qSXsiDTP3IYPbeY78zHSDjljaIK3
njJLMScFeGPyfPpwMsuY4nzrRIgAtXShPA8N/k4ZJcafnpNqKj7QnPxiC1KaIQWm
pOtvb8msUF3/s0UTa5Ys/lNRhVC0eGg32ogXGdojZA2kHZWdm9udLo4CDrDcrQT7
NtDcJASapXSQL63XfAS3snEc4e1941YxcjfYZ33rel8K9juyDZfi1slWR/L3AviI
QFIaqSHzyOtP1oinUkoVwL8ThevKD3Ag9CZflZLzNCV7yqlF8RlhEZ4zcE/3s9El
WzCFsozb5HfE1AZonmrDh3SyOEIBMcS6vG5dWnvJrAuSYv2rX38++K5Pr/MIAfOX
DOI1rtA+XDsHNv9lSwSy0lt+iClawZANO9IXCiN1rOYcVQlwzDFwCNWDgkwdOqS0
gOA2f8NF9lE5nBbeEuYquoOl1Vy8+ICbgOFs9LoWZlnVh7/RyY6ssowiU9vGUnHI
L8f9jqRspIz/Fm3JD86ntZxLVGkeZUz62FqErdohYfkFIVcv7GONTEyrz5HLlnpv
FJ0MR0HjrMrZrnOVZnwBKhpbLocTsH+3t5It4ReYEX0f1DIOL/KRwPvjMvBVkXY5
hblRVDQoOWc=
=d9oG
-----END PGP PUBLIC KEY BLOCK-----
```

2. Import the primary public key to your keyring.

```
$ gpg --import primary-public-key.txt

gpg: directory `/home/.../.gnupg' created
gpg: new configuration file `/home/.../.gnupg/gpg.conf' created
```

```
gpg: WARNING: options in `/home/.../.gnupg/gpg.conf' are not yet active during this
 run
gpg: keyring `/home/.../.gnupg/secring.gpg' created
gpg: keyring `/home/.../.gnupg/pubring.gpg' created
gpg: /home/.../.gnupg/trustdb.gpg: trustdb created
gpg: key 73AD885A: public key "AWS SAM CLI Primary <aws-sam-cli-
primary@amazon.com>" imported
gpg: Total number processed: 1
gpg:               imported: 1  (RSA: 1)
```

3. Copy the signer public key and save it to your local machine as a `.txt` file. For example, *`signer-public-key.txt`*.


```
-----BEGIN PGP PUBLIC KEY BLOCK-----
Version: GnuPG v2.0.22 (GNU/Linux)

mQINBGgrxIgBEADGCTudveeeVbWpZDGX9Ni57mBRMVSJwQJ6F/PC34jw0DozxTtd
H+ZPsXLvLwerN/DVXbK8E1qNZ5RGptak8j7MPz+MC3n4txibEJpB61vpjJJM+9cC
7whaMLDT/SbykHYXdrnHqa8KsUJl7rPLJcaRN722NSxvYVMIOA9ffVXV7cfEyZi5
MbYF2Gc9LNbKaknImIva7EKeeh2/wI6YCqC5yytyfWU5dL6oHXsgTnFL9mhziMxv
WhyzawyJG6EJZsJ3WLlbIKApN6XZSXyCxOvlBrebYZjD5v0nA+TJaQ7is8atjtOI
DGe0AViw7kO8ChTpjA7YG/Uu7n/Fy7qLF/3Nz0b6cBNjemjBazQ3A3KNCpi5hqFM
Uo1WpoVLr5CXQnc0B3fBUnTIoxi0Sk5MKjH9AbYxfgqEX0ZJB9hAlc6LIEy0Yru6
MMBrIHE86IMl1NfE/DeLnCdPG23+1PttwyOt3+9z5QwmPe3VPpEfCySPcdxHKZSP
rLile8qDznEvlPDvQ0qkBxdMtVa2yct5VJkdqy6UrN2xa0dpspHjRUjHh/EY/xMt
fwMUjOKohaZ/1pjotCcksAsZWUxCNcFvLYxuxeytVk4F09Es1hj4ihhLUI+43/ic
3DHSEiext7Q8/UccNArkhSCT7UOvvL7QTuP+pjYTyiC8Vx6g/Y5Ht5+qywARAQAB
tDBBV1MgU0FNIENMSSBUZWFtIDxhd3Mtc2FtLWNsaS1zaWduZXJAYW1hem9uLmNv
bT6JAj8EEwEJACkFAmgrxIgCGy8FCQPCZwAHCwkIBwMCAQYVCAIJCgsEFgIDAQIe
AQIXgAAKCRBAlKuxvt/atJo6EAC/5C8uJs76W5f5V5XNAMzwBFiZuYpop3DRReCo
P68ZZylokAC9ShRZnIOujpDJtlNS7T/G00BzmcpspkYYE531ALaXcHWmb9XV0Ajg
J8iboAVBLY0C7mhL/cbJ3v9QlpXXjyTuhexkJCV8rdHVX/0H8WqTZplEaRuZ7p8q
PMxddg4ClwstYuH3O/dmNdlGqfb4Fqy8MnV1yGSXRs5Jf+sDlN2UO4mbpyk/mr1c
f/jFxmx86IkCWJVvdXWCVTe2AFy3NHCdLtdnEvFhokCOQd9wibUWX0j9vq4cVRZT
qamnpAQaOlH3lXOwrjqo8b1AIPoRWSfMtCYvh6kA8MAJv4cAznzXILSLtOE0mzaU
qp5qoy37wNIjeztX6c/q4wss05qTlJhnNu4s3nh5VHultooaYpmDxp+ala5TWeuM
KZDI4KdAGF4z0Raif+N53ndOYIiXkY0goUbsPCnVrCwoK9PjjyoJncq7c14wNl5O
IQUZEjyYAQDGZqs5XSfY4zW2cCXatrfozKF7R1kSU14DfJwPUyksoNAQEQezfXyq
kr0gfIWK1r2nMdqS7WgSx/ypS5kdyrHuPZdaYfEVtuezpoT2lQQxOSZqqlp5hI4R
nqmPte53WXJhbC0tgTIJWn+Uy/d5Q/aSIfD6o8gNLS1BDs1j1ku0XKu1sFCHUcZG
aerdsIkCHAQQAQkABgUCaCvFeAAKCRBC/V96c62IWt3/D/9gOLzWtz62lqJRCsri
wcA/yz88ayKb/GUv3FCT5Nd9JZt8y1tW+AE3SPTdcpfZmt5UN2sRzljO61mpKJzp
eBvYQ9og/34ZrRQqeg8bz02u34LKYl1gD0xY0bWtB7TGIxIZZYqZECoPR0Dp6ZzB
```

```
abzkRSsJkEk0vbZzJhfWFYs98qfp/G0suFSBE79O8Am33DB2jQ/Sollh1VmNE6Sv
EOgR6+2yEkS2D0+msJMa/V82v9gBTPnxSlNV1d8Dduvt9rbM3LoxiNXUgx/s52yY
U6H3bwUcQ3UY6uRe1UWo5QnMFcDwfg43+q5rmjB4xQyX/BaQyF5K0hZyG+42/pH1
EMwl8qN617FTxo3hvQUi/cBahlhQ8EVYsGnHDVxLCisbq5iZvp7+XtmMy1Q417gT
EQRo8feJh31elGWlccVR2pZgIm1PQ69dzzseHnnKkGhifik0bDGo5/IH2EgI1KFn
SG399RMU/qRzOPLVP3i+zSJmhMqG8cnZaUwE5V4P21vQSclhhd2Hv/C4SVKNqA2i
+oZbHj2vAkuzTTL075AoANebEjPGqwsKZi5mWUE5Pa931JeiXxWZlEB7rkgQ1PAB
fsDBhYLt4MxCWAhifLMA6uQ4BhXu2RuXOqNfSbqa8jVF6DB6cD8eAHGpPKfJOl30
LtZnq+n4SfeNbZjD2FQWZR4CrA==
=lHfs
-----END PGP PUBLIC KEY BLOCK-----
```

4. Import the signer public key to your keyring.

```
$ gpg --import signer-public-key.txt

gpg: key 4094ABB1BEDFDAB4: public key "AWS SAM CLI Team <aws-sam-cli-
signer@amazon.com>" imported
gpg: Total number processed: 1
gpg:               imported: 1  (RSA: 1)
gpg: no ultimately trusted keys found
```

Take note of the key value from the output. For example, *4094ABB1BEDFDAB4*.

5. Use the key value to obtain and verify the signer public key fingerprint.

```
$ gpg --fingerprint 4094ABB1BEDFDAB4

pub   rsa4096 2025-05-19 [SCEA] [expires: 2027-05-19]
      EF46 3E86 CA31 933B B688  CC1A 4094 ABB1 BEDF DAB4
uid           [ unknown] AWS SAM CLI Team <aws-sam-cli-signer@amazon.com>
```

The fingerprint should match the following:

```
EF46 3E86 CA31 933B B688  CC1A 4094 ABB1 BEDF DAB4
```

If the fingerprint string doesn't match, do not use the AWS SAM CLI installer. Escalate to the AWS SAM team by creating an issue in the *aws-sam-cli GitHub repository*.

6. Verify the signatures of the signer public key:

```
$ gpg --check-sigs 4094ABB1BEDFDAB4
```

```
pub   rsa4096 2025-05-19 [SCEA] [expires: 2027-05-19]
      EF463E86CA31933BB688CC1A4094ABB1BEDFDAB4
uid           [ unknown] AWS SAM CLI Team <aws-sam-cli-signer@amazon.com>
sig!3        4094ABB1BEDFDAB4 2025-05-19  [self-signature]
sig!         42FD5F7A73AD885A 2025-05-19  AWS SAM CLI Primary <aws-sam-cli-
primary@amazon.com>
```

If you see `1 signature not checked due to a missing key`, repeat the previous steps to import the primary and signer public keys to your keyring.

You should see the key values for both the primary public key and signer public key listed.

Now that you have verified the integrity of the signer public key, you can use the signer public key to verify the AWS SAM CLI package installer.

To verify the integrity of the AWS SAM CLI package installer

1. **Obtain the AWS SAM CLI package signature file** – Download the signature file for the AWS SAM CLI package installer by using the following command:

```
$ wget https://github.com/aws/aws-sam-cli/releases/latest/download/aws-sam-cli-
linux-arm64.zip.sig
```

2. **Verify the signature file** – Pass both the downloaded `.sig` and `.zip` files as parameters to the gpg command. The following is an example:

```
$ gpg --verify aws-sam-cli-linux-arm64.zip.sig aws-sam-cli-linux-arm64.zip
```

The output should look similar to the following:

```
gpg: Signature made Mon 19 May 2025 01:21:57 AM UTC using RSA key ID
 4094ABB1BEDFDAB4
gpg: Good signature from "AWS SAM CLI Team <aws-sam-cli-signer@amazon.com>"
gpg: WARNING: This key is not certified with a trusted signature!
gpg:          There is no indication that the signature belongs to the owner.
Primary key fingerprint: EF46 3E86 CA31 933B B688  CC1A 4094 ABB1 BEDF DAB4
```

- The `WARNING: This key is not certified with a trusted signature!` message can be ignored. It occurs because there isn't a chain of trust between your personal

PGP key (if you have one) and the AWS SAM CLI PGP key. For more information, see Web of trust.

- If the output contains the phrase `BAD signature`, check that you performed the procedure correctly. If you continue to get this response, escalate to the AWS SAM team by creating an issue in the *aws-sam-cli GitHub repository* and avoid using the downloaded file.

The `Good signature from "AWS SAM CLI Team <aws-sam-cli-signer@amazon.com>"` message means that the signature is verified and you can move forward with installation.

x86_64 - command line installer

AWS SAM uses GnuPG to sign the AWS SAM CLI .zip installer. Verification is performed in the following steps:

1. Use the primary public key to verify the signer public key.
2. Use the signer public key to verify the AWS SAM CLI package installer.

To verify the integrity of the signer public key

1. Copy the primary public key and save it to your local machine as a `.txt` file. For example, *`primary-public-key.txt`*.


```
-----BEGIN PGP PUBLIC KEY BLOCK-----
Version: GnuPG v2.0.22 (GNU/Linux)

mQINBGRuSzMBEADsqiwOy78w7F4+sshaMFRIwRGNRm94p5Qey2KMZBxekFtoryVD
D9jEOnvupx4tvhfBHz5EcUHCEOdl4MTqdBy6vVAshozgxVb9RE8JpECn5lw7XC69
4Y7Gy1TKKQMEWtDXElkGxIFdUWvWjSnPlzfnoXwQYGeE93CUS3h5dImP22Yk1Ct6
eGGhlcbg1X4L8EpFMj7GvcsU8f7ziVI/PyC1Xwy39Q8/I67ip5eU5ddxO/xHqrbL
YC7+8pJPbRMej2twT2LrcpWWYAbprMtRoa6WfE0/thoo3xhHpIMHdPfAA86ZNGIN
kRLjGUg7jnPTRW4Oin3pCc8nT4Tfc1QERkHm641gTC/jUvpmQsM6h/FUVP2i5iE/
JHpJcMuL2Mg6zDo3x+3gTCf+Wqz3rZzxB+wQT3yryZs6efcQy7nROiRxYBxCSXX0
2cNYzsYLb/bYaW8yqWIHD5IqKhw269gp2E5Khs60zgS3CorMb5/xHgXjUCVgcu8a
a8ncdf9fjl3WS5p0ohetPbO2ZjWv+MaqrZOmUIgKbA4RpWZ/fU97P5BW9ylwmIDB
sWy0cMxg8MlvSdLytPieogaM0qMg3u5qXRGBr6Wmevkty0qgnmpGGc5zPiUbtOE8
CnFFqyxBpj5IOnG0KZGVihvn+iRxrv6GO7WWO92+Dc6m94U0EEiBR7QiOwARAQAB
tDRBV1MgU0FNIENMSSBQcmltYXJ5IDxhd3Mtc2FtLWNsaS1wcmltYXJ5QGFtYXpv
bi5jb20+iQI/BBMBCQApBQJkbkszAhsvBQkHhM4ABwsJCAcDAgEGFQgCCQoLBBYC
```

```
AwECHgECF4AACgkQQv1fenOtiFqTuhAAzi5+ju5UVOWqHKevOJSO08T4QB8HcqAE
SVO3mY6/j29knkcL8ubZP/DbpV7QpHPI2PB5qSXsiDTP3IYPbeY78zHSDjljaIK3
njJLMScFeGPyfPpwMsuY4nzrRIgAtXShPA8N/k4ZJcafnpNqKj7QnPxiC1KaIQWm
pOtvb8msUF3/s0UTa5Ys/lNRhVC0eGg32ogXGdojZA2kHZWdm9udLo4CDrDcrQT7
NtDcJASapXSQL63XfAS3snEc4e1941YxcjfYZ33rel8K9juyDZfi1slWR/L3AviI
QFIaqSHzyOtP1oinUkoVwL8ThevKD3Ag9CZflZLzNCV7yqlF8RlhEZ4zcE/3s9El
WzCFsozb5HfE1AZonmrDh3SyOEIBMcS6vG5dWnvJrAuSYv2rX38++K5Pr/MIAfOX
DOI1rtA+XDsHNv9lSwSy0lt+iClawZANO9IXCiN1rOYcVQlwzDFwCNWDgkwdOqS0
gOA2f8NF9lE5nBbeEuYquoOl1Vy8+ICbgOFs9LoWZlnVh7/RyY6ssowiU9vGUnHI
L8f9jqRspIz/Fm3JD86ntZxLVGkeZUz62FqErdohYfkFIVcv7GONTEyrz5HLlnpv
FJ0MR0HjrMrZrnOVZnwBKhpbLocTsH+3t5It4ReYEX0f1DIOL/KRwPvjMvBVkXY5
hblRVDQoOWc=
=d9oG
-----END PGP PUBLIC KEY BLOCK-----
```

2. Import the primary public key to your keyring.

```
$ gpg --import primary-public-key.txt

gpg: directory `/home/.../.gnupg' created
gpg: new configuration file `/home/.../.gnupg/gpg.conf' created
gpg: WARNING: options in `/home/.../.gnupg/gpg.conf' are not yet active during this
 run
gpg: keyring `/home/.../.gnupg/secring.gpg' created
gpg: keyring `/home/.../.gnupg/pubring.gpg' created
gpg: /home/.../.gnupg/trustdb.gpg: trustdb created
gpg: key 73AD885A: public key "AWS SAM CLI Primary <aws-sam-cli-
primary@amazon.com>" imported
gpg: Total number processed: 1
gpg:               imported: 1  (RSA: 1)
```

3. Copy the signer public key and save it to your local machine as a `.txt` file. For example, *`signer-public-key.txt`*.

```
-----BEGIN PGP PUBLIC KEY BLOCK-----
Version: GnuPG v2.0.22 (GNU/Linux)

mQINBGgrxIgBEADGCTudveeeVbWpZDGX9Ni57mBRMVSJwQJ6F/PC34jw0DozxTtd
H+ZPsXLvLwerN/DVXbK8E1qNZ5RGptak8j7MPz+MC3n4txibEJpB61vpjJJM+9cC
7whaMLDT/SbykHYXdrnHqa8KsUJl7rPLJcaRN722NSxvYVMIOA9ffVXV7cfEyZi5
MbYF2Gc9LNbKaknImIva7EKeeh2/wI6YCqC5yytyfWU5dL6oHXsgTnFL9mhziMxv
WhyzawyJG6EJZsJ3WLlbIKApN6XZSXyCxOvlBrebYZjD5v0nA+TJaQ7is8atjtOI
DGe0AViw7kO8ChTpjA7YG/Uu7n/Fy7qLF/3Nz0b6cBNjemjBazQ3A3KNCpi5hqFM
```

```
Uo1WpoVLr5CXQnc0B3fBUnTIoxi0Sk5MKjH9AbYxfgqEX0ZJB9hAlc6LIEy0Yru6
MMBrIHE86IMl1NfE/DeLnCdPG23+1PttwyOt3+9z5QwmPe3VPpEfCySPcdxHKZSP
rLile8qDznEvlPDvQ0qkBxdMtVa2yct5VJkdqy6UrN2xa0dpspHjRUjHh/EY/xMt
fwMUjOKohaZ/1pjotCcksAsZWUxCNcFvLYxuxeytVk4F09Es1hj4ihhLUI+43/ic
3DHSEiext7Q8/UccNArkhSCT7UOvvL7QTuP+pjYTyiC8Vx6g/Y5Ht5+qywARAQAB
tDBBV1MgU0FNIENMSSBUZWFtIDxhd3Mtc2FtLWNsaS1zaWduZXJAYW1hem9uLmNv
bT6JAj8EEwEJACkFAmgrxIgCGy8FCQPCZwAHCwkIBwMCAQYVCAIJCgsEFgIDAQIe
AQIXgAAKCRBAlKuxvt/atJo6EAC/5C8uJs76W5f5V5XNAMzwBFiZuYpop3DRReCo
P68ZZylokAC9ShRZnIOujpDJtlNS7T/G00BzmcpspkYYE531ALaXcHWmb9XV0Ajg
J8iboAVBLY0C7mhL/cbJ3v9QlpXXjyTuhexkJCV8rdHVX/0H8WqTZplEaRuZ7p8q
PMxddg4ClwstYuH3O/dmNdlGqfb4Fqy8MnV1yGSXRs5Jf+sDlN2UO4mbpyk/mr1c
f/jFxmx86IkCWJVvdXWCVTe2AFy3NHCdLtdnEvFhokCOQd9wibUWX0j9vq4cVRZT
qamnpAQaOlH3lXOwrjqo8b1AIPoRWSfMtCYvh6kA8MAJv4cAznzXILSLtOE0mzaU
qp5qoy37wNIjeztX6c/q4wss05qTlJhnNu4s3nh5VHultooaYpmDxp+ala5TWeuM
KZDI4KdAGF4z0Raif+N53ndOYIiXkY0goUbsPCnVrCwoK9PjjyoJncq7c14wNl5O
IQUZEjyYAQDGZqs5XSfY4zW2cCXatrfozKF7R1kSU14DfJwPUyksoNAQEQezfXyq
kr0gfIWK1r2nMdqS7WgSx/ypS5kdyrHuPZdaYfEVtuezpoT2lQQxOSZqqlp5hI4R
nqmPte53WXJhbC0tgTIJWn+Uy/d5Q/aSIfD6o8gNLS1BDs1j1ku0XKu1sFCHUcZG
aerdsIkCHAQQAQkABgUCaCvFeAAKCRBC/V96c62IWt3/D/9gOLzWtz62lqJRCsri
wcA/yz88ayKb/GUv3FCT5Nd9JZt8y1tW+AE3SPTdcpfZmt5UN2sRzljO61mpKJzp
eBvYQ9og/34ZrRQqeg8bz02u34LKYl1gD0xY0bWtB7TGIxIZZYqZECoPR0Dp6ZzB
abzkRSsJkEk0vbZzJhfWFYs98qfp/G0suFSBE79O8Am33DB2jQ/Sollh1VmNE6Sv
EOgR6+2yEkS2D0+msJMa/V82v9gBTPnxSlNV1d8Dduvt9rbM3LoxiNXUgx/s52yY
U6H3bwUcQ3UY6uRe1UWo5QnMFcDwfg43+q5rmjB4xQyX/BaQyF5K0hZyG+42/pH1
EMwl8qN617FTxo3hvQUi/cBahlhQ8EVYsGnHDVxLCisbq5iZvp7+XtmMy1Q417gT
EQRo8feJh31elGWlccVR2pZgIm1PQ69dzzseHnnKkGhifik0bDGo5/IH2EgI1KFn
SG399RMU/qRzOPLVP3i+zSJmhMqG8cnZaUwE5V4P21vQSclhhd2Hv/C4SVKNqA2i
+oZbHj2vAkuzTTL075AoANebEjPGqwsKZi5mWUE5Pa931JeiXxWZlEB7rkgQ1PAB
fsDBhYLt4MxCWAhifLMA6uQ4BhXu2RuXOqNfSbqa8jVF6DB6cD8eAHGpPKfJOl30
LtZnq+n4SfeNbZjD2FQWZR4CrA==
=lHfs
-----END PGP PUBLIC KEY BLOCK-----
```


4. Import the signer public key to your keyring.

```
$ gpg --import signer-public-key.txt

gpg: key 4094ABB1BEDFDAB4: public key "AWS SAM CLI Team <aws-sam-cli-
signer@amazon.com>" imported
gpg: Total number processed: 1
gpg:               imported: 1  (RSA: 1)
gpg: no ultimately trusted keys found
```

Take note of the key value from the output. For example, *4094ABB1BEDFDAB4*.

5. Use the key value to obtain and verify the signer public key fingerprint.

```
$ gpg --fingerprint 4094ABB1BEDFDAB4

pub   rsa4096 2025-05-19 [SCEA] [expires: 2027-05-19]
      EF46 3E86 CA31 933B B688  CC1A 4094 ABB1 BEDF DAB4
uid           [ unknown] AWS SAM CLI Team <aws-sam-cli-signer@amazon.com>
```

The fingerprint should match the following:

```
EF46 3E86 CA31 933B B688  CC1A 4094 ABB1 BEDF DAB4
```

If the fingerprint string doesn't match, do not use the AWS SAM CLI installer. Escalate to the AWS SAM team by creating an issue in the *aws-sam-cli GitHub repository*.

6. Verify the signatures of the signer public key:

```
$ gpg --check-sigs 4094ABB1BEDFDAB4

pub   rsa4096 2025-05-19 [SCEA] [expires: 2027-05-19]
      EF463E86CA31933BB688CC1A4094ABB1BEDFDAB4
uid           [ unknown] AWS SAM CLI Team <aws-sam-cli-signer@amazon.com>
sig!3        4094ABB1BEDFDAB4 2025-05-19  [self-signature]
sig!         42FD5F7A73AD885A 2025-05-19  AWS SAM CLI Primary <aws-sam-cli-
primary@amazon.com>
```

If you see `1 signature not checked due to a missing key`, repeat the previous steps to import the primary and signer public keys to your keyring.

You should see the key values for both the primary public key and signer public key listed.

Now that you have verified the integrity of the signer public key, you can use the signer public key to verify the AWS SAM CLI package installer.

To verify the integrity of the AWS SAM CLI package installer

1. **Obtain the AWS SAM CLI package signature file** – Download the signature file for the AWS SAM CLI package installer by using the following command:

```
$ wget https://github.com/aws/aws-sam-cli/releases/latest/download/aws-sam-cli-linux-x86_64.zip.sig
```

2. **Verify the signature file** – Pass both the downloaded `.sig` and `.zip` files as parameters to the gpg command. The following is an example:

```
$ gpg --verify aws-sam-cli-linux-x86_64.zip.sig aws-sam-cli-linux-x86_64.zip
```

The output should look similar to the following:

```
gpg: Signature made Mon 19 May 2025 01:21:57 AM UTC using RSA key ID
 4094ABB1BEDFDAB4
gpg: Good signature from "AWS SAM CLI Team <aws-sam-cli-signer@amazon.com>"
gpg: WARNING: This key is not certified with a trusted signature!
gpg:          There is no indication that the signature belongs to the owner.
Primary key fingerprint: EF46 3E86 CA31 933B B688  CC1A 4094 ABB1 BEDF DAB4
```

- The `WARNING: This key is not certified with a trusted signature!` message can be ignored. It occurs because there isn't a chain of trust between your personal PGP key (if you have one) and the AWS SAM CLI PGP key. For more information, see Web of trust.
- If the output contains the phrase `BAD signature`, check that you performed the procedure correctly. If you continue to get this response, escalate to the AWS SAM team by creating an issue in the *aws-sam-cli GitHub repository* and avoid using the downloaded file.

The `Good signature from "AWS SAM CLI Team <aws-sam-cli-signer@amazon.com>"` message means that the signature is verified and you can move forward with installation.

macOS

GUI and command line installer

You can verify the integrity of the AWS SAM CLI package installer signature file by using the `pkgutil` tool or manually.

To verify using pkgutil

1. Run the following command, providing the path to the downloaded installer on your local machine:

```
$ pkgutil --check-signature /path/to/aws-sam-cli-installer.pkg
```

   The following is an example:

```
$ pkgutil --check-signature /Users/user/Downloads/aws-sam-cli-macos-arm64.pkg
```

2. From the output, locate the **SHA256 fingerprint** for **Developer ID Installer: AMZN Mobile LLC**. The following is an example:

```
Package "aws-sam-cli-macos-arm64.pkg":
   Status: signed by a developer certificate issued by Apple for distribution
   Notarization: trusted by the Apple notary service
   Signed with a trusted timestamp on: 2026-01-28 07:39:16 +0000
   Certificate Chain:
    1. Developer ID Installer: AMZN Mobile LLC (94KV3E626L)
       Expires: 2030-09-26 00:18:06 +0000
       SHA256 Fingerprint:
           5C 45 BE 63 FD 52 10 07 2D 66 56 77 5C A9 FF 25 91 6D 3F 01 F7 0E
           9A 8A 05 F6 2D 62 B2 88 8D A9
       ------------------------------------------------------------------------
    2. Developer ID Certification Authority
       Expires: 2031-09-17 00:00:00 +0000
       SHA256 Fingerprint:
           F1 6C D3 C5 4C 7F 83 CE A4 BF 1A 3E 6A 08 19 C8 AA A8 E4 A1 52 8F
           D1 44 71 5F 35 06 43 D2 DF 3A
       ------------------------------------------------------------------------
    3. Apple Root CA
       Expires: 2035-02-09 21:40:36 +0000
       SHA256 Fingerprint:
           B0 B1 73 0E CB C7 FF 45 05 14 2C 49 F1 29 5E 6E DA 6B CA ED 7E 2C
           68 C5 BE 91 B5 A1 10 01 F0 24
```

3. The **Developer ID Installer: AMZN Mobile LLC SHA256 fingerprint** should match the following value:

```
5C 45 BE 63 FD 52 10 07 2D 66 56 77 5C A9 FF 25 91 6D 3F 01 F7 0E 9A 8A 05 F6 2D 62
 B2 88 8D A9
```

If the fingerprint string doesn't match, do not use the AWS SAM CLI installer. Escalate to the AWS SAM team by creating an issue in the *aws-sam-cli GitHub repository*. If the fingerprint string does match, you can move forward with using the package installer.

To verify the package installer manually

- See How to verify the authenticity of manually downloaded Apple software updates at the *Apple support website*.

Windows

The AWS SAM CLI installer is packaged as MSI files for the Windows operating system.

To verify the integrity of the installer

1. Right-click on the installer and open the **Properties** window.
2. Choose the **Digital Signatures** tab.
3. From the **Signature List**, choose **Amazon Web Services, Inc.**, and then choose **Details**.
4. Choose the **General** tab, if not already selected, and then choose **View Certificate**.
5. Choose the **Details** tab, and then choose **All** in the **Show** dropdown list, if not already selected.
6. Scroll down until you see the **Thumbprint** field and then choose **Thumbprint**. This displays the entire thumbprint value in the lower window.
7. Match the thumbprint value to the following value. If the value matches, move forward with installation. If not, escalate to the AWS SAM team by creating an issue in the *aws-sam-cli GitHub repository*.

```
cd62479397f09d72a04c7399a254b0a91da53d6c
```

Verify the hash value

Linux

x86_64 - command line installer

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 SHA-256 hash value with the one for your desired AWS SAM CLI version in the AWS SAM CLI release notes on GitHub.

macOS

GUI and command line installer

Verify the integrity and authenticity of the downloaded installer by generating a hash value using the following command:

```
$ shasum -a 256 path-to-pkg-installer/name-of-pkg-installer

# Examples
$ shasum -a 256 ~/Downloads/aws-sam-cli-macos-arm64.pkg
$ shasum -a 256 ~/Downloads/aws-sam-cli-macos-x86_64.pkg
```

Compare your 64-character SHA-256 hash value with the corresponding value in the AWS SAM CLI release notes GitHub repository.

Tutorial: Deploy a Hello World application with AWS SAM

In this tutorial, you use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) to complete the following:

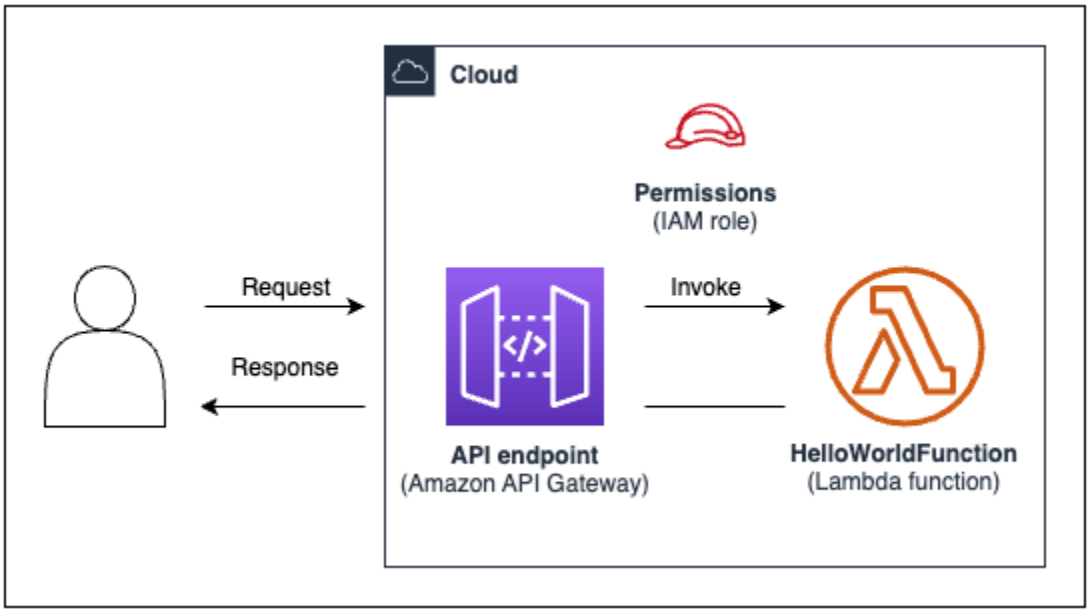
- Initialize, build, and deploy a sample **Hello World** application.
- Make local changes and sync to AWS CloudFormation.

- Perform local testing on your development host.
- Delete the sample application from the AWS Cloud.

The sample **Hello World** application implements a basic API backend. It consists of the following resources:

- **Amazon API Gateway** – API endpoint that you will use to invoke your function.
- **AWS Lambda** – Function that processes the HTTP API GET request and returns a `hello world` message.
- **AWS Identity and Access Management (IAM) role** – Provisions permissions for the services to securely interact.

The following diagram shows the components of this application:



Topics

- Prerequisites
- Step 1: Initialize the sample Hello World application
- Step 2: Build your application
- Step 3: Deploy your application to the AWS Cloud
- Step 4: Run your application
- Step 5: Interact with your function in the AWS Cloud

- Step 6: Modify and sync your application to the AWS Cloud
- Step 7: (Optional) Test your application locally
- Step 8: Delete your application from the AWS Cloud
- Troubleshooting
- Learn more

Prerequisites

Verify that you have completed the following:

- AWS SAM prerequisites
- Install the AWS SAM CLI

> **Note**
>
> If you prefer using Visual Studio Code for serverless development, see Creating serverless applications in the AWS Toolkit for VS Code User Guide for step-by-step instructions using the VS Code interface.

Step 1: Initialize the sample Hello World application

In this step, you will use the AWS SAM CLI to create a sample **Hello World** application project on your local machine.

To initialize the sample Hello World application

1. In your command line, run the following from a starting directory of your choice:

```
$ sam init
```

> **Note**
>
> This command initializes your serverless application and creates a project directory. The directory contains several files and folders, including the `template.yaml` file, which is your AWS SAM template.

The installed Python version must match the `Runtime` property specified in `template.yaml`. For production workloads, we recommend using Python 3.12 or earlier versions that are fully supported in AWS environments. If the Python versions don't match, you'll encounter build errors.
To resolve version compatibility issues:

- Specify a compatible runtime during initialization: `sam init --runtime python3.9`
- Modify the `Runtime` property in `template.yaml` after initialization

2. The AWS SAM CLI will guide you through initializing a new application. Configure the following:

   1. Select **AWS Quick Start Templates** to choose a starting template.
   2. Choose the **Hello World Example** template and download it.
   3. Use the Python runtime and `zip` package type.
   4. For this tutorial, opt out of AWS X-Ray tracing. To learn more, see What is AWS X-Ray? in the *AWS X-Ray Developer Guide*.
   5. For this tutorial, opt out of monitoring with Amazon CloudWatch Application Insights. To learn more, see Amazon CloudWatch Application Insights in the *Amazon CloudWatch User Guide*.
   6. For this tutorial, opt out of setting Structured Logging in JSON format on your Lambda functions.
   7. Name your application as **sam-app**.

   To use the AWS SAM CLI interactive flow:

   - Brackets (`[ ]`) indicate default values. Leave your answer blank to select the default value.
   - Enter **y** for **yes**, and **n** for **no**.

   The following is an example of the `sam init` interactive flow:

```
$ sam init
...
Which template source would you like to use?
    1 - AWS Quick Start Templates
```

```
    2 - Custom Template Location
Choice: 1

Choose an AWS Quick Start application template
    1 - Hello World Example
    2 - Data processing
    3 - Hello World Example with Powertools for AWS Lambda
    4 - Multi-step workflow
    5 - Scheduled task
    6 - Standalone function
    7 - Serverless API
    8 - Infrastructure event management
    9 - Lambda Response Streaming
   10 - GraphQLApi Hello World Example
   11 - Full Stack
   12 - Lambda EFS example
   13 - Serverless Connector Hello World Example
   14 - Multi-step workflow with Connectors
   15 - DynamoDB Example
   16 - Machine Learning
Template: 1

Use the most popular runtime and package type? (Python and zip) [y/N]: y

Would you like to enable X-Ray tracing on the function(s) in your application?  [y/
N]: ENTER

Would you like to enable monitoring using CloudWatch Application Insights?
For more info, please view https://docs.aws.amazon.com/AmazonCloudWatch/latest/
monitoring/cloudwatch-application-insights.html [y/N]: ENTER

Would you like to set Structured Logging in JSON format on your Lambda functions?
 [y/N]: ENTER

Project name [sam-app]: ENTER
```

3. The AWS SAM CLI downloads your starting template and creates the application project directory structure on your local machine. The following is an example of the AWS SAM CLI output:

```
Cloning from https://github.com/aws/aws-sam-cli-app-templates (process may take a
 moment)
```

```
    -----------------------
    Generating application:
    -----------------------
    Name: sam-app
    Runtime: python3.9
    Architectures: x86_64
    Dependency Manager: pip
    Application Template: hello-world
    Output Directory: .
    Configuration file: sam-app/samconfig.toml

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


Commands you can use next
=========================
[*] Create pipeline: cd sam-app && sam pipeline init --bootstrap
[*] Validate SAM template: cd sam-app && sam validate
[*] Test Function in the Cloud: cd sam-app && sam sync --stack-name {stack-name} --
watch
```

4. From your command line, move to the newly created `sam-app` directory. The following is an example of what the AWS SAM CLI has created:

> **Note**
>
> If `tree` command is not auto installed run this command: `brew install tree`

```
$ cd sam-app

$ tree

### README.md
### __init__.py
### events
#   ### event.json
### hello_world
#   ### __init__.py
#   ### app.py
#   ### requirements.txt
### samconfig.toml
```

```
### template.yaml
### tests
    ### __init__.py
    ### integration
    #   ### __init__.py
    #   ### test_api_gateway.py
    ### requirements.txt
    ### unit
        ### __init__.py
        ### test_handler.py

6 directories, 14 files
```

Some important files to highlight:

- `hello_world/app.py` – Contains your Lambda function code.
- `hello_world/requirements.txt` – Contains any Python dependencies that your Lambda function requires.
- `samconfig.toml` – Configuration file for your application that stores default parameters used by the AWS SAM CLI.
- `template.yaml` – The AWS SAM template that contains your application infrastructure code.

You now have a completely authored serverless application on your local machine!

Step 2: Build your application

In this step, you use the AWS SAM CLI to build your application and prepare for deployment. When you build, the AWS SAM CLI creates a `.aws-sam` directory and organizes your function dependencies, project code, and project files there.

To build your application

- In your command line, from the `sam-app` project directory, run the following:

```
$ sam build
```

> **Note**
>
> If you don't have Python on your local machine, use the **sam build --use-container** command instead. The AWS SAM CLI will create a Docker container that includes your function's runtime and dependencies. This command requires Docker on your local machine. To install Docker, see Installing Docker.

The following is an example of the AWS SAM CLI output:

```
$ sam build
Starting Build use cache
Manifest file is changed (new hash: 3298f1304...d4d421) or dependency folder (.aws-
sam/deps/4d3dfad6-a267-47a6-a6cd-e07d6fae318c) is missing for (HelloWorldFunction),
 downloading dependencies and copying/building source
Building codeuri: /Users/.../Demo/sam-tutorial1/sam-app/hello_world runtime:
 python3.9 metadata: {} architecture: x86_64 functions: HelloWorldFunction
Running PythonPipBuilder:CleanUp
Running PythonPipBuilder:ResolveDependencies
Running PythonPipBuilder:CopySource
Running PythonPipBuilder:CopySource

Build Succeeded

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

Commands you can use next
=========================
[*] Validate SAM template: sam validate
[*] Invoke Function: sam local invoke
[*] Test Function in the Cloud: sam sync --stack-name {{stack-name}} --watch
[*] Deploy: sam deploy --guided
```

The following is a shortened example of the `.aws-sam` directory created by the AWS SAM CLI:

```
.aws-sam
### build
#   ### HelloWorldFunction
#   #   ### __init__.py
```

```
#   #   ### app.py
#   #   ### requirements.txt
#   ### template.yaml
### build.toml
```

Some important files to highlight:

- `build/HelloWorldFunction` – Contains your Lambda function code and dependencies. The AWS SAM CLI creates a directory for each function in your application.
- `build/template.yaml` – Contains a copy of your AWS SAM template that is referenced by CloudFormation at deployment.
- `build.toml` – Configuration file that stores default parameter values referenced by the AWS SAM CLI when building and deploying your application.

You are now ready to deploy your application to the AWS Cloud.

Step 3: Deploy your application to the AWS Cloud

> **Note**
>
> This step requires AWS credentials configuration. For more information, see Step 5: Use the AWS CLI to configure AWS credentials in AWS SAM prerequisites.

In this step, you use the AWS SAM CLI to deploy your application to the AWS Cloud. The AWS SAM CLI will do the following:

- Guide you through configuring your application settings for deployment.
- Upload your application files to Amazon Simple Storage Service (Amazon S3).
- Transform your AWS SAM template into an CloudFormation template. It then uploads your template to the CloudFormation service to provision your AWS resources.

To deploy your application

1. In your command line, from the `sam-app` project directory, run the following:

```
$ sam deploy --guided
```

2. Follow the AWS SAM CLI interactive flow to configure your application settings. Configure the following:

   1. The **CloudFormation stack name** – A stack is a collection of AWS resources that you can manage as a single unit. To learn more, see Working with stacks in the *AWS CloudFormation User Guide*.
   2. The **AWS Region** to deploy your CloudFormation stack to. For more information, see CloudFormation endpoints in the *AWS CloudFormation User Guide*.
   3. For this tutorial, opt out of **confirming changes before deploy**.
   4. Allow **IAM role creation** – This lets AWS SAM create the IAM role necessary for your API Gateway resource and Lambda function resource to interact.
   5. For this tutorial, opt out of **disabling rollback**.
   6. Allow **HelloWorldFunction without authorization defined** – This message displays because your API Gateway endpoint is configured to be publicly accessible, without authorization. Since this is the intended configuration for your Hello World application, allow the AWS SAM CLI to continue. For more information about configuring authorization, see Control API access with your AWS SAM template.
   7. **Save arguments to configuration file** – This will update your application's `samconfig.toml` file with your deployment preferences.
   8. Select the default **configuration file name**.
   9. Select the default **configuration environment**.

   The following is an example output of the `sam deploy --guided` interactive flow:

```
$ sam deploy --guided

Configuring SAM deploy
======================

    Looking for config file [samconfig.toml] :  Found
    Reading default arguments  :  Success

    Setting default arguments for 'sam deploy'
    ==========================================
```

```
    Stack Name [sam-app]: ENTER
    AWS Region [us-west-2]: ENTER
    #Shows you resources changes to be deployed and require a 'Y' to initiate
 deploy
    Confirm changes before deploy [Y/n]: n
    #SAM needs permission to be able to create roles to connect to the resources in
 your template
    Allow SAM CLI IAM role creation [Y/n]: ENTER
    #Preserves the state of previously provisioned resources when an operation
 fails
    Disable rollback [y/N]: ENTER
    HelloWorldFunction may not have authorization defined, Is this okay? [y/N]: y
    Save arguments to configuration file [Y/n]: ENTER
    SAM configuration file [samconfig.toml]: ENTER
    SAM configuration environment [default]: ENTER
```

3. The AWS SAM CLI deploys your application by doing the following:

   - The AWS SAM CLI creates an Amazon S3 bucket and uploads your `.aws-sam` directory.
   - The AWS SAM CLI transforms your AWS SAM template into CloudFormation and uploads it to the CloudFormation service.
   - CloudFormation provisions your resources.

   During deployment, the AWS SAM CLI displays your progress. The following is an example output:

```
Looking for resources needed for deployment:

    Managed S3 bucket: aws-sam-cli-managed-default-samclisam-s3-demo-
bucket-1a4x26zbcdkqr
    A different default S3 bucket can be set in samconfig.toml

    Parameter "stack_name=sam-app" in [default.deploy.parameters] is defined as a
 global parameter [default.global.parameters].
    This parameter will be only saved under [default.global.parameters] in /
Users/.../Demo/sam-tutorial1/sam-app/samconfig.toml.

    Saved arguments to config file
    Running 'sam deploy' for future deployments will use the parameters saved
 above.
    The above parameters can be changed by modifying samconfig.toml
    Learn more about samconfig.toml syntax at
```

```
    https://docs.aws.amazon.com/serverless-application-model/latest/developerguide/
serverless-sam-cli-config.html

File with same data already exists at sam-app/da3c598813f1c2151579b73ad788cac8,
 skipping upload

    Deploying with following values
    ===============================
    Stack name                   : sam-app
    Region                       : us-west-2
    Confirm changeset            : False
    Disable rollback             : False
    Deployment s3 bucket         : aws-sam-cli-managed-default-samclisam-s3-demo-
bucket-1a4x26zbcdkqr
    Capabilities                 : ["CAPABILITY_IAM"]
    Parameter overrides          : {}
    Signing Profiles             : {}

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

File with same data already exists at sam-
app/2bebf67c79f6a743cc5312f6dfc1efee.template, skipping upload


Waiting for changeset to be created..

CloudFormation stack changeset
-----------------------------------------------------------------------------------------------
Operation                           LogicalResourceId
 ResourceType                        Replacement
-----------------------------------------------------------------------------------------------
* Modify                            HelloWorldFunction
 AWS::Lambda::Function               False
* Modify                            ServerlessRestApi
 AWS::ApiGateway::RestApi            False
- Delete                            AwsSamAutoDependencyLayerNestedSt
 AWS::CloudFormation::Stack          N/A
                                    ack
-----------------------------------------------------------------------------------------------
```

```
Changeset created successfully. arn:aws:cloudformation:us-
west-2:012345678910:changeSet/samcli-deploy1678917603/22e05525-08f9-4c52-a2c4-
f7f1fd055072


2023-03-15 12:00:16 - Waiting for stack create/update to complete

CloudFormation events from stack operations (refresh every 0.5 seconds)
---------------------------------------------------------------------------------------
ResourceStatus                      ResourceType
 LogicalResourceId                   ResourceStatusReason
---------------------------------------------------------------------------------------
UPDATE_IN_PROGRESS                  AWS::Lambda::Function
 HelloWorldFunction                  -
UPDATE_COMPLETE                     AWS::Lambda::Function
 HelloWorldFunction                  -
UPDATE_COMPLETE_CLEANUP_IN_PROGRE   AWS::CloudFormation::Stack          sam-app
                         -
SS
DELETE_IN_PROGRESS                  AWS::CloudFormation::Stack
 AwsSamAutoDependencyLayerNestedSt   -
                                                                        ack
DELETE_COMPLETE                     AWS::CloudFormation::Stack
 AwsSamAutoDependencyLayerNestedSt   -
                                                                        ack
UPDATE_COMPLETE                     AWS::CloudFormation::Stack          sam-app
                         -
---------------------------------------------------------------------------------------

CloudFormation outputs from deployed stack
---------------------------------------------------------------------------------------
Outputs
---------------------------------------------------------------------------------------
Key                 HelloWorldFunctionIamRole
Description         Implicit IAM Role created for Hello World function
Value               arn:aws:iam::012345678910:role/sam-app-
HelloWorldFunctionRole-15GLOUR9LMT1W

Key                 HelloWorldApi
Description         API Gateway endpoint URL for Prod stage for Hello World
 function
Value               https://<restapiid>.execute-api.us-west-2.amazonaws.com/Prod/
hello/
```

```
Key                 HelloWorldFunction
Description         Hello World Lambda Function ARN
Value               arn:aws:lambda:us-west-2:012345678910:function:sam-app-
HelloWorldFunction-yQDNe17r9maD
-----------------------
```

```
  {
    "LogicalResourceId": "HelloWorldFunction",
    "PhysicalResourceId": "sam-app-HelloWorldFunction-yQDNe17r9maD",
    "CloudEndpoint": "-",
    "Methods": "-"
  },
  {
    "LogicalResourceId": "ServerlessRestApi",
    "PhysicalResourceId": "ets1gv8lxi",
    "CloudEndpoint": [
      "https://ets1gv8lxi.execute-api.us-west-2.amazonaws.com/Prod",
      "https://ets1gv8lxi.execute-api.us-west-2.amazonaws.com/Stage"
    ],
    "Methods": [
      "/hello['get']"
    ]
  }
]
```

To invoke your function

- Using your browser or the command line, send a GET request to your API endpoint. The following is an example using the curl command:

```
$ curl https://ets1gv8lxi.execute-api.us-west-2.amazonaws.com/Prod/hello/
{"message": "hello world"}
```

Step 5: Interact with your function in the AWS Cloud

In this step, you use the AWS SAM CLI to invoke your Lambda function in the AWS Cloud.

To invoke your Lambda function in the cloud

1. Take note of your function's `LogicalResourceId` from the previous step. It should be `HelloWorldFunction`.
2. In your command line, from the `sam-app` project directory, run the following:

```
$ sam remote invoke HelloWorldFunction --stack-name sam-app
```

3. The AWS SAM CLI invokes your function in the cloud and returns a response. The following is an example output:

```
$ sam remote invoke HelloWorldFunction --stack-name sam-app

Invoking Lambda Function HelloWorldFunction
START RequestId: d5ef494b-5f45-4086-86fd-d7322fa1a1f9 Version: $LATEST
END RequestId: d5ef494b-5f45-4086-86fd-d7322fa1a1f9
REPORT RequestId: d5ef494b-5f45-4086-86fd-d7322fa1a1f9  Duration: 6.62 ms
 Billed Duration: 7 ms     Memory Size: 128 MB     Max Memory Used: 67 MB  Init
 Duration: 164.06 ms
{"statusCode":200,"body":"{\"message\":\"hello world\"}"}%
```

Step 6: Modify and sync your application to the AWS Cloud

In this step, you use the AWS SAM CLI **sam sync --watch** command to sync local changes to the AWS Cloud.

To use sam sync

1. In your command line, from the `sam-app` project directory, run the following:

```
$ sam sync --watch
```

2. The AWS SAM CLI prompts you to confirm that you are syncing a development stack. Since the **sam sync --watch** command automatically deploys local changes to the AWS Cloud in real time, we recommend it for development environments only.

   The AWS SAM CLI performs an initial deployment before it begins monitoring for local changes. The following is an example output:

```
$ sam sync --watch
The SAM CLI will use the AWS Lambda, Amazon API Gateway, and AWS StepFunctions APIs
 to upload your code without
performing a CloudFormation deployment. This will cause drift in your
 CloudFormation stack.
**The sync command should only be used against a development stack**.

Confirm that you are synchronizing a development stack.
```

```
Enter Y to proceed with the command, or enter N to cancel:
 [Y/n]: y
Queued infra sync. Waiting for in progress code syncs to complete...
Starting infra sync.
Manifest is not changed for (HelloWorldFunction), running incremental build
Building codeuri: /Users/.../Demo/sam-tutorial1/sam-app/hello_world runtime:
 python3.9 metadata: {} architecture: x86_64 functions: HelloWorldFunction
Running PythonPipBuilder:CopySource

Build Succeeded

Successfully packaged artifacts and wrote output template to file /var/
folders/45/5ct135bx3fn2551_ptl5g6_80000gr/T/tmpq3x9vh63.
Execute the following command to deploy the packaged template
sam deploy --template-file /var/folders/45/5ct135bx3fn2551_ptl5g6_80000gr/T/
tmpq3x9vh63 --stack-name <YOUR STACK NAME>


    Deploying with following values
    ===============================
    Stack name                   : sam-app
    Region                       : us-west-2
    Disable rollback             : False
    Deployment s3 bucket         : aws-sam-cli-managed-default-samclisam-s3-demo-
bucket-1a4x26zbcdkqr
    Capabilities                 : ["CAPABILITY_NAMED_IAM",
 "CAPABILITY_AUTO_EXPAND"]
    Parameter overrides          : {}
    Signing Profiles             : null

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


2023-03-15 13:10:05 - Waiting for stack create/update to complete

CloudFormation events from stack operations (refresh every 0.5 seconds)
---------------------------------------------------------------------------------------------
ResourceStatus                      ResourceType
 LogicalResourceId                   ResourceStatusReason
---------------------------------------------------------------------------------------------
UPDATE_IN_PROGRESS                  AWS::CloudFormation::Stack          sam-app
                           Transformation succeeded
```

```
CREATE_IN_PROGRESS                  AWS::CloudFormation::Stack
 AwsSamAutoDependencyLayerNestedSt   -
                                                                    ack
CREATE_IN_PROGRESS                  AWS::CloudFormation::Stack
 AwsSamAutoDependencyLayerNestedSt   Resource creation Initiated
                                                                    ack
CREATE_COMPLETE                     AWS::CloudFormation::Stack
 AwsSamAutoDependencyLayerNestedSt   -
                                                                    ack
UPDATE_IN_PROGRESS                  AWS::Lambda::Function
 HelloWorldFunction                  -
UPDATE_COMPLETE                     AWS::Lambda::Function
 HelloWorldFunction                  -
UPDATE_COMPLETE_CLEANUP_IN_PROGRE   AWS::CloudFormation::Stack          sam-app
                         -
SS
UPDATE_COMPLETE                     AWS::CloudFormation::Stack          sam-app
                         -
-------------------------------------------------------------------------------------------

CloudFormation outputs from deployed stack
-------------------------------------------------------------------------------------------
Outputs
-------------------------------------------------------------------------------------------
Key                 HelloWorldFunctionIamRole
Description         Implicit IAM Role created for Hello World function
Value               arn:aws:iam::012345678910:role/sam-app-
HelloWorldFunctionRole-15GLOUR9LMT1W

Key                 HelloWorldApi
Description         API Gateway endpoint URL for Prod stage for Hello World
 function
Value               https://ets1gv8lxi.execute-api.us-west-2.amazonaws.com/Prod/
hello/

Key                 HelloWorldFunction
Description         Hello World Lambda Function ARN
Value               arn:aws:lambda:us-west-2:012345678910:function:sam-app-
HelloWorldFunction-yQDNe17r9maD
-------------------------------------------------------------------------------------------



Stack update succeeded. Sync infra completed.
```

```
Infra sync completed.
CodeTrigger not created as CodeUri or DefinitionUri is missing for
 ServerlessRestApi.
```

Next, you will modify your Lambda function code. The AWS SAM CLI will automatically detect this change and sync your application to the AWS Cloud.

To modify and sync your application

1. In your IDE of choice, open the `sam-app/hello_world/app.py` file.
2. Change the `message` and save your file. The following is an example:

```
import json
...
def lambda_handler(event, context):
    ...
    return {
        "statusCode": 200,
        "body": json.dumps({
            "message": "hello everyone!",
            ...
        }),
    }
```

3. The AWS SAM CLI detects your change and syncs your application to the AWS Cloud. The following is an example output:

```
Syncing Lambda Function HelloWorldFunction...
Manifest is not changed for (HelloWorldFunction), running incremental build
Building codeuri: /Users/.../Demo/sam-tutorial1/sam-app/hello_world runtime:
 python3.9 metadata: {} architecture: x86_64 functions: HelloWorldFunction
Running PythonPipBuilder:CopySource
Finished syncing Lambda Function HelloWorldFunction.
```

4. To verify your change, send a GET request to your API endpoint again.

```
$ curl https://ets1gv8lxi.execute-api.us-west-2.amazonaws.com/Prod/hello/
{"message": "hello everyone!"}
```

Step 7: (Optional) Test your application locally

> **Note**
>
> This step is optional.

> **Important**
>
> This step requires Docker on your local machine. You must have Docker installed and configured to use the AWS SAM CLI for local testing. For more information, see Installing Docker.

In this step, you use the AWS SAM CLI **sam local** command to test your application locally. To accomplish this, the AWS SAM CLI creates a local environment using Docker. This local environment emulates the cloud-based execution environment of your Lambda function.

You will do the following:

1. Create a local environment for your Lambda function and invoke it.
2. Host your HTTP API endpoint locally and use it to invoke your Lambda function.

To invoke your Lambda function locally

1. In your command line, from the `sam-app` project directory, run the following:

```
$ sam local invoke
```

2. The AWS SAM CLI creates a local Docker container and invokes your function. The following is an example output:

```
$ sam local invoke
Invoking app.lambda_handler (python3.9)
Local image was not found.
Removing rapid images for repo public.ecr.aws/sam/emulation-python3.9
Building image.....................
Using local image: public.ecr.aws/lambda/python:3.9-rapid-x86_64.
```

```
Mounting /Users/.../Demo/sam-tutorial1/sam-app/.aws-sam/build/HelloWorldFunction
 as /var/task:ro,delegated inside runtime container
START RequestId: b046db01-2a00-415d-af97-35f3a02e9eb6 Version: $LATEST
END RequestId: b046db01-2a00-415d-af97-35f3a02e9eb6
REPORT RequestId: b046db01-2a00-415d-af97-35f3a02e9eb6    Init Duration: 1.01 ms
    Duration: 633.45 ms    Billed Duration: 634 ms    Memory Size: 128 MB    Max
 Memory Used: 128 MB
{"statusCode": 200, "body": "{\"message\": \"hello world\"}"}
```

To host your API locally

1. In your command line, from the `sam-app` project directory, run the following:

```
$ sam local start-api
```

2. The AWS SAM CLI creates a local Docker container for your Lambda function and creates a local HTTP server to simulate your API endpoint. The following is an example output:

```
$ sam local start-api
Initializing the lambda functions containers.
Local image is up-to-date
Using local image: public.ecr.aws/lambda/python:3.9-rapid-x86_64.

Mounting /Users/.../Demo/sam-tutorial1/sam-app/.aws-sam/build/HelloWorldFunction
 as /var/task:ro,delegated inside runtime container
Containers Initialization is done.
Mounting HelloWorldFunction at http://127.0.0.1:3000/hello [GET]
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. If you used sam build before running local
 commands, you will need to re-run sam build for the changes to be picked up. You
 only need to restart AWS SAM CLI if you update your AWS SAM template
2023-03-15 14:25:21 WARNING: This is a development server. Do not use it in a
 production deployment. Use a production WSGI server instead.
 * Running on http://127.0.0.1:3000
2023-03-15 14:25:21 Press CTRL+C to quit
```

3. Using your browser or the command line, send a GET request to your local API endpoint. The following is an example using the curl command:

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

```
{"message": "hello world"}
```

Step 8: Delete your application from the AWS Cloud

In this step, you use the AWS SAM CLI **sam delete** command to delete your application from the AWS Cloud.

To delete your application from the AWS Cloud

1. In your command line, from the `sam-app` project directory, run the following:

```
$ sam delete
```

2. The AWS SAM CLI will ask you to confirm. Then, it will delete your application's Amazon S3 bucket and CloudFormation stack. The following is an example output:

```
$ sam delete
    Are you sure you want to delete the stack sam-app in the region us-west-2 ? [y/
N]: y
    Are you sure you want to delete the folder sam-app in S3 which contains the
 artifacts? [y/N]: y
    - Deleting S3 object with key c6ce8fa8b5a97dd022ecd006536eb5a4
    - Deleting S3 object with key 5d513a459d062d644f3b7dd0c8b56a2a.template
    - Deleting S3 object with key sam-app/2bebf67c79f6a743cc5312f6dfc1efee.template
    - Deleting S3 object with key sam-app/6b208d0e42ad15d1cee77d967834784b.template
    - Deleting S3 object with key sam-app/da3c598813f1c2151579b73ad788cac8
    - Deleting S3 object with key sam-app/f798cdd93cee188a71d120f14a035b11
    - Deleting Cloudformation stack sam-app

Deleted successfully
```

Troubleshooting

To troubleshoot the AWS SAM CLI, see AWS SAM CLI troubleshooting.

Learn more

To continue learning about AWS SAM, see the following resources:

- **The Complete AWS SAM Workshop** – A workshop designed to teach you many of the major features that AWS SAM provides.
- **Sessions with SAM** – Video series created by our AWS Serverless Developer Advocate team on using AWS SAM.
- **Serverless Land** – Site that brings together the latest information, blogs, videos, code, and learning resources for AWS serverless.

Converting Lambda Functions to AWS SAM Applications

If you have a function in the Lambda console that you want to manage in VS Code as infrastructure as code (IaC), you can transfer it to VS Code and then convert it to an AWS SAM template. With your function converted to an AWS SAM template, you can control the versioning of your infrastructure, automate deployments, remotely debug functions, and maintain consistent environments across your development lifecycle. With local and remote debugging capabilities, you can also troubleshoot issues more effectively by stepping through your code, inspecting variables, and setting breakpoints both locally and in the AWS cloud.

For instructions on moving your functions from the console and setting up local development, see Developing Lambda functions locally with VS Code in the *AWS Lambda Developer Guide*. Follow these instructions to move a Lambda function from the console to VS Code and then convert it to an AWS SAM template. After doing this, you can:

- **Remotely debug your function in the AWS cloud.** For details, see Remotely debug Lambda functions with VS Code in the *AWS Lambda Developer Guide*.
- **Manage associated resources and permissions as infrastructure as code.** For details, see Using Lambda with infrastructure as code (IaC) in the *AWS Lambda Developer Guide*
- **Deploy and update your application using the AWS SAM CLI.** For details, see AWS SAM CLI.
- **Visually design your serverless architecture using Infrastructure Composer.** For details, refer to the Infrastructure Composer Developer Guide.

Learn more

To continue learning about AWS SAM, see the following resources:

- **The Complete AWS SAM Workshop** – A workshop designed to teach you many of the major features that AWS SAM provides.

- **Sessions with SAM** – Video series created by our AWS Serverless Developer Advocate team on using AWS SAM.
- **Serverless Land** – Site that brings together the latest information, blogs, videos, code, and learning resources for AWS serverless.

How to use AWS Serverless Application Model (AWS SAM)

The primary tools you use to develop your application are the **AWS SAM CLI** and the **AWS SAM template and AWS SAM project** (which is your application project directory). You use these tools to:

1. Develop your application (this includes initializing your application, defining your resources, and building your application).
2. Test your application.
3. Debug your application.
4. Deploy your application and resources.
5. Monitor your application.

AWS SAM creates your AWS SAM project after you run the **sam init** command and complete its subsequent workflow. You define your serverless application by adding code to your AWS SAM project. While your AWS SAM project consists of a set of files and folders, the most important file in it is your AWS SAM template (named `template.yaml`). In this template, you write your code to express resources, event source mappings, and other properties that define your serverless application.

The AWS SAM CLI contains a repository of commands you use on your AWS SAM project. More specifically, the AWS SAM CLI is what you use to build, transform, deploy, debug, package, initialize, and sync your AWS SAM project. In other words, it's what you use to turn your AWS SAM project into your serverless application.

For more details on these tools, see the following chapters:

AWS SAM CLI - Learn about the AWS SAM CLI and how to use it to build and run your serverless applications.

AWS SAM project and AWS SAM template - Learn about the AWS SAM project structure and how to use the AWS SAM template to define your serverless application.

AWS SAM CLI

AWS Serverless Application Model Command Line Interface (AWS SAM CLI) is a command-line tool for local development and testing of serverless applications. The AWS SAM CLI allows you to build, transform, deploy, debug, package, initialize, and sync your serverless applications locally before deploying to the cloud.

AWS SAM CLI works with serverless applications that are defined using different frameworks and infrastructure as code (IaC) tools, with varying levels of support:

- **AWS SAM templates** – Provides native support with the full feature set, including local testing, debugging, packaging, and deployment capabilities.
- **AWS CDK applications** – Supports local testing of Lambda functions after you synthesize the AWS CDK application to CloudFormation templates using the cdk synth command.
- **CloudFormation templates** – Offers direct compatibility because AWS SAM extends CloudFormation, supporting serverless resources that are defined in standard CloudFormation templates.
- **Terraform applications** – Provides limited support for building and local testing of Lambda functions. Requires you to generate AWS SAM template artifacts that represent your Terraform-defined Lambda functions.

For the most comprehensive feature support and streamlined developer experience, we recommend using native AWS SAM templates.

Topics

- How AWS SAM CLI commands are documented
- Configuring the AWS SAM CLI
- AWS SAM CLI core commands
- Local testing with AWS SAM CLI

How AWS SAM CLI commands are documented

AWS SAM CLI commands are documented using the following format:

- **Prompt** – The Linux prompt is documented by default and is displayed as (`$ `). For commands that are Windows specific, (`> `) is used as the prompt. Do not include the prompt when you type commands.
- **Directory** – When commands must be executed from a specific directory, the directory name is shown before the prompt symbol.
- **User input** – Command text that you enter at the command line is formatted as **`user input`**.
- **Replaceable text** – Variable text, such as file names and parameters are formatted as *`replaceable text`*. In multiple-line commands or commands where specific keyboard input is required, keyboard input can also be shown as replaceable text. For example, *ENTER*.
- **Output** – Output returned as a response to the command is formatted as `computer output`.

The following `sam deploy` command and output is an example:

```
$ sam deploy --guided --template template.yaml

Configuring SAM deploy
======================

    Looking for config file [samconfig.toml] :  Found
    Reading default arguments  :  Success

    Setting default arguments for 'sam deploy'
    =========================================
    Stack Name [sam-app]: ENTER
    AWS Region [us-west-2]: ENTER
    #Shows you resources changes to be deployed and require a 'Y' to initiate deploy
    Confirm changes before deploy [y/N]: ENTER
    #SAM needs permission to be able to create roles to connect to the resources in
 your template
    Allow SAM CLI IAM role creation [Y/n]: ENTER
    #Preserves the state of previously provisioned resources when an operation fails
    Disable rollback [y/N]: ENTER
    HelloWorldFunction may not have authorization defined, Is this okay? [y/N]: y
    Save arguments to configuration file [Y/n]: ENTER
    SAM configuration file [samconfig.toml]: ENTER
    SAM configuration environment [default]: ENTER
```

1. `sam deploy --guided --template template.yaml` is the command you enter at the command line.

2. **`sam deploy --guided --template`** should be provided as is.
3. *`template.yaml`* can be replaced with your specific file name.
4. The output starts at `Configuring SAM deploy`.
5. In the output, *`ENTER`* and *`y`* indicate replaceable values that you provide.

Configuring the AWS SAM CLI

One of the benefits of AWS SAM is that it optimizes a developer's time by removing repetitive tasks. AWS SAM CLI includes a configuration file named `samconfig` for this purpose. By default, no configuration to the AWS SAM CLI is needed, but you can update your configuration file to allow you to run commands with fewer parameters by allowing AWS SAM to instead reference your customized parameters in your configuration file. The examples in the following table show how you can optimize your commands:

Original	Optimized with `samconfig`
sam build --cached --parallel --use-containers	**sam build**
sam local invoke --env-vars locals.json	**sam local invoke**
sam local start-api --env-vars locals.json --warm-containers EAGER	**sam local start-api**

The AWS SAM CLI provides a set of commands to help developers create, develop, and deploy serverless applications. Each of these commands is configurable with optional flags based on the preferences of the application and developer. For more information, see the AWS SAM CLI content in GitHub

The topics in this section show you how to create your AWS SAM CLI configuration file and customize its default settings to optimize development time for your serverless application.

Topics

- How to create your configuration file (the samconfig file)
- Configure project settings
- Configure credentials and basic settings

How to create your configuration file (the `samconfig` file)

The AWS SAM CLI configuration file (filename `samconfig`) is a text file that typically uses the TOML structure, but can also be in YAML. When using an AWS Quick Start Template, this file is created when you run the **sam init** command. You can update this file when you deploy an application using the **sam deploy -\-guided** command.

After the deployment is complete, the `samconfig` file contains a profile named `default` if you used the default values. When you rerun the **deploy** command, AWS SAM applies the stored configuration settings from this profile.

The benefit of the `samconfig` file is that AWS SAM stores configuration settings for any other commands available in addition to the deploy command. Beyond these values created at a new deploy, there are a number of attributes that you can set in the `samconfig` file that can simplify other aspects of the developer workflow with AWS SAM CLI.

Configure project settings

You can specify project-specific settings, such as AWS SAM CLI command parameter values, in a configuration file to use with the AWS SAM CLI. For more information about this configuration file, see AWS SAM CLI configuration file.

Using configuration files

Configuration files are structured by environment, command, and parameter value. For more information, see Configuration file basics.

To configure a new environment

1. Specify your new environment in your configuration file.

   The following is an example of specifying a new `prod` environment:

   TOML

   ```
   [prod.global.parameters]
   ```

   YAML

   ```
   prod:
   ```

```
  global:
    parameters:
```

2. Specify parameter values as key-value pairs in the parameters section of the configuration file.

   The following is an example of specifying your application's stack name for the `prod` environment.

   TOML

   ```
   [prod.global.parameters]
   stack_name = "prod-app"
   ```

   YAML

   ```
   prod:
     global:
       parameters:
         stack_name: prod-app
   ```

3. Use the `--config-env` option to specify the environment to use.

   The following is an example:

   ```
   $ sam deploy --config-env "prod"
   ```

To configure parameter values

1. Specify the AWS SAM CLI command that you'd like to configure parameter values for. To configure parameter values for all AWS SAM CLI commands, use the `global` identifier.

   The following is an example of specifying parameter values for the `default` environment's `sam deploy` command:

   TOML

   ```
   [default.deploy.parameters]
   confirm_changeset = true
   ```

YAML

```
default:
  deploy:
    parameters:
      confirm_changeset: true
```

The following is an example of specifying parameter values for all AWS SAM CLI commands in the `default` environment:

TOML

```
[default.global.parameters]
stack_name = "sam-app"
```

YAML

```
default:
  global:
    parameters:
      stack_name: sam-app
```

2. You can also specify parameter values and modify your configuration file through the AWS SAM CLI interactive flow.

   The following is an example of the `sam deploy --guided` interactive flow:

```
$ sam deploy --guided

Configuring SAM deploy
======================

    Looking for config file [samconfig.toml] :  Found
    Reading default arguments  :  Success

    Setting default arguments for 'sam deploy'
    =========================================
    Stack Name [sam-app]: ENTER
    AWS Region [us-west-2]: ENTER
```

```
   #Shows you resources changes to be deployed and require a 'Y' to initiate
deploy
   Confirm changes before deploy [Y/n]: n
   #SAM needs permission to be able to create roles to connect to the resources in
your template
   Allow SAM CLI IAM role creation [Y/n]: ENTER
   #Preserves the state of previously provisioned resources when an operation
fails
   Disable rollback [y/N]: ENTER
   HelloWorldFunction may not have authorization defined, Is this okay? [y/N]: y
   Save arguments to configuration file [Y/n]: ENTER
   SAM configuration file [samconfig.toml]: ENTER
   SAM configuration environment [default]: ENTER
```

For more information, see Creating and modifying configuration files.

Examples

Basic TOML example

The following is an example of a `samconfig.toml` configuration file:

```
...
version = 0.1

[default]
[default.global]
[default.global.parameters]
stack_name = "sam-app"

[default.build.parameters]
cached = true
parallel = true

[default.deploy.parameters]
capabilities = "CAPABILITY_IAM"
confirm_changeset = true
resolve_s3 = true

[default.sync.parameters]
watch = true

[default.local_start_api.parameters]
```

```
warm_containers = "EAGER"

[prod]
[prod.sync]
[prod.sync.parameters]
watch = false
```

Basic YAML example

The following is an example of a `samconfig.yaml` configuration file:

```
version 0.1
default:
  global:
    parameters:
      stack_name: sam-app
  build:
    parameters:
      cached: true
      parallel: true
  deploy:
    parameters:
      capabilities: CAPABILITY_IAM
      confirm_changeset: true
      resolve_s3: true
  sync:
    parameters:
      watch: true
  local_start_api:
    parameters:
      warm_containers: EAGER
prod:
  sync:
    parameters:
      watch: false
```

Configure credentials and basic settings

Use the AWS Command Line Interface (AWS CLI) to configure basic settings such as AWS credentials, default region name, and default output format. Once configured, you can use these settings with the AWS SAM CLI. To learn more, see the following from the *AWS Command Line Interface User Guide*:

- Configuration basics
- Configuration and credential file settings
- Named profiles for the AWS CLI
- Using an IAM Identity Center enabled named profile

For quick setup instructions, see Step 5: Use the AWS CLI to configure AWS credentials.

AWS SAM CLI core commands

AWS SAM CLI has some basic commands you use to create, build, test, deploy, and sync your serverless application. The table below lists these commands and provides links with more information for each.

For a complete list of AWS SAM CLI commands, see AWS SAM CLI command reference.

Command	What it does	Related topics
sam build	Prepares an application for subsequent steps in the developer workflow, such as local testing or deploying to the AWS Cloud.	• Introduction to building with AWS SAM • sam build
sam deploy	Deploys an application to the AWS Cloud using CloudFormation.	• Introduction to deploying with AWS SAM • sam deploy
sam init	Provides options to initialize and create a new serverless application.	• Create your application in AWS SAM • sam init
sam local	Provides subcommands to test your serverless applications locally.	• Introduction to testing with the sam local command • sam local generate-event • sam local invoke • sam local start-api

Command	What it does	Related topics
		• sam local start-lambda
sam remote invoke	Provides a way to interact with supported AWS resources in the AWS Cloud.	• Introduction to testing in the cloud with sam remote invoke • sam remote invoke
sam remote test-event	Provides a way to access and manage shareable test events for your AWS Lambda functions.	• Introduction to cloud testing with sam remote test-event • sam remote test-event
sam sync	Provides options to quickly sync local application changes to the AWS Cloud.	• Introduction to using sam sync to sync to AWS Cloud • sam sync

Local testing with AWS SAM CLI

The AWS SAM CLI enables you to test serverless applications locally across different infrastructure as code (IaC) tools. This guide explains how to use the AWS SAM CLI for local testing with various IaC frameworks.

Key benefits of using AWS SAM CLI for local testing include:

- **Rapid development** - Test code changes without deploying to AWS
- **Cost efficiency** - Develop and test without incurring AWS charges
- **Offline capability** - Work on your applications without an internet connection
- **Simplified debugging** - Step through Lambda function code locally using a debugger
- **Realistic testing** - Test your applications using local emulation of AWS services

Test AWS SAM applications locally

For information about testing applications defined using AWS SAM templates, see Testing and debugging serverless applications in this guide.

Test CloudFormation templates locally

To use the AWS SAM CLI's local testing capabilities with CloudFormation, add the AWS SAM transform to your CloudFormation template. For more information, see AWS SAM template anatomy for:

- Adding AWS SAM transform to CloudFormation templates
- Understanding template compatibility
- Exploring serverless resource syntax

Test AWS CDK applications locally

You can use the AWS SAM CLI to test AWS CDK applications locally after you synthesize the AWS CDK application to CloudFormation templates using the cdk synth command.

For more information, look at Locally test and build AWS CDK applications with the AWS SAM CLI in the AWS CDK developer guide. This includes:

- Getting started with locally testing
- Local testing AWS CDK applications with AWS SAM

Test Terraform applications locally

The AWS SAM CLI supports Terraform projects and Terraform Cloud. You can use it to perform local debugging and testing of: Lambda functions and layers and the Amazon API Gateway HTTP and REST APIs.

To set up your environment and learn about all available features, see Terraform Support in this guide. This includes:

- Getting started with Terraform support for AWS SAM CLI
- Using the AWS SAM CLI with Terraform for local debugging and testing

AWS SAM template

After you run the **sam init** command and complete its subsequent workflow, AWS SAM creates your application project directory, which is your AWS SAM project. You define your serverless application by adding code to your AWS SAM project. While your AWS SAM project consists of a set of files and folders, the file you primarily work with is your AWS SAM template (named `template.yaml`). In this template, you write the code to express resources, event source mappings, and other properties that define your serverless application.

> **Note**
>
> A key element of the AWS SAM template is the AWS SAM template specification. This specification provides the short-hand syntax that, when compared to CloudFormation, allows to you use fewer lines of code to to define the resources, event source mappings, permissions, APIs, and other properties of your serverless application.

This section provides details on how you use sections in the AWS SAM template to define resources types, resource properties, data types, resource attributes, intrinsic functions, and API Gateway extensions.

AWS SAM templates are an extension of CloudFormation templates, with unique syntax types that use shorthand syntax with fewer lines of code than CloudFormation. This speeds up your development when building a serverless application. For more information, refer to AWS SAM resources and properties. For the full reference for CloudFormation templates, see CloudFormation Template Reference in the *AWS CloudFormation User Guide*.

When developing, you will often find it beneficial to break up your application code into separate files to better organize and manage your application. A basic example of this is using a separate file for your AWS Lambda function code rather than having this code in your AWS SAM template. Do this by organizing your Lambda function code in a subdirectory of your project and referencing its local path within your AWS Serverless Application Model (AWS SAM) template.

Topics

- AWS SAM template anatomy
- AWS SAM resources and properties
- Generated CloudFormation resources for AWS SAM

- Resource attributes supported by AWS SAM
- API Gateway extensions for AWS SAM
- Intrinsic functions for AWS SAM

AWS SAM template anatomy

An AWS SAM template file closely follows the format of an CloudFormation template file, which is described in Template anatomy in the *AWS CloudFormation User Guide*. The primary differences between AWS SAM template files and 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 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`, `AWS::Serverless::CapacityProvider`, `AWS::Serverless::HttpApi`, `AWS::Serverless::SimpleTable`, and `AWS::Serverless::StateMachine` 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.
- **Resources section.** In AWS SAM templates the `Resources` section can contain a combination of CloudFormation resources and AWS SAM resources. For more information about 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 resources and properties.

All other sections of an AWS SAM template file correspond to the 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, if using language extensions, you should add `AWS::LanguageExtensions` *before* the serverless transform (that is, before `AWS::Serverless-2016-10-31`) as shown in the following example:

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

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)

Properties that are common to all your serverless functions, APIs, and simple tables. All the `AWS::Serverless::Function`, `AWS::Serverless::Api`, `AWS::Serverless::CapacityProvider`, `AWS::Serverless::HttpApi`, `AWS::Serverless::SimpleTable`, and `AWS::Serverless::StateMachine` 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 CloudFormation templates.

Description (optional)

A text string that describes the template.

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

Metadata (optional)

Objects that provide additional information about the template.

This section corresponds directly with the `Metadata` section of 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. Objects that are declared in the `Parameters` section cause the **sam deploy --guided** command to present additional prompts to the user.

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

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 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 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 CloudFormation templates. In AWS SAM templates, this section can contain AWS SAM resources in addition to 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 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 and follow the instructions in Tutorial: Deploy a Hello World application with AWS SAM.

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 supports the following AWS SAM resource types:

- `AWS::Serverless::Api`
- `AWS::Serverless::CapacityProvider`
- `AWS::Serverless::Function`
- `AWS::Serverless::HttpApi`
- `AWS::Serverless::SimpleTable`
- `AWS::Serverless::StateMachine`

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

  CapacityProvider:
    InstanceRequirements:
    KmsKeyArn:
    OperatorRole:
    PropagateTags:
    ScalingConfig:
    Tags:
    VpcConfig:

  Function:
    Architectures:
    AssumeRolePolicyDocument:
    AutoPublishAlias:
```

```
    AutoPublishAliasAllProperties:
    CapacityProviderConfig:
    CodeSigningConfigArn:
    CodeUri:
    DeadLetterQueue:
    DeploymentPreference:
    Description:
    DurableConfig:
    Environment:
    EphemeralStorage:
    EventInvokeConfig:
    FileSystemConfigs:
    FunctionScalingConfig:
    FunctionUrlConfig:
    Handler:
    KmsKeyArn:
    Layers:
    LoggingConfig:
    MemorySize:
    PermissionsBoundary:
    PropagateTags:
    ProvisionedConcurrencyConfig:
    PublishToLatestPublished:
    RecursiveLoop:
    ReservedConcurrentExecutions:
    RolePath:
    Runtime:
    RuntimeManagementConfig:
    SnapStart:
    SourceKMSKeyArn:
    Tags:
    TenancyConfig:
    Timeout:
    Tracing:
    VersionDeletionPolicy:
    VpcConfig:

  HttpApi:
    AccessLogSettings:
    Auth:
    PropagateTags:
    StageVariables:
    Tags:
```

```
  SimpleTable:
    SSESpecification:

  StateMachine:
    PropagateTags:
```

> **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: python3.9
```

The `Runtime` for `MyFunction` is set to `python3.9`.

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 resources and properties

This section desribes the resource and property types that are specific to AWS SAM. You define these resources and properties using the AWS SAM shorthand syntax. AWS SAM also supports CloudFormation resource and property types. For reference information for all the AWS resource and property types CloudFormation and AWS SAM support, see AWS resource and property types reference in the *AWS CloudFormation User Guide*.

Topics

- AWS::Serverless::Api
- AWS::Serverless::Application

- AWS::Serverless::CapacityProvider
- AWS::Serverless::Connector
- AWS::Serverless::Function
- AWS::Serverless::GraphQLApi
- AWS::Serverless::HttpApi
- AWS::Serverless::LayerVersion
- AWS::Serverless::SimpleTable
- AWS::Serverless::StateMachine

AWS::Serverless::Api

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

An AWS::Serverless::Api 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 resources defined in the template that do not refer to an AWS::Serverless::Api resource.

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

We recommend that you use CloudFormation hooks or IAM policies to verify that API Gateway resources have authorizers attached to them to control access to them.

For more information about using CloudFormation hooks, see Registering hooks in the *CloudFormation CLI user guide* and the apigw-enforce-authorizer GitHub repository.

For more information about using IAM policies, see Require that API routes have authorization in the *API Gateway Developer Guide*.

> **Note**
>
> When you deploy to AWS CloudFormation, AWS SAM transforms your AWS SAM resources into CloudFormation resources. For more information, see Generated CloudFormation resources for AWS SAM.

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
  AlwaysDeploy: Boolean
  ApiKeySourceType: String
  Auth: ApiAuth
  BinaryMediaTypes: List
  CacheClusterEnabled: Boolean
  CacheClusterSize: String
  CanarySetting: CanarySetting
  Cors: String | CorsConfiguration
  DefinitionBody: JSON
  DefinitionUri: String | ApiDefinition
  Description: String
  DisableExecuteApiEndpoint: Boolean
  Domain: DomainConfiguration
  EndpointConfiguration: EndpointConfiguration
  FailOnWarnings: Boolean
  GatewayResponses: Map
  MergeDefinitions: Boolean
  MethodSettings: MethodSettings
  MinimumCompressionSize: Integer
  Mode: String
  Models: Map
  Name: String
  OpenApiVersion: String
  PropagateTags: Boolean
  Policy: JSON
  StageName: String
  Tags: Map
  TracingEnabled: Boolean
  Variables: Map
```

Properties

`AccessLogSetting`

Configures Access Log Setting for a stage.

Type: AccessLogSetting

Required: No

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

`AlwaysDeploy`

Always deploys the API, even when no changes to the API have been detected.

Type: Boolean

Required: No

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

`ApiKeySourceType`

The source of the API key for metering requests according to a usage plan. Valid values are `HEADER` and `AUTHORIZER`.

Type: String

Required: No

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

`Auth`

Configure authorization to control access to your API Gateway API.

For more information about configuring access using AWS SAM see Control API access with your AWS SAM template. For an example showing how to override a global authorizer, see the section called “Override a global authorizer for your Amazon API Gateway REST API”.

Type: ApiAuth

Required: No

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

`BinaryMediaTypes`

List of MIME types that your API could return. Use this to enable binary support for APIs.

Type: List

Required: No

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 CloudFormation resource and the OpenAPI document.

`CacheClusterEnabled`

Indicates whether caching is enabled for the stage. To cache responses, you must also set `CachingEnabled` to `true` under `MethodSettings`.

Type: Boolean

Required: No

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

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

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. Create an inline OpenAPI definition in the `DefinitionBody` to turn on CORS.

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

Type: String | CorsConfiguration

Required: No

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

To reference a local OpenAPI file that defines your API, use the `AWS::Include` transform. To learn more, see How AWS SAM uploads local files.

Type: JSON

Required: No

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

Required: No

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

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

`DisableExecuteApiEndpoint`

Specifies whether clients can invoke your API by using the default `execute-api` endpoint. By default, clients can invoke your API with the default `https://{api_id}.execute-api.{region}.amazonaws.com`. To require that clients use a custom domain name to invoke your API, specify `True`.

Type: Boolean

Required: No

CloudFormation compatibility: This property is similar to the `DisableExecuteApiEndpoint` property of an `AWS::ApiGateway::RestApi` resource. It is passed directly to the `disableExecuteApiEndpoint` property of an `x-amazon-apigateway-endpoint-configuration` extension, which gets added to the `Body` property of an `AWS::ApiGateway::RestApi` resource.

`Domain`

Configures a custom domain for this API Gateway API.

Type: DomainConfiguration

Required: No

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

`EndpointConfiguration`

The endpoint type of a REST API.

Type: EndpointConfiguration

Required: No

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

`FailOnWarnings`

Specifies whether to roll back the API creation (`true`) or not (`false`) when a warning is encountered. The default value is `false`.

Type: Boolean

Required: No

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

`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

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

`MergeDefinitions`

AWS SAM generates an OpenAPI specification from your API event source. Specify `true` to have AWS SAM merge this into the inline OpenAPI specification defined in your `AWS::Serverless::Api` resource. Specify `false` to not merge.

`MergeDefinitions` requires the `DefinitionBody` property for `AWS::Serverless::Api` to be defined. `MergeDefinitions` is not compatible with the `DefinitionUri` property for `AWS::Serverless::Api`.

Default value: `false`

Type: Boolean

Required: No

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

`MethodSettings`

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

Type: List of MethodSetting

Required: No

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

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

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

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

`Name`

A name for the API Gateway RestApi resource

Type: String

Required: No

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**
>
> AWS SAM creates a stage called `Stage` by default. Setting this property to any valid value will prevent the creation of the stage `Stage`.

Type: String

Required: No

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

`PropagateTags`

Indicate whether or not to pass tags from the `Tags` property to your AWS::Serverless::Api generated resources. Specify `True` to propagate tags in your generated resources.

Type: Boolean

Required: No

Default: `False`

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

`Policy`

A policy document that contains the permissions for the API. To set the ARN for the policy, use the `!Join` intrinsic function with `""` as delimiter and values of `"execute-api:/"` and `"*"`.

Type: JSON

Required: No

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

`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 resource is specified, see CloudFormation resources generated when AWS::Serverless::Api is specified. For general information about generated CloudFormation resources, see Generated CloudFormation resources for AWS SAM.

Type: String

Required: Yes

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

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

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

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 method at the root resource via an Api event
    Type: AWS::Serverless::Function
    Properties:
      Events:
        ApiEvent:
          Type: Api
          Properties:
            Path: /
            Method: get
            RestApiId:
              Ref: ApiGatewayApi
      Runtime: python3.10
      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 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 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 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
```

Caching example

A Hello World AWS SAM template file that contains a Lambda Function with an API endpoint. The API has caching enabled for one resource and method. For more information about caching, see Enabling API caching to enhance responsiveness in the *API Gateway Developer Guide*.

YAML

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
Description: AWS SAM template with a simple API definition with caching turned on
Resources:
  ApiGatewayApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: prod
```

```
      CacheClusterEnabled: true
      CacheClusterSize: '0.5'
      MethodSettings:
        - ResourcePath: /
          HttpMethod: GET
          CachingEnabled: true
          CacheTtlInSeconds: 300
      Tags:
        CacheMethods: All

  ApiFunction: # Adds a GET method at the root resource via an Api event
    Type: AWS::Serverless::Function
    Properties:
      Events:
        ApiEvent:
          Type: Api
          Properties:
            Path: /
            Method: get
            RestApiId:
              Ref: ApiGatewayApi
      Runtime: python3.10
      Handler: index.handler
      InlineCode: |
        def handler(event, context):
            return {'body': 'Hello World!', 'statusCode': 200}
```

Custom domain with a private API example

A Hello World AWS SAM template file that contains a Lambda function with an API endpoint mapped to a private domain. The template creates a domain access association between a VPC endpoint and the private domain. For more information, see Custom domain names for private APIs in API Gateway.

YAML

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
Description: AWS SAM template configured with a custom domain using a private API

Parameters:
    DomainName:
      Type: String
```

```
      Default: mydomain.example.com
    CertificateArn:
      Type: String
    HostedZoneId:
      Type: String
    VpcEndpointId:
      Type: String
    VpcEndpointDomainName:
      Type: String
    VpcEndpointHostedZoneId:
      Type: String

Resources:
  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      InlineCode: |
        def handler(event, context):
            return {'body': 'Hello World!', 'statusCode': 200}
      Handler: index.handler
      Runtime: python3.13
      Events:
        Fetch:
          Type: Api
          Properties:
            RestApiId:
              Ref: MyApi
            Method: Get
            Path: /get
  MyApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      EndpointConfiguration:
        Type: PRIVATE
        VPCEndpointIds:
        - !Ref VpcEndpointId
      Policy:
        Version: '2012-10-17       '
        Statement:
        - Effect: Allow
          Principal: '*'
          Action: execute-api:Invoke
          Resource: execute-api:/*
```

```
        - Effect: Deny
          Principal: '*'
          Action: execute-api:Invoke
          Resource: execute-api:/*
          Condition:
            StringNotEquals:
              aws:SourceVpce: !Ref VpcEndpointId
      Domain:
        DomainName: !Ref DomainName
        CertificateArn: !Ref CertificateArn
        EndpointConfiguration: PRIVATE
        BasePath:
        - /
        Route53:
          HostedZoneId: !Ref HostedZoneId
          VpcEndpointDomainName: !Ref VpcEndpointDomainName
          VpcEndpointHostedZoneId: !Ref VpcEndpointHostedZoneId
        AccessAssociation:
          VpcEndpointId: !Ref VpcEndpointId
        Policy:
          Version: '2012-10-17       '
          Statement:
          - Effect: Allow
            Principal: '*'
            Action: execute-api:Invoke
            Resource: execute-api:/*
          - Effect: Deny
            Principal: '*'
            Action: execute-api:Invoke
            Resource: execute-api:/*
            Condition:
              StringNotEquals:
                aws:SourceVpce: !Ref VpcEndpointId
```

ApiAuth

Configure authorization to control access to your API Gateway API.

For more information and examples for configuring access using AWS SAM see Control API access with your AWS SAM template.

Syntax

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

YAML

```yaml
  AddApiKeyRequiredToCorsPreflight: Boolean
  AddDefaultAuthorizerToCorsPreflight: Boolean
  ApiKeyRequired: Boolean
  Authorizers: CognitoAuthorizer | LambdaTokenAuthorizer | LambdaRequestAuthorizer |
AWS_IAM
  DefaultAuthorizer: String
  InvokeRole: String
  ResourcePolicy: ResourcePolicyStatement
  UsagePlan: ApiUsagePlan
```

> **Note**
>
> The `Authorizers` property includes `AWS_IAM`, but there is no extra configuration needed for `AWS_IAM`. For an example, see AWS IAM.

Properties

`AddApiKeyRequiredToCorsPreflight`

If the `ApiKeyRequired` and `Cors` properties are set, then setting `AddApiKeyRequiredToCorsPreflight` will cause the API key to be added to the `Options` property.

Type: Boolean

Required: No

Default: `True`

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

`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

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

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

`Authorizers`

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

For more information, see Control API access with your AWS SAM template.

Type: CognitoAuthorizer | LambdaTokenAuthorizer | LambdaRequestAuthorizer | AWS_IAM

Required: No

Default: None

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

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

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

`ResourcePolicy`

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

Type: ResourcePolicyStatement

Required: No

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

Additional notes: This setting can also be defined on individual `AWS::Serverless::Function` using the ApiFunctionAuth. 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 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. For general information about generated CloudFormation resources, see Generated CloudFormation resources for AWS SAM.

Type: ApiUsagePlan

Required: No

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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"
          }
        }
    }]
    IpRangeDenylist:
      - "10.20.30.40"
```

AWS IAM

AWS IAM example

YAML

```
Auth:
  Authorizers: AWS_IAM
```

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.

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

Type: String

Required: Yes

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

`Description`

A description of the usage plan.

Type: String

Required: No

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

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

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

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

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 Control API access with your AWS SAM template.

Syntax

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

YAML

```
  AuthorizationScopes: List
  Identity: CognitoAuthorizationIdentity
```

```
  UserPoolArn: String
```

Properties

`AuthorizationScopes`

List of authorization scopes for this authorizer.

Type: List

Required: No

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

`Identity`

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

Type: CognitoAuthorizationIdentity

Required: No

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

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

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

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

`ValidationExpression`

Specify a validation expression for validating the incoming Identity

Type: String

Required: No

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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 Control API access with your AWS SAM template.

Syntax

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

YAML

```
DisableFunctionDefaultPermissions: Boolean
FunctionArn: String
FunctionInvokeRole: String
FunctionPayloadType: String
Identity: LambdaRequestAuthorizationIdentity
```

Properties

`DisableFunctionDefaultPermissions`

Specify `true` to prevent AWS SAM from automatically creating an `AWS::Lambda::Permissions` resource to provision permissions between your `AWS::Serverless::Api` resource and authorizer Lambda function.

Default value: `false`

Type: Boolean

Required: No

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

`FunctionArn`

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

> **Note**
>
> AWS SAM will automatically create an `AWS::Lambda::Permissions` resource when `FunctionArn` is specified for `AWS::Serverless::Api`. The

`AWS::Lambda::Permissions` resource provisions permissions between your API and authorizer Lambda function.

Type: String

Required: Yes

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

`FunctionInvokeRole`

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

Type: String

Required: No

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

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

Required: Conditional

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

Examples

LambdaRequestAuth

YAML

```
Authorizers:
  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

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

`Headers`

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

Type: List

Required: No

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

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

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

`StageVariables`

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

Type: List

Required: No

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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 Control API access with your AWS SAM template.

Syntax

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

YAML

```yaml
DisableFunctionDefaultPermissions: Boolean
FunctionArn: String
FunctionInvokeRole: String
FunctionPayloadType: String
Identity: LambdaTokenAuthorizationIdentity
```

Properties

`DisableFunctionDefaultPermissions`

Specify `true` to prevent AWS SAM from automatically creating an `AWS::Lambda::Permissions` resource to provision permissions between your `AWS::Serverless::Api` resource and authorizer Lambda function.

Default value: `false`

Type: Boolean

Required: No

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

`FunctionArn`

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

> **Note**
>
> AWS SAM will automatically create an `AWS::Lambda::Permissions` resource when `FunctionArn` is specified for `AWS::Serverless::Api`. The `AWS::Lambda::Permissions` resource provisions permissions between your API and authorizer Lambda function.

Type: String

Required: Yes

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

`FunctionInvokeRole`

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

Type: String

Required: No

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

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

Required: Conditional

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

```
  Header: String
```

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

Properties

`Header`

Specify the header name for Authorization in the OpenApi definition.

Type: String

Required: No

Default: Authorization

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

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

`ValidationExpression`

Specify a validation expression for validating the incoming Identity.

Type: String

Required: No

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

Examples

LambdaTokenIdentity

YAML

```
Identity:
  Header: MyCustomAuthHeader
  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 of String

Required: No

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

Required: No

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

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

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

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

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

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

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

`IpRangeWhitelist`

The IP addresses or address ranges to allow.

Type: List

Required: No

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

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

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

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

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

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: amzn-s3-demo-bucket-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 AWS SAM to modify your OpenAPI definition. Create an inline OpenAPI definition in the `DefinitionBody` to turn on CORS. If the `CorsConfiguration` is set in the OpenAPI definition and also at the property level, AWS SAM merges them. The property level takes precedence over the OpenAPI definition.

For more information about CORS, see Enable CORS for an API Gateway REST API Resource 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

```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

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

`AllowHeaders`

String of headers to allow.

Type: String

Required: No

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

`AllowMethods`

String containing the HTTP methods to allow.

Type: String

Required: No

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

`AllowOrigin`

String of origin to allow. This can be a comma-separated list in string format.

Type: String

Required: Yes

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

`MaxAge`

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

Type: String

Required: No

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

Examples

CorsConfiguration

CORS Configuration example. This is just a portion of an AWS SAM template file showing an AWS::Serverless::Api definition with CORS configured and a AWS::Serverless::Function. If you use a Lambda proxy integration or a HTTP proxy integration, your backend must return the `Access-Control-Allow-Origin`, `Access-Control-Allow-Methods`, and `Access-Control-Allow-Headers` headers.

YAML

```
Resources:
  ApiGatewayApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      Cors:
        AllowMethods: "'POST, GET'"
        AllowHeaders: "'X-Forwarded-For'"
        AllowOrigin: "'https://example.com'"
        MaxAge: "'600'"
        AllowCredentials: true
  ApiFunction: # Adds a GET method at the root resource via an Api event
    Type: AWS::Serverless::Function
    Properties:
      Events:
        ApiEvent:
          Type: Api
          Properties:
            Path: /
            Method: get
            RestApiId:
              Ref: ApiGatewayApi
      Runtime: python3.10
      Handler: index.handler
      InlineCode: |
        import json
        def handler(event, context):
          return {
          'statusCode': 200,
          'headers': {
            'Access-Control-Allow-Headers': 'Content-Type',
```

```
            'Access-Control-Allow-Origin': 'https://example.com',
            'Access-Control-Allow-Methods': 'POST, GET'
            },
          'body': json.dumps('Hello from Lambda!')
          }
```

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

```
AccessAssociation: DomainAccessAssociation
BasePath: List
CertificateArn: String
DomainName: String
EndpointConfiguration: String
MutualTlsAuthentication: MutualTlsAuthentication
NormalizeBasePath: Boolean
OwnershipVerificationCertificateArn: String
Policy: Json
Route53: Route53Configuration
SecurityPolicy: String
```

Properties

`AccessAssociation`

The configuration required to generate `AWS::ApiGateway::DomainNameAccessAssociation` resource.

AWS SAM generates an AWS::ApiGateway::DomainNameAccessAssociation resource when this property is set. For information about generated CloudFormation resources, see Generated CloudFormation resources for AWS SAM.

Type: DomainAccessAssociation

Required: No

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

`BasePath`

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

Type: List

Required: No

Default: /

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

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`. If `EndpointConfiguration` is set to `PRIVATE`, this property is passed to the AWS::ApiGateway::DomainNameV2 resource.

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. For information about generated CloudFormation resources, see Generated CloudFormation resources for AWS SAM.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `DomainName` property of an `AWS::ApiGateway::DomainName` resource, or to `AWS::ApiGateway::DomainNameV2` when EndpointConfiguration is set to `PRIVATE`.

`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 CloudFormation.

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

Type: String

Required: No

Default: `REGIONAL`

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

`MutualTlsAuthentication`

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

Type: MutualTlsAuthentication

Required: No

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

`NormalizeBasePath`

Indicates whether non-alphanumeric characters are allowed in basepaths defined by the `BasePath` property. When set to `True`, non-alphanumeric characters are removed from basepaths.

Use `NormalizeBasePath` with the `BasePath` property.

Type: Boolean

Required: No

Default: True

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

`OwnershipVerificationCertificateArn`

The ARN of the public certificate issued by ACM to validate ownership of your custom domain. Required only when you configure mutual TLS and you specify an ACM imported or private CA certificate ARN for the `CertificateArn`.

Type: String

Required: No

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

`Policy`

The IAM policy to attach to the API Gateway domain name. Only applicable when `EndpointConfiguration` is set to `PRIVATE`.

Type: Json

Required: No

CloudFormation compatibility: This property is passed directly to the `Policy` property of an `AWS::ApiGateway::DomainNameV2` resource when `EndpointConfiguration` is set to `PRIVATE`. For examples of valid policy documents, see AWS::ApiGateway::DomainNameV2.

`Route53`

Defines an Amazon Route 53 configuration.

Type: Route53Configuration

Required: No

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

`SecurityPolicy`

The TLS version plus cipher suite for this domain name.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `SecurityPolicy` property of an `AWS::ApiGateway::DomainName` resource, or to `AWS::ApiGateway::DomainNameV2` when `EndpointConfiguration` is set to `PRIVATE`. For `PRIVATE` endpoints, only TLS_1_2 is supported.

Examples

DomainName

DomainName example

YAML

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

DomainAccessAssociation

Configures a domain access association between an access association source and a private custom domain name. The only supported access association source is a VPC endpoint ID. For more information, see Custom domain names for private APIs in API Gateway.

Syntax

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

YAML

```
VpcEndpointId: String
```

Properties

`VpcEndpointId`

The endpoint ID of the VPC interface endpoint associated with the API Gateway VPC service.

Type: String

Required: Yes

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

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
Region: String
SetIdentifier: String
VpcEndpointDomainName: String
```

```
VpcEndpointHostedZoneId: String
```

Properties

`DistributionDomainName`

Configures a custom distribution of the API custom domain name.

Type: String

Required: No

Default: Use the API Gateway distribution.

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

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

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

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

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

`Region`

Latency-based resource record sets only: The Amazon EC2 Region where you created the resource that this resource record set refers to. The resource typically is an AWS resource, such as an EC2 instance or an ELB load balancer, and is referred to by an IP address or a DNS domain name, depending on the record type.

When Amazon Route 53 receives a DNS query for a domain name and type for which you have created latency resource record sets, Route 53 selects the latency resource record set that has the lowest latency between the end user and the associated Amazon EC2 Region. Route 53 then returns the value that is associated with the selected resource record set.

Note the following:

- You can only specify one `ResourceRecord` per latency resource record set.

- You can only create one latency resource record set for each Amazon EC2 Region.
- You aren't required to create latency resource record sets for all Amazon EC2 Regions. Route 53 will choose the region with the best latency from among the regions that you create latency resource record sets for.
- You can't create non-latency resource record sets that have the same values for the `Name` and `Type` elements as latency resource record sets.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `Region` property of an `AWS::Route53::RecordSetGroup` `RecordSet` data type.

`SetIdentifier`

Resource record sets that have a routing policy other than simple: An identifier that differentiates among multiple resource record sets that have the same combination of name and type, such as multiple weighted resource record sets named acme.example.com that have a type of A. In a group of resource record sets that have the same name and type, the value of `SetIdentifier` must be unique for each resource record set.

For information about routing policies, see Choosing a routing policy in the *Amazon Route 53 Developer Guide*.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `SetIdentifier` property of an `AWS::Route53::RecordSetGroup` `RecordSet` data type.

`VpcEndpointDomainName`

A DNS name of the VPC interface endpoint associated with the API Gateway VPC service. This property is required only for private domains.

Type: String

Required: No

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

`VpcEndpointHostedZoneId`

The hosted zone ID of the VPC interface endpoint associated with the API Gateway VPC service. This property is required only for private domains.

Type: String

Required: No

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

Examples

Basic example

In this example, we configure a custom domain and Route 53 record sets for our API.

YAML

```
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      Domain:
        DomainName: www.example.com
        CertificateArn: arn:aws:acm:us-east-1:123456789012:certificate/
abcdef12-3456-7890-abcd-ef1234567890
        EndpointConfiguration: REGIONAL
        Route53:
          HostedZoneId: ABCDEFGHIJKLMNOP
```

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

```yaml
IpAddressType: String
Type: String
VPCEndpointIds: List
```

Properties

`IpAddressType`

The IP address types that can invoke an API (RestApi).

Valid values: `ipv4` or `dualstack`

Type: String

Required: No

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

`Type`

The endpoint type of a REST API.

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

Type: String

Required: No

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

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 resources.

> **Note**
>
> When you deploy to AWS CloudFormation, AWS SAM transforms your AWS SAM resources into CloudFormation resources. For more information, see Generated CloudFormation resources for AWS SAM.

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
  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 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

Required: Yes

CloudFormation compatibility: This property is similar to the `TemplateURL` property of an `AWS::CloudFormation::Stack` resource. The CloudFormation version does not take an ApplicationLocationObject 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

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

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

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 CloudFormation waits for the nested stack to reach the `CREATE_COMPLETE` state. The default is no timeout. When 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`, CloudFormation marks the nested stack as failed and rolls back both the nested stack and parent stack.

Type: Integer

Required: No

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/sam-s3-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

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

`SemanticVersion`

The semantic version of the application.

Type: String

Required: Yes

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

Creates a capacity provider for AWS Lambda functions that enables running Lambda Managed Instances on customer-owned Amazon Elastic Compute Cloud instances. This resource is part of the Lambda Managed Instances feature, which provides cost optimization for large-scale Lambda workloads by utilizing Amazon EC2 pricing models.

The capacity provider manages the lifecycle of Amazon EC2 instances and provides the necessary infrastructure for Lambda functions to execute on customer-owned compute resources while maintaining the serverless programming model.

> **Note**
>
> When you deploy to AWS CloudFormation, AWS SAM transforms your AWS SAM resources into CloudFormation resources. For more information, see Generated CloudFormation resources for AWS SAM.

Syntax

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

YAML

```yaml
Type: AWS::Serverless::CapacityProvider
Properties:
  CapacityProviderName: String
  VpcConfig: VpcConfig
  OperatorRole: String
  Tags: Map
  PropagateTags: Boolean
  InstanceRequirements: InstanceRequirements
  ScalingConfig: ScalingConfig
  KmsKeyArn: String
```

Properties

`CapacityProviderName`

The name of the capacity provider. This name must be unique within your AWS account and region.

Type: String

Required: No

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

`VpcConfig`

The VPC configuration for the capacity provider. Specifies the VPC subnets and security groups where Amazon EC2 instances will be launched.

Type: VpcConfig

Required: Yes

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

`OperatorRole`

The ARN of the operator role for Lambda with permissions to create and manage Amazon EC2 instances and related resources in the customer account. If not provided, AWS SAM automatically generates a role with the necessary permissions.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `CapacityProviderOperatorRoleArn` property of `PermissionsConfig` of an `AWS::Lambda::CapacityProvider` resource.

`Tags`

A map of key-value pairs to apply to the capacity provider and its associated resources.

Type: Map

Required: No

CloudFormation compatibility: This property is passed directly to the `Tags` property of an `AWS::Lambda::CapacityProvider` resource. The `Tags` property in AWS SAM consists of key-value pairs (whereas in 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 generated for this function.

`PropagateTags`

Indicates whether or not to pass tags from the Tags property to your `AWS::Serverless::CapacityProvider` generated resources. Set this to `True` to propagate tags in your generated resources.

Type: Boolean

Required: No

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

`InstanceRequirements`

Specifications for the types of compute instances that the capacity provider can use. This includes architecture requirements and `allowed` or `excluded` instance types.

Type: InstanceRequirements

Required: No

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

`ScalingConfig`

The scaling configuration for the capacity provider. Defines how the capacity provider scales Amazon EC2 instances based on demand.

Type: ScalingConfig

Required: No

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

`KmsKeyArn`

The ARN of the AWS KMS key used to encrypt data at rest and in transit for the capacity provider.

Type: String

Required: No

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

Return Values

Ref

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

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 capacity provider.

Examples

Basic capacity provider

The following example creates a basic capacity provider with VPC configuration.

```
MyCapacityProvider:
  Type: AWS::Serverless::CapacityProvider
  Properties:
    CapacityProviderName: my-capacity-provider
    VpcConfig:
      SubnetIds:
        - subnet-12345678
        - subnet-87654321
      SecurityGroupIds:
        - sg-12345678
    Tags:
      Environment: Production
      Team: ServerlessTeam
```

Advanced capacity provider with scaling

The following example creates a capacity provider with custom instance requirements and scaling configuration.

```
AdvancedCapacityProvider:
  Type: AWS::Serverless::CapacityProvider
  Properties:
    CapacityProviderName: advanced-capacity-provider
    VpcConfig:
      SubnetIds:
        - subnet-12345678
        - subnet-87654321
      SecurityGroupIds:
```

```
        - sg-12345678
    OperatorRole: arn:aws:iam::123456789012:role/MyCapacityProviderRole
    PropagateTags: true
    InstanceRequirements:
      Architectures:
        - x86_64
      ExcludedTypes:
        - t2.micro
    ScalingConfig:
      MaxInstanceCount: 10
      ManualScalingPolicies:
        AverageCPUUtilization: 70.0
    KmsKeyArn: arn:aws:kms:us-
east-1:123456789012:key/12345678-1234-1234-1234-123456789012
    Tags:
      Environment: Production
      CostCenter: Engineering
```

VpcConfig

Configures the VPC settings for a capacity provider, including the subnets and security groups where EC2 instances will be launched.

Syntax

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

YAML

```
SubnetIds: List
SecurityGroupIds: List
```

Properties

`SubnetIds`

A list of subnet IDs where EC2 instances will be launched. At least one subnet must be specified.

Type: List

Required: Yes

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

`SecurityGroupIds`

A list of security group IDs to associate with the EC2 instances. If not specified, the default security group for the VPC will be used.

Type: List

Required: No

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

Examples

VPC configuration

The following example shows a VPC configuration with multiple subnets and security groups.

```
VpcConfig:
  SubnetIds:
    - subnet-12345678
    - subnet-87654321
  SecurityGroupIds:
    - sg-12345678
    - sg-87654321
```

InstanceRequirements

Specifies the requirements for EC2 instances that will be launched by the capacity provider, including architectures and instance type constraints.

Syntax

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

YAML

```
Architectures: List
```

```
AllowedTypes: List
ExcludedTypes: List
```

> **Note**
>
> You can choose to specify either `AllowedTypes` or `ExcludedTypes` when defining instance requirements for your capacity provider, but not both.

Properties

`Architectures`

The instruction set architectures for the capacity provider instances.

Valid values: `x86_64` or `arm64`

Type: List

Required: No

Default: `x86_64`

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

`AllowedTypes`

A list of allowed EC2 instance types for the capacity provider instance.

Type: List

Required: No

CloudFormation compatibility: This property is passed directly to the `AllowedInstanceTypes` property of `InstanceRequirements` of an `AWS::Lambda::CapacityProvider` resource.

`ExcludedTypes`

A list of EC2 instance types to exclude from the capacity provider.

Type: List

Required: No

CloudFormation compatibility: This property is passed directly to the `ExcludedInstanceTypes` property of `InstanceRequirements` of an `AWS::Lambda::CapacityProvider` resource.

Examples

Instance requirements configuration

The following example shows instance requirements with specific architecture and instance type constraints.

```
InstanceRequirements:
  Architectures:
    - x86_64
  ExcludedTypes:
    - t2.micro
```

ScalingConfig

Configures how the capacity provider scales EC2 instances based on demand, including maximum instance limits and scaling policies.

Syntax

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

YAML

```
MaxVCpuCount: Integer
AverageCPUUtilization: Double
```

Properties

`MaxVCpuCount`

The maximum number of vCPUs that the capacity provider can provision across all compute instances.

Type: Integer

Required: No

CloudFormation compatibility: This property is passed directly to the `MaxVCpuCount` property of `CapacityProviderScalingConfig` of an `AWS::Lambda::CapacityProvider` resource.

`AverageCPUUtilization`

The target average CPU utilization percentage (0-100) for scaling decisions. When the average CPU utilization exceeds this threshold, the capacity provider will scale up Amazon EC2 instances. When specified, AWS SAM constructs `CapacityProviderScalingConfig` of an `AWS::Lambda::CapacityProvider` resource with the `ScalingMode` set to `'Manual'` and `ScalingPolicies` set to `[{PredefinedMetricType: 'LambdaCapacityProviderAverageCPUUtilization', TargetValue: <this value>}]`.

Type: Double

Required: No

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

Examples

Scaling configuration

The following example shows a scaling configuration with maximum VCpu count and average CPU utilization.

```
ScalingConfig:
  MaxVCpuCount: 10
  AverageCPUUtilization: 70.0
```

AWS::Serverless::Connector

Configures permissions between two resources. For an introduction to connectors, see Managing resource permissions with AWS SAM connectors.

For more information on generated AWS CloudFormation resources, see CloudFormation resources generated when you specify AWS::Serverless::Connector.

To provide feedback on connectors, submit a new issue at the *serverless-application-model AWS GitHub repository*.

> **Note**
>
> When you deploy to AWS CloudFormation, AWS SAM transforms your AWS SAM resources into CloudFormation resources. For more information, see Generated CloudFormation resources for AWS SAM.

Syntax

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

> **Note**
>
> We recommend using the embedded connectors syntax for most use cases. Being embedded within the source resource makes it easier to read and maintain over time. When you need to reference a source resource that is not within the same AWS SAM template, such as a resource in a nested stack or a shared resource, use the `AWS::Serverless::Connector` syntax.

Embedded connectors

```
<source-resource-logical-id>:
  Connectors:
    <connector-logical-id:
      Properties:
        Destination: ResourceReference | List of ResourceReference
        Permissions: List
        SourceReference: SourceReference
```

AWS::Serverless::Connector

```
Type: AWS::Serverless::Connector
Properties:
  Destination: ResourceReference | List of ResourceReference
  Permissions: List
```

```
Source: ResourceReference
```

Properties

`Destination`

The destination resource.

Type: ResourceReference | List of ResourceReference

Required: Yes

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

`Permissions`

The permission type that the source resource is allowed to perform on the destination resource.

`Read` includes AWS Identity and Access Management (IAM) actions that allow reading data from the resource.

`Write` inclues IAM actions that allow initiating and writing data to a resource.

Valid values: `Read` or `Write`

Type: List

Required: Yes

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

`Source`

The source resource. Required when using the `AWS::Serverless::Connector` syntax.

Type: ResourceReference

Required: Conditional

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

`SourceReference`

The source resource.

> **Note**
>
> Use with the embedded connectors syntax when defining additional properties for the source resource.

Type: SourceReference

Required: No

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

Examples

Embedded connectors

The following example uses embedded connectors to define a `Write` data connection between an AWS Lambda function and Amazon DynamoDB table:

```
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyTable:
    Type: AWS::Serverless::SimpleTable
  MyFunction:
    Type: AWS::Serverless::Function
    Connectors:
      MyConn:
        Properties:
          Destination:
            Id: MyTable
          Permissions:
            - Write
    ...
```

The following example uses embedded connectors to define `Read` and `Write` permissions:

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

```
  MyFunction:
    Type: AWS::Serverless::Function
    Connectors:
      MyConn:
        Properties:
          Destination:
            Id: MyTable
          Permissions:
            - Read
            - Write
  MyTable:
    Type: AWS::DynamoDB::Table
    ...
```

The following example uses embedded connectors to define a source resource with a property other than `Id`:

```
Transform: AWS::Serverless-2016-10-31
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Connectors:
      ApitoLambdaConn:
        Properties:
          SourceReference:
            Qualifier: Prod/GET/foobar
          Destination:
            Id: MyTable
          Permissions:
            - Read
            - Write
  MyTable:
    Type: AWS::DynamoDB::Table
    ...
```

AWS::Serverless::Connector

The following example uses the AWS::Serverless::Connector resource to have an AWS Lambda function read from, and write to an Amazon DynamoDB table:

```
MyConnector:
```

```
  Type: AWS::Serverless::Connector
  Properties:
    Source:
      Id: MyFunction
    Destination:
      Id: MyTable
    Permissions:
      - Read
      - Write
```

The following example uses the AWS::Serverless::Connector resource to have a Lambda function write to an Amazon SNS topic, with both resources in the same template:

```
MyConnector:
  Type: AWS::Serverless::Connector
  Properties:
    Source:
      Id: MyLambda
    Destination:
      Id: MySNSTopic
    Permissions:
      - Write
```

The following example uses the AWS::Serverless::Connector resource to have an Amazon SNS topic write to a Lambda function, which then writes to an Amazon DynamoDB table, with all resources in the same template:

```
Transform: AWS::Serverless-2016-10-31
Resources:
  Topic:
    Type: AWS::SNS::Topic
    Properties:
      Subscription:
        - Endpoint: !GetAtt Function.Arn
          Protocol: lambda

  Function:
    Type: AWS::Serverless::Function
    Properties:
      Runtime: nodejs16.x
      Handler: index.handler
      InlineCode: |
```

```
        const AWS = require('aws-sdk');
        exports.handler = async (event, context) => {
          const docClient = new AWS.DynamoDB.DocumentClient();
          await docClient.put({
            TableName: process.env.TABLE_NAME,
            Item: {
              id: context.awsRequestId,
              event: JSON.stringify(event)
            }
          }).promise();
        };
      Environment:
        Variables:
          TABLE_NAME: !Ref Table

  Table:
    Type: AWS::Serverless::SimpleTable

  TopicToFunctionConnector:
    Type: AWS::Serverless::Connector
    Properties:
      Source:
        Id: Topic
      Destination:
        Id: Function
      Permissions:
        - Write

  FunctionToTableConnector:
    Type: AWS::Serverless::Connector
    Properties:
      Source:
        Id: Function
      Destination:
        Id: Table
      Permissions:
        - Write
```

The following is the transformed AWS CloudFormation template from the example above:

```
"FunctionToTableConnectorPolicy": {
  "Type": "AWS::IAM::ManagedPolicy",
  "Metadata": {
```

```
    "aws:sam:connectors": {
      "FunctionToTableConnector": {
        "Source": {
          "Type": "AWS::Lambda::Function"
        },
        "Destination": {
          "Type": "AWS::DynamoDB::Table"
        }
      }
    }
  },
  "Properties": {
    "PolicyDocument": {
      "Version": "2012-10-17",
      "Statement": [
        {
          "Effect": "Allow",
          "Action": [
            "dynamodb:PutItem",
            "dynamodb:UpdateItem",
            "dynamodb:DeleteItem",
            "dynamodb:BatchWriteItem",
            "dynamodb:PartiQLDelete",
            "dynamodb:PartiQLInsert",
            "dynamodb:PartiQLUpdate"
          ],
          "Resource": [
            {
              "Fn::GetAtt": [
                "MyTable",
                "Arn"
              ]
            },
            {
              "Fn::Sub": [
                "${DestinationArn}/index/*",
                {
                  "DestinationArn": {
                    "Fn::GetAtt": [
                      "MyTable",
                      "Arn"
                    ]
                  }
                }
```

```
                ]
              }
            ]
          }
        ]
      },
      "Roles": [
        {
          "Ref": "MyFunctionRole"
        }
      ]
    }
}
```

ResourceReference

A reference to a resource that the AWS::Serverless::Connector resource type uses.

> **Note**
>
> For resources in the same template, provide the `Id`. For resources not in the same template, use a combination of other properties. For more information, see AWS SAM connector reference.

Syntax

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

YAML

```
Arn: String
Id: String
Name: String
Qualifier: String
QueueUrl: String
ResourceId: String
RoleName: String
Type: String
```

Properties

`Arn`

The ARN of a resource.

Type: String

Required: Conditional

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

`Id`

The logical ID of a resource in the same template.

> **Note**
>
> When `Id` is specified, if the connector generates AWS Identity and Access Management (IAM) policies, the IAM role associated to those policies will be inferred from the resource `Id`. When `Id` is not specified, provide `RoleName` of the resource for connectors to attach generated IAM policies to an IAM role.

Type: String

Required: Conditional

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

`Name`

The name of a resource.

Type: String

Required: Conditional

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

`Qualifier`

A qualifier for a resource that narrows its scope. `Qualifier` replaces the `*` value at the end of a resource constraint ARN. For an example, see API Gateway invoking a Lambda function.

> **Note**
>
> Qualifier definition varies per resource type. For a list of supported source and destination resource types, see AWS SAM connector reference.

Type: String

Required: Conditional

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

`QueueUrl`

The Amazon SQS queue URL. This property only applies to Amazon SQS resources.

Type: String

Required: Conditional

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

`ResourceId`

The ID of a resource. For example, the API Gateway API ID.

Type: String

Required: Conditional

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

`RoleName`

The role name associated with a resource.

> **Note**
>
> When `Id` is specified, if the connector generates IAM policies, the IAM role associated to those policies will be inferred from the resource `Id`. When `Id` is not specified, provide `RoleName` of the resource for connectors to attach generated IAM policies to an IAM role.

Type: String

Required: Conditional

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

`Type`

The CloudFormation type of a resource. For more information, go to AWS resource and property types reference.

Type: String

Required: Conditional

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

Examples

API Gateway invoking a Lambda function

The following example uses the AWS::Serverless::Connector resource to allow Amazon API Gateway to invoke an AWS Lambda function.

YAML

```
Transform: AWS::Serverless-2016-10-31
Resources:
  MyRole:
    Type: AWS::IAM::Role
    Properties:
      AssumeRolePolicyDocument:
```

```
        Statement:
          - Effect: Allow
            Action: sts:AssumeRole
            Principal:
              Service: lambda.amazonaws.com
      ManagedPolicyArns:
        - !Sub arn:${AWS::Partition}:iam::aws:policy/service-role/
AWSLambdaBasicExecutionRole

  MyFunction:
    Type: AWS::Lambda::Function
    Properties:
      Role: !GetAtt MyRole.Arn
      Runtime: nodejs16.x
      Handler: index.handler
      Code:
        ZipFile: |
          exports.handler = async (event) => {
            return {
              statusCode: 200,
              body: JSON.stringify({
                "message": "It works!"
              }),
            };
          };

  MyApi:
    Type: AWS::ApiGatewayV2::Api
    Properties:
      Name: MyApi
      ProtocolType: HTTP

  MyStage:
    Type: AWS::ApiGatewayV2::Stage
    Properties:
      ApiId: !Ref MyApi
      StageName: prod
      AutoDeploy: True

  MyIntegration:
    Type: AWS::ApiGatewayV2::Integration
    Properties:
      ApiId: !Ref MyApi
      IntegrationType: AWS_PROXY
```

```
      IntegrationUri: !Sub arn:aws:apigateway:${AWS::Region}:lambda:path/2015-03-31/
functions/${MyFunction.Arn}/invocations
      IntegrationMethod: POST
      PayloadFormatVersion: "2.0"

  MyRoute:
    Type: AWS::ApiGatewayV2::Route
    Properties:
      ApiId: !Ref MyApi
      RouteKey: GET /hello
      Target: !Sub integrations/${MyIntegration}

  MyConnector:
    Type: AWS::Serverless::Connector
    Properties:
      Source: # Use 'Id' when resource is in the same template
        Type: AWS::ApiGatewayV2::Api
        ResourceId: !Ref MyApi
        Qualifier: prod/GET/hello # Or "*" to allow all routes
      Destination: # Use 'Id' when resource is in the same template
        Type: AWS::Lambda::Function
        Arn: !GetAtt MyFunction.Arn
      Permissions:
        - Write

Outputs:
  Endpoint:
    Value: !Sub https://${MyApi}.execute-api.${AWS::Region}.${AWS::URLSuffix}/prod/
hello
```

SourceReference

A reference to a source resource that the AWS::Serverless::Connector resource type uses.

Syntax

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

YAML

```
Qualifier: String
```

Properties

`Qualifier`

A qualifier for a resource that narrows its scope. `Qualifier` replaces the `*` value at the end of a resource constraint ARN.

> **Note**
>
> Qualifier definition varies per resource type. For a list of supported source and destination resource types, see AWS SAM connector reference.

Type: String

Required: Conditional

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

Examples

The following example uses embedded connectors to define a source resource with a property other than `Id`:

```
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Connectors:
      ApitoLambdaConn:
        Properties:
          SourceReference:
            Qualifier: Prod/GET/foobar
          Destination:
            Id: MyTable
          Permissions:
            - Read
            - Write
  MyTable:
```

```
    Type: AWS::DynamoDB::Table
    ...
```

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 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 Lambda functions with custom runtimes in AWS SAM.

> **Note**
>
> When you deploy to AWS CloudFormation, AWS SAM transforms your AWS SAM resources into CloudFormation resources. For more information, see Generated CloudFormation resources for AWS SAM.

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
  AutoPublishAliasAllProperties: Boolean
  AutoPublishCodeSha256: String
  CapacityProviderConfig: CapacityProviderConfig
  CodeSigningConfigArn: String
  CodeUri: String | FunctionCode
  DeadLetterQueue: Map | DeadLetterQueue
  DeploymentPreference: DeploymentPreference
  Description: String
  DurableConfig: DurableConfig
```

```
  Environment: Environment
  EphemeralStorage: EphemeralStorage
  EventInvokeConfig: EventInvokeConfiguration
  Events: EventSource
  FileSystemConfigs: List
  FunctionName: String
  FunctionScalingConfig: FunctionScalingConfig
  FunctionUrlConfig: FunctionUrlConfig
  Handler: String
  ImageConfig: ImageConfig
  ImageUri: String
  InlineCode: String
  KmsKeyArn: String
  Layers: List
  LoggingConfig: LoggingConfig
  MemorySize: Integer
  PackageType: String
  PermissionsBoundary: String
  Policies: String | List | Map
  PublishToLatestPublished: Boolean
  PropagateTags: Boolean
  ProvisionedConcurrencyConfig: ProvisionedConcurrencyConfig
  RecursiveLoop: String
  ReservedConcurrentExecutions: Integer
  Role: String
  RolePath: String
  Runtime: String
  RuntimeManagementConfig: RuntimeManagementConfig
  SnapStart: SnapStart
  SourceKMSKeyArn: String
  Tags: Map
  TenancyConfig: TenancyConfig
  Timeout: Integer
  Tracing: String
  VersionDescription: String
  VersionDeletionPolicy: 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`

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

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 with AWS SAM.

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. For general information about generated CloudFormation resources, see Generated CloudFormation resources for AWS SAM.

Type: String

Required: No

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

`AutoPublishAliasAllProperties`

Specifies when a new `AWS::Lambda::Version` is created. When `true`, a new Lambda version is created when any property in the Lambda function is modified. When `false`, a new Lambda version is created only when any of the following properties are modified:

- `Environment`, `MemorySize`, or `SnapStart`.
- Any change that results in an update to the `Code` property, such as `CodeDict`, `ImageUri`, or `InlineCode`.

This property requires `AutoPublishAlias` to be defined.

If `AutoPublishCodeSha256` is also specified, its behavior takes precedence over `AutoPublishAliasAllProperties: true`.

Type: Boolean

Required: No

Default value: `false`

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

`AutoPublishCodeSha256`

When used, this string works with the `CodeUri` value to determine if a new Lambda version needs to be published. This property is often used to resolve the following deployment issue: A deployment package is stored in an Amazon S3 location and is replaced by a new deployment package with 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).

This problem is marked by an AWS SAM template having the following characteristics:

- The `DeploymentPreference` object is configured for gradual deployments (as described in Deploying serverless applications gradually with AWS SAM)
- The `AutoPublishAlias` property is set and doesn't change between deployments
- The `CodeUri` property is set and doesn't change between deployments.

In this scenario, updating `AutoPublishCodeSha256` results in a new Lambda version being created successfully. However, new function code deployed to Amazon S3 will not be recognized. To recognize new function code, consider using versioning in your Amazon S3 bucket. Specify the `Version` property for your Lambda function and configure your bucket to always use the latest deployment package.

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

Type: String

Required: No

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

`CapacityProviderConfig`

Configures the capacity provider to which published versions of the function will be attached. This enables the function to run on customer-owned EC2 instances managed by Lambda Managed Instances.

Type: CapacityProviderConfig

Required: No

CloudFormation compatibility: SAM flattens the property passed to the `CapacityProviderConfig` property of an `AWS::Lambda::Function` resource and reconstructs the nested structure.

`CodeSigningConfigArn`

The ARN of the AWS::Lambda::CodeSigningConfig resource, used to enable code signing for this function. For more information about code signing, see Set up code signing for your AWS SAM application.

Type: String

Required: No

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

`CodeUri`

The code for the function. Accepted values include:

- The function's Amazon S3 URI. For example, `s3://bucket-123456789/sam-app/1234567890abcdefg`.
- The local path to the function. For example, `hello_world/`.
- A FunctionCode object.

> **Note**
>
> If you provide a function's Amazon S3 URI or FunctionCode object, you must reference a valid Lambda deployment package.
> If you provide a local file path, use the AWS SAM CLI to upload the local file at deployment. To learn more, see How AWS SAM uploads local files at deployment.
> If you use intrinsic functions in `CodeUri` property, AWS SAM will not be able to correctly parse the values. Consider using AWS::LanguageExtensions transform instead.

Type: [String | FunctionCode]

Required: Conditional. When `PackageType` is set to `Zip`, one of `CodeUri` or `InlineCode` is required.

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 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

Required: No

CloudFormation compatibility: This property is similar to the `DeadLetterConfig` property of an `AWS::Lambda::Function` resource. In 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

Required: No

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

See also: For more information about this property, see Deploying serverless applications gradually with AWS SAM.

`Description`

A description of the function.

Type: String

Required: No

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

`DurableConfig`

Configuration for durable functions. Enables stateful execution with automatic checkpointing and replay capabilities.

Type: DurableConfig

Required: No

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

`Environment`

The configuration for the runtime environment.

Type: Environment

Required: No

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

`EphemeralStorage`

An object that specifies the disk space, in MB, available to your Lambda function in `/tmp`.

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

Type: EphemeralStorage

Required: No

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

`EventInvokeConfig`

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

Type: EventInvokeConfiguration

Required: No

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

Required: No

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

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

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

`FunctionScalingConfig`

Configures the scaling behavior for Lambda functions running on capacity providers. Defines the minimum and maximum number of execution environments.

Type: FunctionScalingConfig

Required: No

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

`FunctionUrlConfig`

The object that describes a function URL. A function URL is an HTTPS endpoint that you can use to invoke your function.

For more information, see Function URLs in the *AWS Lambda Developer Guide*.

Type: FunctionUrlConfig

Required: No

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

`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

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

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 Default build with AWS SAM.

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

Type: String

Required: No

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

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

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. The version is either a full ARN including the version or a reference to a LayerVersion resource. For example, a reference to a `LayerVersion` will be `!Ref MyLayer` while a full ARN including the version will be `arn:aws:lambda:`*`region`*`:`*`account-id`*`:layer:`*`layer-name`*`:`*`version`*.

Type: List

Required: No

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

`LoggingConfig`

The function's Amazon CloudWatch Logs configuration settings.

Type: LoggingConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `LoggingConfig` 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

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 function's container image can be auto created by the AWS SAM CLI. For more information, see sam deploy.

Valid values: `Zip` or `Image`

Type: String

Required: No

Default: `Zip`

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

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

`Policies`

Permission policies for this function. Policies will be appended to the function's default AWS Identity and Access Management (IAM) execution role.

This property accepts a single value or list of values. Allowed values include:

- AWS SAM policy templates.
- The ARN of an AWS managed policy or customer managed policy.
- The name of an AWS managed policy from the following list.
- An inline IAM policy formatted in YAML as a map.

> **Note**
>
> If you set the `Role` property, this property is ignored.

Type: String | List | Map

Required: No

CloudFormation compatibility: This property is similar to the `Policies` property of an `AWS::IAM::Role` resource.

`PublishToLatestPublished`

Specifies whether to publish the latest function version when the function is updated.

Type: Boolean

Required: No

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

`PropagateTags`

Indicate whether or not to pass tags from the `Tags` property to your AWS::Serverless::Function generated resources. Specify `True` to propagate tags in your generated resources.

Type: Boolean

Required: No

Default: `False`

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

`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

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

`RecursiveLoop`

The status of your function's recursive loop detection configuration.

When this value is set to `Allow` and Lambda detects your function being invoked as part of a recursive loop, it doesn't take any action.

When this value is set to `Terminate` and Lambda detects your function being invoked as part of a recursive loop, it stops your function being invoked and notifies you.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `RecursiveLoop` property of the `AWS::Lambda::Function` 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

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

CloudFormation compatibility: This property is similar to the `Role` property of an `AWS::Lambda::Function` resource. This is required in 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`.

`RolePath`

The path to the function's IAM execution role.

Use this property when the role is generated for you. Do not use when the role is specified with the `Role` property.

Type: String

Required: Conditional

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

`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 Lambda functions with custom runtimes in AWS SAM.

Type: String

Required: Conditional

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

`RuntimeManagementConfig`

Configure runtime management options for your Lambda functions such as runtime environment updates, rollback behavior, and selecting a specific runtime version. To learn more, see Lambda runtime updates in the *AWS Lambda Developer Guide*.

Type: RuntimeManagementConfig

Required: No

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

`SnapStart`

Create a snapshot of any new Lambda function version. A snapshot is a cached state of your initialized function, including all of its dependencies. The function is initialized just once and the cached state is reused for all future invocations, improving application performance by reducing the number of times your function must be initialized. To learn more, see Improving startup performance with Lambda SnapStart in the *AWS Lambda Developer Guide*.

Type: SnapStart

Required: No

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

`SourceKMSKeyArn`

Represents a KMS key ARN that is used to encrypt the customer's ZIP function code.

Type: String

Required: No

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

`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

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 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.

`TenancyConfig`

Configuration for Lambda tenant isolation mode. Ensures execution environments are never shared between different tenant IDs, providing compute-level isolation for multi-tenant applications.

Type: TenancyConfig

Required: No

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

`Timeout`

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

Type: Integer

Required: No

Default: 3

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.

- `Active` – Activates X-Ray tracing for the function.
- `Disabled` – Deactivates X-Ray for the function.
- `PassThrough` – Activates X-Ray tracing for the function. Sampling decision is delegated to the downstream services.

If specified as `Active` or `PassThrough` and the `Role` property is not set, AWS SAM adds the `arn:aws:iam::aws:policy/AWSXrayWriteOnlyAccess` policy to the Lambda execution role that it creates for you.

For more information about X-Ray, see Using AWS Lambda with AWS X-Ray in the *AWS Lambda Developer Guide*.

Valid values: [`Active`|`Disabled`|`PassThrough`]

Type: String

Required: No

CloudFormation compatibility: This property is similar to the `TracingConfig` property of an `AWS::Lambda::Function` resource.

`VersionDescription`

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

Type: String

Required: No

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

`VersionDeletionPolicy`

Specifies the deletion policy for the Lambda version resource that is created when `AutoPublishAlias` is set. This controls whether the version resource is retained or deleted when the stack is deleted.

Valid values: `Delete`, `Retain`, or `Snapshot`

Type: String

Required: No

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an CloudFormation equivalent. It sets the `DeletionPolicy` attribute on the generated `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

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 resource of package type `Zip` (default) and function code in an Amazon S3 bucket.

YAML

```
Type: AWS::Serverless::Function
Properties:
  Handler: index.handler
  Runtime: python3.9
  CodeUri: s3://bucket-name/key-name
```

Function properties example

The following is an example of an AWS::Serverless::Function 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: python3.9
  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:::sam-s3-demo-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"
```

RuntimeManagementConfig examples

A Lambda function configured to update its runtime environment according to current behavior:

```
TestFunction
  Type: AWS::Serverless::Function
  Properties:
    ...
    Runtime: python3.9
    RuntimeManagementConfig:
      UpdateRuntimeOn: Auto
```

A Lambda function configured to update its runtime environment when the function is updated:

```
TestFunction
  Type: AWS::Serverless::Function
  Properties:
    ...
    Runtime: python3.9
    RuntimeManagementConfig:
      UpdateRuntimeOn: FunctionUpdate
```

A Lambda function configured to update its runtime environment manually:

```
TestFunction
  Type: AWS::Serverless::Function
  Properties:
    ...
    Runtime: python3.9
    RuntimeManagementConfig:
      RuntimeVersionArn: arn:aws:lambda:us-
east-1::runtime:4c459dd0104ee29ec65dcad056c0b3ddbe20d6db76b265ade7eda9a066859b1e
      UpdateRuntimeOn: Manual
```

SnapStart examples

Example of a Lambda function with SnapStart turned on for future versions:

```
TestFunc
  Type: AWS::Serverless::Function
  Properties:
    ...
    SnapStart:
      ApplyOn: PublishedVersions
```

TenancyConfig examples

Example of a Lambda function with tenant isolation mode turned on:

```
TestFunction
  Type: AWS::Serverless::Function
  Properties:
    ...
    TenancyConfig:
```

```
      TenantIsolationMode: PER_TENANT
```

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 Dead-letter queues in the *AWS Lambda Developer Guide*.

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

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

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

> **Note**
>
> You must specify an `AutoPublishAlias` in your AWS::Serverless::Function 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
  PassthroughCondition: Boolean
```

```
  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

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

`Enabled`

Whether this deployment preference is enabled.

Type: Boolean

Required: No

Default: True

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

`Hooks`

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

Type: Hooks

Required: No

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

`PassthroughCondition`

If True, and if this deployment preference is enabled, the function's Condition will be passed through to the generated CodeDeploy resource. Generally, you should set this to True. Otherwise, the CodeDeploy resource would be created even if the function's Condition resolves to False.

Type: Boolean

Required: No

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

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

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 with AWS SAM.

Type: String

Required: Yes

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

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

`PreTraffic`

Lambda function that is run before traffic shifting.

Type: String

Required: No

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

Examples

Hooks

Example hook functions

YAML

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

DurableConfig

Configures durable execution settings for AWS Lambda functions. Durable functions can run for up to one year and automatically checkpoint progress, enabling long-running workflows and fault-tolerant applications. For more information about durable functions, see Lambda durable functions 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

```
  ExecutionTimeout: Integer
  RetentionPeriodInDays: Integer
```

Properties

`ExecutionTimeout`

The amount of time (in seconds) that Lambda allows a durable function to run before stopping it. The maximum is one 366-day year or 31,622,400 seconds.

Type: Integer

Required: Yes

Minimum: 1

Maximum: 31622400

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

`RetentionPeriodInDays`

The number of days after a durable execution is closed that Lambda retains its history, from one to 90 days. The default is 14 days.

Type: Integer

Required: No

Default: 14

Minimum: 1

Maximum: 90

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

Examples

DurableConfig

Durable configuration example for a function with a 1-hour execution timeout and 7-day retention period.

YAML

```
DurableConfig:
  ExecutionTimeout: 3600
  RetentionPeriodInDays: 7
```

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
MaximumEventAgeInSeconds: Integer
MaximumRetryAttempts: Integer
```

Properties

`DestinationConfig`

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

Type: EventInvokeDestinationConfiguration

Required: No

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

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

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
```

```
  OnSuccess: OnSuccess
```

Properties

`OnFailure`

A destination for events that failed processing.

Type: OnFailure

Required: No

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

Required: No

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

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`, `S3`, `Lambda`, and `EventBridge`.

Type: String

Required: No

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

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`, `S3`, `Lambda`, and `EventBridge`.

Type: String

Required: No

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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: AlexaSkill | Api | CloudWatchEvent | CloudWatchLogs | Cognito
 | DocumentDB | DynamoDB | EventBridgeRule | HttpApi | IoTRule | Kinesis | MQ | MSK
 | S3 | Schedule | ScheduleV2 | SelfManagedKafka | SNS | SQS
  Type: String
```

Properties

`Properties`

Object describing properties of this event mapping. The set of properties must conform to the defined Type.

Type: AlexaSkill | Api | CloudWatchEvent | CloudWatchLogs | Cognito | DocumentDB | DynamoDB | EventBridgeRule | HttpApi | IoTRule | Kinesis | MQ | MSK | S3 | Schedule | ScheduleV2 | SelfManagedKafka | SNS | SQS

Required: Yes

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

`Type`

The event type.

Valid values: `AlexaSkill`, `Api`, `CloudWatchEvent`, `CloudWatchLogs`, `Cognito`, `DocumentDB`, `DynamoDB`, `EventBridgeRule`, `HttpApi`, `IoTRule`, `Kinesis`, `MQ`, `MSK`, `S3`, `Schedule`, `ScheduleV2`, `SelfManagedKafka`, `SNS`, `SQS`

Type: String

Required: Yes

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

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

```yaml
Auth: ApiFunctionAuth
Method: String
Path: String
RequestModel: RequestModel
RequestParameters: List of [ String | RequestParameter ]
RestApiId: String
ResponseTransferMode: String
TimeoutInMillis: Integer
```

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

Required: No

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

`Method`

HTTP method for which this function is invoked. Options include `DELETE`, `GET`, `HEAD`, `OPTIONS`, `PATCH`, `POST`, `PUT`, and `ANY`. Refer to Set up an HTTP method in the *API Gateway Developer Guide* for details.

Type: String

Required: Yes

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

`Path`

Uri path for which this function is invoked. Must start with `/`.

Type: String

Required: Yes

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

Type: RequestModel

Required: No

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

A list can contain both parameter name strings and RequestParameter objects. For strings, the `Required` and `Caching` properties will default to `false`.

Type: List of [String | RequestParameter]

Required: No

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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 resource defined in this template.

If you don't define this property, AWS SAM creates a default AWS::Serverless::Api 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 resource defined in another template.

Type: String

Required: No

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

`ResponseTransferMode`

The response transfer mode for the Lambda function integration. Set to `RESPONSE_STREAM` to enable Lambda response streaming through API Gateway, allowing the function to stream responses back to clients. When set to `RESPONSE_STREAM`, API Gateway uses the Lambda InvokeWithResponseStreaming API.

Type: String

Required: No

Valid values: `BUFFERED` | `RESPONSE_STREAM`

CloudFormation compatibility: This property is passed directly to the `ResponseTransferMode` property of an `AWS::ApiGateway::Method Integration`.

`TimeoutInMillis`

Custom timeout between 50 and 29,000 milliseconds.

> **Note**
>
> When you specify this property, AWS SAM modifies your OpenAPI definition. The OpenAPI definition must be specified inline using the `DefinitionBody` property.

Type: Integer

Required: No

Default: 29,000 milliseconds or 29 seconds

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

Examples

Basic example

YAML

```
Events:
  ApiEvent:
    Type: Api
    Properties:
      Path: /path
      Method: get
      RequestParameters:
        - method.request.header.Authorization
        - method.request.querystring.keyword:
            Required: true
            Caching: false
```

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
  OverrideApiAuth: Boolean
  ResourcePolicy: ResourcePolicyStatement
```

Properties

`ApiKeyRequired`

Requires an API key for this API, path, and method.

Type: Boolean

Required: No

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

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

`Authorizer`

The `Authorizer` for a specific function.

If you have a global authorizer specified for your `AWS::Serverless::Api` resource, you can override the authorizer by setting `Authorizer` to `NONE`. For an example, see Override a global authorizer for your Amazon API Gateway REST API.

> **Note**
>
> If you use the `DefinitionBody` property of an `AWS::Serverless::Api` resource to describe your API, you must use `OverrideApiAuth` with `Authorizer` to override your global authorizer. See `OverrideApiAuth` for more information.

Valid values: `AWS_IAM`, `NONE`, or the logical ID for any authorizer defined in your AWS SAM template.

Type: String

Required: No

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

`InvokeRole`

Specifies the `InvokeRole` to use for `AWS_IAM` authorization.

Type: String

Required: No

Default: `CALLER_CREDENTIALS`

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

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

`OverrideApiAuth`

Specify as `true` to override the global authorizer configuration of your `AWS::Serverless::Api` resource. This property is only required if you specify a global authorizer and use the `DefinitionBody` property of an `AWS::Serverless::Api` resource to describe your API.

> **Note**
>
> When you specify `OverrideApiAuth` as `true`, AWS SAM will override your global authorizer with any values provided for `ApiKeyRequired`, `Authorizer`, or `ResourcePolicy`. Therefore, at least one of these properties must also be specified when using `OverrideApiAuth`. For an example, see Override a global authorizer when DefinitionBody for AWS::Serverless::Api is specified.

Type: Boolean

Required: No

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

`ResourcePolicy`

Configure Resource Policy for this path on an API.

Type: ResourcePolicyStatement

Required: No

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

Examples

Function-Auth

The following example specifies authorization at the function level.

YAML

```
Auth:
  ApiKeyRequired: true
  Authorizer: NONE
```

Override a global authorizer for your Amazon API Gateway REST API

You can specify a global authorizer for your `AWS::Serverless::Api` resource. The following is an example that configures a global default authorizer:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyApiWithLambdaRequestAuth:
    Type: AWS::Serverless::Api
    Properties:
      ...
      Auth:
        Authorizers:
          MyLambdaRequestAuth:
            FunctionArn: !GetAtt MyAuthFn.Arn
        DefaultAuthorizer: MyLambdaRequestAuth
```

To override the default authorizer for your AWS Lambda function, you can specify `Authorizer` as `NONE`. The following is an example:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  ...
  MyFn:
    Type: AWS::Serverless::Function
    Properties:
      ...
      Events:
        LambdaRequest:
          Type: Api
          Properties:
            RestApiId: !Ref MyApiWithLambdaRequestAuth
            Method: GET
            Auth:
              Authorizer: NONE
```

Override a global authorizer when DefinitionBody for AWS::Serverless::Api is specified

When using the `DefinitionBody` property to describe your `AWS::Serverless::Api` resource, the previous override method does not work. The following is an example of using the `DefinitionBody` property for an `AWS::Serverless::Api` resource:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyApiWithLambdaRequestAuth:
    Type: AWS::Serverless::Api
    Properties:
      ...
      DefinitionBody:
        swagger: 2.0
        ...
        paths:
          /lambda-request:
            ...
      Auth:
        Authorizers:
```

```
          MyLambdaRequestAuth:
            FunctionArn: !GetAtt MyAuthFn.Arn
        DefaultAuthorizer: MyLambdaRequestAuth
```

To override the global authorizer, use the `OverrideApiAuth` property. The following is an example that uses `OverrideApiAuth` to override the global authorizer with the value provided for `Authorizer`:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyApiWithLambdaRequestAuth:
    Type: AWS::Serverless::Api
    Properties:
      ...
      DefinitionBody:
        swagger: 2-0
        ...
        paths:
          /lambda-request:
            ...
      Auth:
        Authorizers:
          MyLambdaRequestAuth:
            FunctionArn: !GetAtt MyAuthFn.Arn
        DefaultAuthorizer: MyLambdaRequestAuth

    MyAuthFn:
      Type: AWS::Serverless::Function
      ...

    MyFn:
      Type: AWS::Serverless::Function
        Properties:
          ...
          Events:
            LambdaRequest:
              Type: Api
              Properties:
                RestApiId: !Ref MyApiWithLambdaRequestAuth
                Method: GET
                Auth:
```

```
                    Authorizer: NONE
                    OverrideApiAuth: true
                  Path: /lambda-token
```

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 of String

Required: No

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

Required: No

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

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

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

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

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

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

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

`IpRangeWhitelist`

The IP addresses or address ranges to allow.

Type: List

Required: No

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

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

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

Configures a 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
ValidateBody: Boolean
ValidateParameters: Boolean
```

Properties

`Model`

Name of a model defined in the Models property of the AWS::Serverless::Api.

Type: String

Required: Yes

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

`Required`

Adds a `required` property in the parameters section of the OpenApi definition for the given API endpoint.

Type: Boolean

Required: No

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

`ValidateBody`

Specifies whether API Gateway uses the `Model` to validate the request body. For more information, see Enable request validation in API Gateway in the *API Gateway Developer Guide*.

Type: Boolean

Required: No

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

`ValidateParameters`

Specifies whether API Gateway uses the `Model` to validate request path parameters, query strings, and headers. For more information, see Enable request validation in API Gateway in the *API Gateway Developer Guide*.

Type: Boolean

Required: No

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

Examples

Request Model

Request Model Example

YAML

```
RequestModel:
  Model: User
  Required: true
  ValidateBody: true
  ValidateParameters: 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

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

`Required`

This field specifies whether a parameter is required

Type: Boolean

Required: Conditional

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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 is the preferred event source type to use, instead of `CloudWatchEvent`. `EventBridgeRule` and `CloudWatchEvent` use the same underlying service, API, and 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
Enabled: Boolean
EventBusName: String
Input: String
InputPath: String
Pattern: EventPattern
State: String
```

Properties

`Enabled`

Indicates whether the rule is enabled.

To disable the rule, set this property to `false`.

> **Note**
>
> Specify either the `Enabled` or `State` property, but not both.

Type: Boolean

Required: No

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`.

`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

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

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

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

CloudFormation compatibility: This property is passed directly to the `EventPattern` property of an `AWS::Events::Rule` resource.

`State`

The state of the rule.

Accepted values: `DISABLED | ENABLED`

> **Note**
>
> Specify either the `Enabled` or `State` property, but not both.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `State` 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:
    Enabled: false
    Input: '{"Key": "Value"}'
    Pattern:
      detail:
        state:
          - running
```

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

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

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

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

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

Examples

Cognito Event

Cognito Event Example

YAML

```
CognitoUserPoolPreSignup:
  Type: Cognito
  Properties:
    UserPool:
      Ref: MyCognitoUserPool
    Trigger: PreSignUp
```

DocumentDB

The object describing a `DocumentDB` event source type. For more information, see Using AWS Lambda with Amazon DocumentDB in the *AWS Lambda Developer Guide*.

Syntax

To declare this entity in your AWS SAM template, use the following syntax.

YAML

```
BatchSize: Integer
Cluster: String
CollectionName: String
DatabaseName: String
Enabled: Boolean
FilterCriteria: FilterCriteria
FullDocument: String
KmsKeyArn: String
MaximumBatchingWindowInSeconds: Integer
SecretsManagerKmsKeyId: String
SourceAccessConfigurations: List
StartingPosition: String
StartingPositionTimestamp: Double
```

Properties

`BatchSize`

The maximum number of items to retrieve in a single batch.

Type: Integer

Required: No

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

`Cluster`

The Amazon Resource Name (ARN) of the Amazon DocumentDB cluster.

Type: String

Required: Yes

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

`CollectionName`

The name of the collection to consume within the database. If you do not specify a collection, Lambda consumes all collections.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `CollectionName` property of an `AWS::Lambda::EventSourceMapping` `DocumentDBEventSourceConfig` data type.

`DatabaseName`

The name of the database to consume within the Amazon DocumentDB cluster.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `DatabaseName` property of an `AWS::Lambda::EventSourceMapping` `DocumentDBEventSourceConfig`data type.

`Enabled`

If `true`, the event source mapping is active. To pause polling and invocation, set to `false`.

Type: Boolean

Required: No

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

`FilterCriteria`

An object that defines the criteria that determines whether Lambda should process an event. For more information, see Lambda event filtering in the *AWS Lambda Developer Guide*.

Type: FilterCriteria

Required: No

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

`FullDocument`

Determines what Amazon DocumentDB sends to your event stream during document update operations. If set to `UpdateLookup`, Amazon DocumentDB sends a delta describing the changes, along with a copy of the entire document. Otherwise, Amazon DocumentDB sends only a partial document that contains the changes.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `FullDocument` property of an `AWS::Lambda::EventSourceMapping` `DocumentDBEventSourceConfig` data type.

`KmsKeyArn`

The Amazon Resource Name (ARN) of the key to encrypt information related to this event.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `KmsKeyArn` 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

CloudFormation compatibility: This property is passed directly to the `MaximumBatchingWindowInSeconds` 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. Required when you use a customer managed key from Secrets Manager with a Lambda execution role that 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

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

`SourceAccessConfigurations`

An array of the authentication protocol or virtual host. Specify this using the SourceAccessConfigurations data type.

For the `DocumentDB` event source type, the only valid configuration type is `BASIC_AUTH`.

- `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.

Type: List

Required: Yes

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

`StartingPosition`

The position in a stream from which to start reading.

- `AT_TIMESTAMP` – Specify a time from which to start reading records.
- `LATEST` – Read only new records.
- `TRIM_HORIZON` – Process all available records.

Type: String

Required: Yes

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

`StartingPositionTimestamp`

The time from which to start reading, in Unix time seconds. Define `StartingPositionTimestamp` when `StartingPosition` is specified as `AT_TIMESTAMP`.

Type: Double

Required: No

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

Examples

Amazon DocumentDB event source

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyFunction:
    Type: AWS::Serverless::Function
```

```
    Properties:
    ...
      Events:
        MyDDBEvent:
          Type: DocumentDB
          Properties:
            Cluster: "arn:aws:rds:us-west-2:123456789012:cluster:docdb-2023-01-01"
            BatchSize: 10
            MaximumBatchingWindowInSeconds: 5
            DatabaseName: "db1"
            CollectionName: "collection1"
            FullDocument: "UpdateLookup"
            SourceAccessConfigurations:
              - Type: BASIC_AUTH
                URI: "arn:aws:secretsmanager:us-west-2:123456789012:secret:doc-db"
```

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
  FilterCriteria: FilterCriteria
  FunctionResponseTypes: List
  KmsKeyArn: String
  MaximumBatchingWindowInSeconds: Integer
  MaximumRecordAgeInSeconds: Integer
  MaximumRetryAttempts: Integer
  MetricsConfig: MetricsConfig
  ParallelizationFactor: Integer
  StartingPosition: String
```

```
  StartingPositionTimestamp: Double
  Stream: String
  TumblingWindowInSeconds: Integer
```

Properties

`BatchSize`

The maximum number of items to retrieve in a single batch.

Type: Integer

Required: No

Default: 100

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

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

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

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

`FilterCriteria`

A object that defines the criteria to determine whether Lambda should process an event. For more information, see AWS Lambda event filtering in the *AWS Lambda Developer Guide*.

Type: FilterCriteria

Required: No

CloudFormation compatibility: This property is passed directly to the `FilterCriteria` 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

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

`KmsKeyArn`

The Amazon Resource Name (ARN) of the key to encrypt information related to this event.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `KmsKeyArn` 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

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

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

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

`MetricsConfig`

An opt-in configuration to get enhanced metrics for event source mappings that capture each stage of processing. For an example, see MetricsConfig event.

Type: MetricsConfig

Required: No

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

`ParallelizationFactor`

The number of batches to process from each shard concurrently.

Type: Integer

Required: No

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.

- `AT_TIMESTAMP` – Specify a time from which to start reading records.
- `LATEST` – Read only new records.
- `TRIM_HORIZON` – Process all available records.

Valid values: `AT_TIMESTAMP` | `LATEST` | `TRIM_HORIZON`

Type: String

Required: Yes

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

`StartingPositionTimestamp`

The time from which to start reading, in Unix time seconds. Define `StartingPositionTimestamp` when `StartingPosition` is specified as `AT_TIMESTAMP`.

Type: Double

Required: No

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

`Stream`

The Amazon Resource Name (ARN) of the DynamoDB stream.

Type: String

Required: Yes

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

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

Examples

MetricsConfig event

The following is an example of a resource that uses the `MetricsConfig` property to capture each stage of processing for their event source mappings.

```
Resources:
  FilteredEventsFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: s3://sam-demo-bucket/metricsConfig.zip
      Handler: index.handler
```

```
      Runtime: nodejs16.x
      Events:
        KinesisStream:
          Type: Kinesis
          Properties:
            Stream: !GetAtt KinesisStream.Arn
            StartingPosition: LATEST
            MetricsConfig:
              Metrics:
              - EventCount
```

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. AWS SAM also creates an `AWS::Lambda::Permission` resource, which is needed so the `EventBridgeRule` can call Lambda.

Syntax

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

YAML

```
DeadLetterConfig: DeadLetterConfig
EventBusName: String
Input: String
InputPath: String
InputTransformer: InputTransformer
Pattern: EventPattern
RetryPolicy: RetryPolicy
RuleName: String
State: String
Target: Target
```

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 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 Dead-letter queues in the *AWS Lambda Developer Guide*.

Type: DeadLetterConfig

Required: No

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

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

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

CloudFormation compatibility: This property is passed directly to the `InputPath` property of an `AWS::Events::Rule Target` resource.

`InputTransformer`

Settings to enable you to provide custom input to a target based on certain event data. You can extract one or more key-value pairs from the event and then use that data to send customized input to the target. For more information, see Amazon EventBridge input transformation in the *Amazon EventBridge User Guide*.

Type: InputTransformer

Required: No

CloudFormation compatibility: This property is passed directly to the `InputTransformer` property of an `AWS::Events::Rule Target` data type.

`Pattern`

Describes which events are routed to the specified target. For more information, see Amazon EventBridge events and EventBridge event patterns in the *Amazon EventBridge User Guide*.

Type: EventPattern

Required: Yes

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

CloudFormation compatibility: This property is passed directly to the `RetryPolicy` property of the `AWS::Events::Rule Target` data type.

`RuleName`

The name of the rule.

Type: String

Required: No

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

`State`

The state of the rule.

Accepted values: `DISABLED` | `ENABLED` | `ENABLED_WITH_ALL_CLOUDTRAIL_MANAGEMENT_EVENTS`

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `State` property of an `AWS::Events::Rule` resource.

`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

Required: No

CloudFormation compatibility: This property is similar to the `Targets` property of an `AWS::Events::Rule` resource. `Amazon EC2 RebootInstances API call` is an example of

a target property. 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 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 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

```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

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

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

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

CloudFormation compatibility: This property is passed directly to the `Id` property of the `AWS::Events::Rule Target` data type.

Examples

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

```yaml
ApiId: String
Auth: HttpApiFunctionAuth
Method: String
Path: String
PayloadFormatVersion: String
RouteSettings: RouteSettings
TimeoutInMillis: Integer
```

Properties

`ApiId`

Identifier of an AWS::Serverless::HttpApi resource defined in this template.

If not defined, a default AWS::Serverless::HttpApi 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 resource defined in another template.

Type: String

Required: No

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

Required: No

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

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

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

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

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

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

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

`Authorizer`

The `Authorizer` for a specific Function. To use IAM authorization, specify `AWS_IAM` and specify `true` for `EnableIamAuthorizer` in the `Globals` section of your template.

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

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

Examples

Function-Auth

Specifing Authorization at Function level

YAML

```
Auth:
  Authorizer: OpenIdAuth
  AuthorizationScopes:
    - scope1
    - scope2
```

IAM authorization

Specifies IAM authorization at the event level. To use `AWS_IAM` authorization at the event level, you must also specify `true` for `EnableIamAuthorizer` in the `Globals` section of your template. For more information, see Globals section of the AWS SAM template.

YAML

```
Globals:
  HttpApi:
    Auth:
      EnableIamAuthorizer: true

Resources:
  HttpApiFunctionWithIamAuth:
    Type: AWS::Serverless::Function
    Properties:
      Events:
        ApiEvent:
          Type: HttpApi
          Properties:
            Path: /iam-auth
            Method: GET
            Auth:
              Authorizer: AWS_IAM
```

```
      Handler: index.handler
      InlineCode: |
        def handler(event, context):
          return {'body': 'HttpApiFunctionWithIamAuth', 'statusCode': 200}
      Runtime: python3.9
```

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 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

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

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
  FilterCriteria: FilterCriteria
  FunctionResponseTypes: List
  KmsKeyArn: String
  MaximumBatchingWindowInSeconds: Integer
  MaximumRecordAgeInSeconds: Integer
  MaximumRetryAttempts: Integer
  MetricsConfig: MetricsConfig
  ParallelizationFactor: Integer
```

```
  StartingPosition: String
  StartingPositionTimestamp: Double
  Stream: String
  TumblingWindowInSeconds: Integer
```

Properties

`BatchSize`

The maximum number of items to retrieve in a single batch.

Type: Integer

Required: No

Default: 100

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

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

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

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

`FilterCriteria`

A object that defines the criteria to determine whether Lambda should process an event. For more information, see AWS Lambda event filtering in the *AWS Lambda Developer Guide*.

Type: FilterCriteria

Required: No

CloudFormation compatibility: This property is passed directly to the `FilterCriteria` 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

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

`KmsKeyArn`

The Amazon Resource Name (ARN) of the key to encrypt information related to this event.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `KmsKeyArn` 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

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

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

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

`MetricsConfig`

An opt-in configuration to get enhanced metrics for event source mappings that capture each stage of processing. For an example, see MetricsConfig event.

Type: MetricsConfig

Required: No

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

`ParallelizationFactor`

The number of batches to process from each shard concurrently.

Type: Integer

Required: No

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.

- `AT_TIMESTAMP` – Specify a time from which to start reading records.
- `LATEST` – Read only new records.
- `TRIM_HORIZON` – Process all available records.

Valid values: `AT_TIMESTAMP` | `LATEST` | `TRIM_HORIZON`

Type: String

Required: Yes

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

`StartingPositionTimestamp`

The time from which to start reading, in Unix time seconds. Define `StartingPositionTimestamp` when `StartingPosition` is specified as `AT_TIMESTAMP`.

Type: Double

Required: No

CloudFormation compatibility: This property is passed directly to the `StartingPositionTimestamp` 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

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

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

Examples

MetricsConfig event

The following is an example of a resource that uses the `MetricsConfig` property to capture each stage of processing for their event source mappings.

```
Resources:
  FilteredEventsFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: s3://sam-demo-bucket/metricsConfig.zip
      Handler: index.handler
      Runtime: nodejs16.x
      Events:
        KinesisStream:
          Type: Kinesis
          Properties:
            Stream: !GetAtt KinesisStream.Arn
```

```
            StartingPosition: LATEST
            MetricsConfig:
              Metrics:
              - EventCount
```

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
      FilterCriteria:
        Filters:
          - Pattern: '{"key": ["val1", "val2"]}'
```

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 Serverless Application Model (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) that connects to a 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 SAM template, use the following syntax.

YAML

```yaml
BatchSize: Integer
Broker: String
DynamicPolicyName: Boolean
Enabled: Boolean
FilterCriteria: FilterCriteria
KmsKeyArn: String
MaximumBatchingWindowInSeconds: Integer
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

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

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

`DynamicPolicyName`

By default, the AWS Identity and Access Management (IAM) policy name is `SamAutoGeneratedAMQPolicy` for backward compatibility. Specify `true` to use an auto-generated name for your IAM policy. This name will include the Amazon MQ event source logical ID.

> **Note**
>
> When using more than one Amazon MQ event source, specify `true` to avoid duplicate IAM policy names.

Type: Boolean

Required: No

Default: `false`

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

`Enabled`

If `true`, the event source mapping is active. To pause polling and invocation, set to `false`.

Type: Boolean

Required: No

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

`FilterCriteria`

A object that defines the criteria that determines whether Lambda should process an event. For more information, see AWS Lambda event filtering in the *AWS Lambda Developer Guide*.

Type: FilterCriteria

Required: No

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

`KmsKeyArn`

The Amazon Resource Name (ARN) of the key to encrypt information related to this event.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `KmsKeyArn` 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

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

`Queues`

The name of the Amazon MQ broker destination queue to consume.

Type: List

Required: Yes

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. Required when you use a customer managed key from Secrets Manager with a Lambda execution role that doesn't included the `kms:Decrypt` permission.

The value of this property is a UUID. For example: `1abc23d4-567f-8ab9-cde0-1fab234c5d67`.

Type: String

Required: Conditional

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

`SourceAccessConfigurations`

An array of the authentication protocol or vitual host. Specify this using the SourceAccessConfigurations data type.

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

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 Serverless Application Model (AWS SAM) generates an AWS::Lambda::EventSourceMapping resource when this event type is set.

To use Schema Registry, you need to define specific IAM role permissions for your function. See Complete setup with IAM roles for an example of the required configuration.

Syntax

To declare this entity in your AWS SAM template, use the following syntax.

YAML

```
  BatchSize: Integer
  BisectBatchOnFunctionError: Boolean
  ConsumerGroupId: String
  DestinationConfig: DestinationConfig
  Enabled: Boolean
  FilterCriteria: FilterCriteria
  FunctionResponseTypes: List
  KmsKeyArn: String
  MaximumBatchingWindowInSeconds: Integer
  MaximumRecordAgeInSeconds: Integer
  MaximumRetryAttempts: Integer
```

```
  LoggingConfig: LoggingConfig
  MetricsConfig: MetricsConfig
  ProvisionedPollerConfig: ProvisionedPollerConfig
  SchemaRegistryConfig: SchemaRegistryConfig
  SourceAccessConfigurations: SourceAccessConfigurations
  StartingPosition: String
  StartingPositionTimestamp: Double
  Stream: String
  Topics: List
```

Properties

`BatchSize`

The maximum number of records in each batch that Lambda pulls from your stream or queue and sends to your function. Lambda passes all of the records in the batch to the function in a single call, up to the payload limit for synchronous invocation (6 MB).

Default: 100

Valid Range: Minimum value of 1. Maximum value of 10,000.

Type: Integer

Required: No

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

`BisectBatchOnFunctionError`

If the function returns an error, split the batch in two and retry.

Type: Boolean

Required: No

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

`ConsumerGroupId`

A string that configures how events will be read from Kafka topics.

Type: String

Required: No

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

`DestinationConfig`

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

Use this property to specify the destination of failed invocations from the Amazon MSK event source.

Type: DestinationConfig

Required: No

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

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

`FilterCriteria`

A object that defines the criteria that determines whether Lambda should process an event. For more information, see AWS Lambda event filtering in the *AWS Lambda Developer Guide*.

Type: FilterCriteria

Required: No

CloudFormation compatibility: This property is passed directly to the `FilterCriteria` 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

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

`KmsKeyArn`

The Amazon Resource Name (ARN) of the key to encrypt information related to this event.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `KmsKeyArn` 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

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

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

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

`LoggingConfig`

A configuration object that specifies the logging configuration for the event source mapping.

Type: LoggingConfig

Required: No

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

`MetricsConfig`

A configuration object that specifies the metrics configuration for the event source mapping.

Type: MetricsConfig

Required: No

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

`ProvisionedPollerConfig`

Configuration to increase the amount of pollers used to compute event source mappings. This configuration allows for a minimum of 1 poller and a maximum of 2000 pollers. For an example, refer to ProvisionedPollerConfig example.

Type: ProvisionedPollerConfig

Required: No

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

`SchemaRegistryConfig`

Configuration for using a schema registry with the Kafka event source.

> **Note**
>
> This feature requires `ProvisionedPollerConfig` to be configured.

Type: SchemaRegistryConfig

Required: No

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

`SourceAccessConfigurations`

An array of the authentication protocol, VPC components, or virtual host to secure and define your event source.

Valid values: `CLIENT_CERTIFICATE_TLS_AUTH`

Type: List of SourceAccessConfiguration

Required: No

CloudFormation compatibility: This propertyrty is part of the AmazonManagedKafkaEventSourceConfig property of an `AWS::Lambda::EventSourceMapping` resource.

`StartingPosition`

The position in a stream from which to start reading.

- `AT_TIMESTAMP` – Specify a time from which to start reading records.
- `LATEST` – Read only new records.

- `TRIM_HORIZON` – Process all available records.

Valid values: `AT_TIMESTAMP` | `LATEST` | `TRIM_HORIZON`

Type: String

Required: No

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

`StartingPositionTimestamp`

The time from which to start reading, in Unix time seconds. Define `StartingPositionTimestamp` when `StartingPosition` is specified as `AT_TIMESTAMP`.

Type: Double

Required: No

CloudFormation compatibility: This property is passed directly to the `StartingPositionTimestamp` 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

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

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

Examples

Complete setup with IAM roles

The following example shows a complete setup including the required IAM role configuration for using Schema Registry:

```
Parameters:
  PreCreatedSubnetOne:
    Type: String
  PreCreatedSubnetTwo:
    Type: String
  MskClusterName4:
    Type: String

Resources:
  MyLambdaExecutionRole:
    Type: AWS::IAM::Role
    Properties:
      AssumeRolePolicyDocument:
        Version: '2012-10-17       '
        Statement:
        - Action: [sts:AssumeRole]
          Effect: Allow
          Principal:
            Service: [lambda.amazonaws.com]
      Policies:
      - PolicyName: KafkaClusterPermissions
        PolicyDocument:
          Statement:
          - Action: [kafka:DescribeClusterV2, kafka:GetBootstrapBrokers]
            Effect: Allow
            Resource: 'arn:aws:kafka:us-east-1:123456789012:cluster/*'
      - PolicyName: KafkaAuthPolicy
        PolicyDocument:
          Statement:
          - Action: [secretsmanager:GetSecretValue, kms:Decrypt]
            Effect: "Allow"
            Resource: ['arn:aws:secretsmanager:us-
west-2:123456789012:secret:kafkaSecret-******',
                        'arn:aws:kms:us-west-2:123456789012:key/keyId']
      - PolicyName: ENIPolicy
        PolicyDocument:
          Statement:
```

```
          - Action: [ec2:CreateNetworkInterface,
              ec2:DescribeNetworkInterfaces, ec2:DescribeVpcs,
 ec2:DeleteNetworkInterface,
              ec2:DescribeSubnets, ec2:DescribeSecurityGroups]
            Effect: Allow
            Resource: '*'
      - PolicyName: SchemaRegistryPolicy
        PolicyDocument:
          Statement:
          - Action: [glue:GetRegistry]
            Effect: Allow
            Resource: 'arn:aws:glue:{region}:{account-id}:registry/{registry-name}'
      - PolicyName: SchemaVersionsPolicy
        PolicyDocument:
          Statement:
          - Action: [glue:GetSchemaVersions]
            Effect: Allow
            Resource: '*'
      ManagedPolicyArns:
      - !Sub arn:${AWS::Partition}:iam::aws:policy/service-role/
AWSLambdaBasicExecutionRole
      Tags:
      - {Value: SAM, Key: lambda:createdBy}

  MyMskCluster:
    Type: AWS::MSK::Cluster
    Properties:
      BrokerNodeGroupInfo:
        ClientSubnets:
        - Ref: PreCreatedSubnetOne
        - Ref: PreCreatedSubnetTwo
        InstanceType: kafka.t3.small
        StorageInfo:
          EBSStorageInfo:
            VolumeSize: 1
      ClusterName:
        Ref: MskClusterName4
      KafkaVersion: 3.8.x
      NumberOfBrokerNodes: 2

  MyMskStreamProcessor:
    Type: AWS::Serverless::Function
    Properties:
      Runtime: nodejs18.x
```

```
      Handler: index.handler
      CodeUri: ${codeuri}
      Role:
        Fn::GetAtt: [MyLambdaExecutionRole, Arn]
      Events:
        MyMskEvent:
          Type: MSK
          Properties:
            StartingPosition: LATEST
            Stream:
              Ref: MyMskCluster
            SourceAccessConfigurations:
            - Type: SASL_SCRAM_512_AUTH
              URI: !Sub arn:${AWS::Partition}:secretsmanager:us-
west-2:123456789012:secret:my-path/my-secret-name-1a2b3c
            Topics:
            - SchemaRegistryTestTopic
            ProvisionedPollerConfig:
              MinimumPollers: 1
            SchemaRegistryConfig:
              AccessConfigs:
              - Type: BASIC_AUTH
                URI: !Sub arn:${AWS::Partition}:secretsmanager:us-
west-2:123456789012:secret:my-path/my-secret-name-1a2b3c
              SchemaValidationConfigs:
              - Attribute: KEY
              EventRecordFormat: JSON
              SchemaRegistryURI: !Sub arn:${AWS::Partition}:glue:us-
west-2:123456789012:registry/myregistry
```

ProvisionedPollerConfig example

```
ProvisionedPollerConfig:
  MinimumPollers: 1
  MaximumPollers: 200
```

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
```

MSK Event Source with Schema Registry

The following is an example of an `MSK` event source type configured with a schema registry.

```
Events:
  MSKEvent:
    Type: MSK
    Properties:
      StartingPosition: LATEST
      Stream:
        Ref: MyMskCluster
```

```
      Topics:
        - SchemaRegistryTestTopic
      ProvisionedPollerConfig:
        MinimumPollers: 1
      SchemaRegistryConfig:
        SchemaRegistryURI: !Sub arn:${AWS::Partition}:glue:us-
west-2:123456789012:registry/myregistry
        EventRecordFormat: JSON
        SchemaValidationConfigs:
          - Attribute: KEY
          - Attribute: VALUE
```

MSK Event Source with Confluent Schema Registry

The following is an example of an `MSK` event source type configured with a Confluent Schema Registry.

```
Events:
  MSKEvent:
    Type: MSK
    Properties:
      StartingPosition: LATEST
      Stream:
        Ref: MyMskCluster
      Topics:
        - SchemaRegistryTestTopic
      ProvisionedPollerConfig:
        MinimumPollers: 1
      SchemaRegistryConfig:
        SchemaRegistryURI: https://my-schema-registry.confluent.cloud
        AccessConfigs:
          - Type: BASIC_AUTH
            URI: !Sub arn:${AWS::Partition}:secretsmanager:us-
west-2:123456789012:secret:my-secret
        EventRecordFormat: JSON
        SchemaValidationConfigs:
          - Attribute: KEY
          - Attribute: VALUE
```

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

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

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

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 Amazon 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.

> **Note**
>
> EventBridge now offers a new scheduling capability, Amazon EventBridge Scheduler. Amazon EventBridge Scheduler is a serverless scheduler that allows you to create, run,

and manage tasks from one central, managed service. EventBridge Scheduler is highly customizable, and offers improved scalability over EventBridge scheduled rules, with a wider set of target API operations and AWS services.
We recommend that you use EventBridge Scheduler to invoke targets on a schedule. To define this event source type in your AWS SAM templates, see ScheduleV2.

Syntax

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

YAML

```yaml
DeadLetterConfig: DeadLetterConfig
Description: String
Enabled: Boolean
Input: String
Name: String
RetryPolicy: RetryPolicy
Schedule: String
State: 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 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 Dead-letter queues in the *AWS Lambda Developer Guide*.

Type: DeadLetterConfig

Required: No

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

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`.

> **Note**
>
> Specify either the `Enabled` or `State` property, but not both.

Type: Boolean

Required: No

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

CloudFormation compatibility: This property is passed directly to the `Input` property of an `AWS::Events::Rule Target` resource.

`Name`

The name of the rule. If you don't specify a name, CloudFormation generates a unique physical ID and uses that ID for the rule name.

Type: String

Required: No

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

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

CloudFormation compatibility: This property is passed directly to the `ScheduleExpression` property of an `AWS::Events::Rule` resource.

`State`

The state of the rule.

Accepted values: `DISABLED | ENABLED`

> **Note**
>
> Specify either the `Enabled` or `State` property, but not both.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `State` 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 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 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

```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

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

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

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

Examples

DeadLetterConfig

DeadLetterConfig

YAML

```
DeadLetterConfig:
  Type: SQS
  QueueLogicalId: MyDLQ
```

ScheduleV2

The object describing a `ScheduleV2` event source type, which sets your serverless function as the target of an Amazon EventBridge Scheduler event that triggers on a schedule. For more information, see What is Amazon EventBridge Scheduler? in the *EventBridge Scheduler User Guide*.

AWS Serverless Application Model (AWS SAM) generates an AWS::Scheduler::Schedule 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
Description: String
EndDate: String
FlexibleTimeWindow: FlexibleTimeWindow
GroupName: String
Input: String
KmsKeyArn: String
Name: String
OmitName: Boolean
PermissionsBoundary: String
RetryPolicy: RetryPolicy
RoleArn: String
ScheduleExpression: String
ScheduleExpressionTimezone: String
StartDate: String
State: 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 Configuring a dead-letter queue for EventBridge Scheduler in the *EventBridge Scheduler User Guide*.

> **Note**
>
> The AWS::Serverless::Function 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 Dead-letter queues in the *AWS Lambda Developer Guide*.

Type: DeadLetterConfig

Required: No

CloudFormation compatibility: This property is similar to the `DeadLetterConfig` property of the `AWS::Scheduler::Schedule 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 schedule.

Type: String

Required: No

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

`EndDate`

The date, in UTC, before which the schedule can invoke its target. Depending on the schedule's recurrence expression, invocations might stop on, or before, the **EndDate** you specify.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `EndDate` property of an `AWS::Scheduler::Schedule` resource.

`FlexibleTimeWindow`

Allows configuration of a window within which a schedule can be invoked.

Type: FlexibleTimeWindow

Required: No

CloudFormation compatibility: This property is passed directly to the `FlexibleTimeWindow` property of an `AWS::Scheduler::Schedule` resource.

`GroupName`

The name of the schedule group to associate with this schedule. If not defined, the default group is used.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `GroupName` property of an `AWS::Scheduler::Schedule` 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

CloudFormation compatibility: This property is passed directly to the `Input` property of an `AWS::Scheduler::Schedule Target` resource.

`KmsKeyArn`

The ARN for a KMS Key that will be used to encrypt customer data.

Type: String

Required: No

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

`Name`

The name of the schedule. If you don't specify a name, AWS SAM generates a name in the format *`Function-Logical-IDEvent-Source-Name`* and uses that ID for the schedule name.

Type: String

Required: No

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

`OmitName`

By default, AWS SAM generates and uses a schedule name in the format of *`<Function-logical-ID><event-source-name>`*. Set this property to `true` to have CloudFormation generate a unique physical ID and use that for the schedule name instead.

Type: Boolean

Required: No

Default: `false`

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

`PermissionsBoundary`

The ARN of the policy used to set the permissions boundary for the role.

> **Note**
>
> If `PermissionsBoundary` is defined, AWS SAM will apply the same boundaries to the scheduler schedule's target IAM role.

Type: String

Required: No

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

`RetryPolicy`

A **RetryPolicy** object that includes information about the retry policy settings.

Type: RetryPolicy

Required: No

CloudFormation compatibility: This property is passed directly to the `RetryPolicy` property of the `AWS::Scheduler::Schedule Target` data type.

`RoleArn`

The ARN of the IAM role that EventBridge Scheduler will use for the target when the schedule is invoked.

Type: RoleArn

Required: No

CloudFormation compatibility: This property is passed directly to the `RoleArn` property of the `AWS::Scheduler::Schedule Target` data type.

`ScheduleExpression`

The scheduling expression that determines when and how often the scheduler schedule event runs.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `ScheduleExpression` property of an `AWS::Scheduler::Schedule` resource.

`ScheduleExpressionTimezone`

The timezone in which the scheduling expression is evaluated.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `ScheduleExpressionTimezone` property of an `AWS::Scheduler::Schedule` resource.

`StartDate`

The date, in UTC, after which the schedule can begin invoking a target. Depending on the schedule's recurrence expression, invocations might occur on, or after, the **StartDate** you specify.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `StartDate` property of an `AWS::Scheduler::Schedule` resource.

`State`

The state of the Scheduler schedule.

Accepted values: `DISABLED | ENABLED`

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `State` property of an `AWS::Scheduler::Schedule` resource.

Examples

Basic example of defining a ScheduleV2 resource

```
Resources:
```

```
  Function:
    Properties:
      ...
      Events:
        ScheduleEvent:
          Type: ScheduleV2
          Properties:
            ScheduleExpression: "rate(1 minute)"
        ComplexScheduleEvent:
          Type: ScheduleV2
          Properties:
            ScheduleExpression: rate(1 minute)
            FlexibleTimeWindow:
              Mode: FLEXIBLE
              MaximumWindowInMinutes: 5
            StartDate: '2022-12-28T12:00:00.000Z'
            EndDate: '2023-01-28T12:00:00.000Z'
            ScheduleExpressionTimezone: UTC
            RetryPolicy:
              MaximumRetryAttempts: 5
              MaximumEventAgeInSeconds: 300
            DeadLetterConfig:
              Type: SQS
```

> **Note**
>
> The generated physical ID of ScheduleV2 does not include stack name.

SelfManagedKafka

The object describing a `SelfManagedKafka` event source type. For more information, see Using AWS Lambda with self-managed Apache Kafka in the *AWS Lambda Developer Guide*.

AWS Serverless Application Model (AWS SAM) generates an AWS::Lambda::EventSourceMapping resource when this event type is set.

To use Schema Registry, you need to define specific IAM role permissions for your function. See Complete setup with IAM roles for an example of the required configuration.

Syntax

To declare this entity in your AWS SAM template, use the following syntax.

YAML

```yaml
  BatchSize: Integer
  BisectBatchOnFunctionError: Boolean
  ConsumerGroupId: String
  DestinationConfig: DestinationConfig
  Enabled: Boolean
  FilterCriteria: FilterCriteria
  KafkaBootstrapServers: List
  FunctionResponseTypes: List
  KmsKeyArn: String
  LoggingConfig: LoggingConfig
  MaximumRecordAgeInSeconds: Integer
  MaximumRetryAttempts: Integer
  MetricsConfig: MetricsConfig
  ProvisionedPollerConfig: ProvisionedPollerConfig
  SchemaRegistryConfig: SchemaRegistryConfig
  SourceAccessConfigurations: SourceAccessConfigurations
  StartingPosition: String
  StartingPositionTimestamp: Double
  Topics: List
```

Properties

`BatchSize`

The maximum number of records in each batch that Lambda pulls from your stream and sends to your function.

Type: Integer

Required: No

Default: 100

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

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

`ConsumerGroupId`

A string that configures how events will be read from Kafka topics.

Type: String

Required: No

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

`DestinationConfig`

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

Use this property to specify the destination of failed invocations from the self-managed Kafka event source.

Type: DestinationConfig

Required: No

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

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

`FilterCriteria`

A object that defines the criteria to determine whether Lambda should process an event. For more information, see AWS Lambda event filtering in the *AWS Lambda Developer Guide*.

Type: FilterCriteria

Required: No

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

`KafkaBootstrapServers`

The list of bootstrap servers for your Kafka brokers. Include the port, for example `broker.example.com:xxxx`

Type: List

Required: No

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

`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

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

`KmsKeyArn`

The Amazon Resource Name (ARN) of the key to encrypt information related to this event.

Type: String

Required: No

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

`LoggingConfig`

The logging configuration for your event source.

Type: LoggingConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `LoggingConfig` 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

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

`MetricsConfig`

The metrics configuration for your event source.

Type: MetricsConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `MetricsConfig` 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

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

`ProvisionedPollerConfig`

Configuration to increase the amount of pollers used to compute event source mappings. This configuration allows for a minumum of 1 poller and a maximum of 2000 pollers. For an example, refer to ProvisionedPollerConfig example

Type: ProvisionedPollerConfig

Required: No

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

`SchemaRegistryConfig`

Configuration for using a schema registry with the self-managed Kafka event source.

> **Note**
>
> This feature requires `ProvisionedPollerConfig` to be configured.

Type: SchemaRegistryConfig

Required: No

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

`SourceAccessConfigurations`

An array of the authentication protocol, VPC components, or virtual host to secure and define your event source.

Valid values: `BASIC_AUTH | CLIENT_CERTIFICATE_TLS_AUTH | SASL_SCRAM_256_AUTH | SASL_SCRAM_512_AUTH | SERVER_ROOT_CA_CERTIFICATE`

Type: List of SourceAccessConfiguration

Required: Yes

CloudFormation compatibility: This property is part of the `SelfManagedKafkaEventSourceConfig` property of an `AWS::Lambda::EventSourceMapping` resource.

`StartingPosition`

The position in a stream from which to start reading.

- `AT_TIMESTAMP` – Specify a time from which to start reading records.
- `LATEST` – Read only new records.
- `TRIM_HORIZON` – Process all available records.

Valid values: `AT_TIMESTAMP` | `LATEST` | `TRIM_HORIZON`

Type: String

Required: No

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

`StartingPositionTimestamp`

The time from which to start reading, in Unix time seconds. Define `StartingPositionTimestamp` when `StartingPosition` is specified as `AT_TIMESTAMP`.

Type: Double

Required: No

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

`Topics`

The name of the Kafka topic.

Type: List

Required: Yes

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

Examples

Complete setup with IAM roles

The following example shows a complete setup including the required IAM role configuration for using Schema Registry:

```
Parameters:
  PreCreatedSubnetOne:
    Type: String
  PreCreatedSubnetTwo:
    Type: String

Resources:
  MyLambdaExecutionRole:
    Type: AWS::IAM::Role
    Properties:
      AssumeRolePolicyDocument:
        Version: '2012-10-17       '
        Statement:
        - Action: [sts:AssumeRole]
          Effect: Allow
          Principal:
            Service: [lambda.amazonaws.com]
      Policies:
      - PolicyName: KafkaAuthPolicy
        PolicyDocument:
          Statement:
          - Action: [secretsmanager:GetSecretValue, kms:Decrypt]
            Effect: "Allow"
            Resource: ['arn:aws:secretsmanager:us-
west-2:123456789012:secret:kafkaSecret-******',
                        'arn:aws:kms:us-west-2:123456789012:key/keyId']
      - PolicyName: ENIPolicy
        PolicyDocument:
          Statement:
          - Action: [ec2:CreateNetworkInterface,
              ec2:DescribeNetworkInterfaces, ec2:DescribeVpcs,
 ec2:DeleteNetworkInterface,
              ec2:DescribeSubnets, ec2:DescribeSecurityGroups]
            Effect: Allow
            Resource: '*'
      - PolicyName: SchemaRegistryPolicy
        PolicyDocument:
```

```
          Statement:
          - Action: [glue:GetRegistry]
            Effect: Allow
            Resource: 'arn:aws:glue:{region}:{account-id}:registry/{registry-name}'
      - PolicyName: SchemaVersionsPolicy
        PolicyDocument:
          Statement:
          - Action: [glue:GetSchemaVersions]
            Effect: Allow
            Resource: '*'
      ManagedPolicyArns:
      - !Sub arn:${AWS::Partition}:iam::aws:policy/service-role/
AWSLambdaBasicExecutionRole
      Tags:
      - {Value: SAM, Key: lambda:createdBy}

  MyKafkaProcessor:
    Type: AWS::Serverless::Function
    Properties:
      Runtime: nodejs18.x
      Handler: index.handler
      CodeUri: ${codeuri}
      Role:
        Fn::GetAtt: [MyLambdaExecutionRole, Arn]
      Events:
        SelfManagedKafkaEvent:
          Type: SelfManagedKafka
          Properties:
            KafkaBootstrapServers:
              - my-kafka-broker-1:9092
              - my-kafka-broker-2:9092
            Topics:
              - SchemaRegistryTestTopic
            StartingPosition: LATEST
            SourceAccessConfigurations:
              - Type: VPC_SUBNET
                URI: subnet:subnet-12345678
              - Type: VPC_SECURITY_GROUP
                URI: security_group:sg-12345678
              - Type: BASIC_AUTH
                URI: !Sub arn:${AWS::Partition}:secretsmanager:us-
west-2:123456789012:secret:my-path/my-secret-name-1a2b3c
            ProvisionedPollerConfig:
              MinimumPollers: 1
```

```
            SchemaRegistryConfig:
              AccessConfigs:
              - Type: BASIC_AUTH
                URI: !Sub arn:${AWS::Partition}:secretsmanager:us-
west-2:123456789012:secret:my-path/my-secret-name-1a2b3c
              SchemaValidationConfigs:
              - Attribute: KEY
              EventRecordFormat: JSON
              SchemaRegistryURI: !Sub arn:${AWS::Partition}:glue:us-
west-2:123456789012:registry/myregistry
```

ProvisionedPollerConfig example

```
ProvisionedPollerConfig:
  MinimumPollers: 1
  MaximumPollers: 200
```

Self-managed Kafka event source

The following is an example of a `SelfManagedKafka` event source type.

YAML

```
Events:
  SelfManagedKafkaEvent:
    Type: SelfManagedKafka
    Properties:
      BatchSize: 1000
      Enabled: true
      KafkaBootstrapServers:
        - abc.xyz.com:xxxx
      SourceAccessConfigurations:
        -  Type: BASIC_AUTH
           URI: arn:aws:secretsmanager:us-west-2:123456789012:secret:my-path/my-secret-
name-1a2b3c
      Topics:
        - MyKafkaTopic
```

Self-managed Kafka Event Source with AWS Glue Schema Registry

The following is an example of a `SelfManagedKafka` event source type configured with AWS Glue Schema Registry.

```
Events:
  SelfManagedKafkaEvent:
    Type: SelfManagedKafka
    Properties:
      KafkaBootstrapServers:
        - abc.xyz.com:9092
      Topics:
        - SchemaRegistryTestTopic
      StartingPosition: LATEST
      ProvisionedPollerConfig:
        MinimumPollers: 1
      SchemaRegistryConfig:
        SchemaRegistryURI: !Sub arn:${AWS::Partition}:glue:us-
west-2:123456789012:registry/myregistry
        EventRecordFormat: JSON
        SchemaValidationConfigs:
          - Attribute: KEY
          - Attribute: VALUE
      SourceAccessConfigurations:
        - Type: VPC_SUBNET
          URI: subnet:subnet-12345678
        - Type: VPC_SECURITY_GROUP
          URI: security_group:sg-12345678
```

Self-managed Kafka Event Source with Confluent Schema Registry

The following is an example of a `SelfManagedKafka` event source type configured with Confluent Schema Registry.

```
Events:
  SelfManagedKafkaEvent:
    Type: SelfManagedKafka
    Properties:
      KafkaBootstrapServers:
        - abc.xyz.com:9092
      Topics:
        - SchemaRegistryTestTopic
      StartingPosition: LATEST
      ProvisionedPollerConfig:
        MinimumPollers: 1
      SchemaRegistryConfig:
        SchemaRegistryURI: https://my-schema-registry.confluent.cloud
        AccessConfigs:
```

```
          - Type: BASIC_AUTH
            URI: !Sub arn:${AWS::Partition}:secretsmanager:us-
west-2:123456789012:secret:my-secret
        EventRecordFormat: JSON
        SchemaValidationConfigs:
          - Attribute: KEY
          - Attribute: VALUE
      SourceAccessConfigurations:
        - Type: VPC_SUBNET
          URI: subnet:subnet-12345678
        - Type: VPC_SECURITY_GROUP
          URI: security_group:sg-12345678
        - Type: BASIC_AUTH
          URI: !Sub arn:${AWS::Partition}:secretsmanager:us-
west-2:123456789012:secret:kafka-secret
```

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
  FilterPolicyScope: String
  RedrivePolicy: Json
  Region: String
  SqsSubscription: Boolean | SqsSubscriptionObject
  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

CloudFormation compatibility: This property is passed directly to the `FilterPolicy` property of an `AWS::SNS::Subscription` resource.

`FilterPolicyScope`

This attribute lets you choose the filtering scope by using one of the following string value types:

- `MessageAttributes` – The filter is applied on the message attributes.
- `MessageBody` – The filter is applied on the message body.

Type: String

Required: No

Default: `MessageAttributes`

CloudFormation compatibility: This property is passed directly to the `FilterPolicyScope` property of an `AWS::SNS::Subscription` resource.

`RedrivePolicy`

When specified, sends undeliverable messages to the specified Amazon SQS dead-letter queue. Messages that can't be delivered due to client errors (for example, when the subscribed endpoint is unreachable) or server errors (for example, when the service that powers the subscribed endpoint becomes unavailable) are held in the dead-letter queue for further analysis or reprocessing.

For more information about the redrive policy and dead-letter queues, see Amazon SQS dead-letter queues in the *Amazon Simple Queue Service Developer Guide*.

Type: Json

Required: No

CloudFormation compatibility: This property is passed directly to the `RedrivePolicy` 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

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

Required: No

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

`Topic`

The ARN of the topic to subscribe to.

Type: String

Required: Yes

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

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

`Enabled`

Disables the SQS event source mapping to pause polling and invocation.

Type: Boolean

Required: No

Default: True

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

`QueueArn`

Specify an existing SQS queue arn.

Type: String

Required: Yes

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

`QueuePolicyLogicalId`

Give a custom logicalId name for the AWS::SQS::QueuePolicy resource.

Type: String

Required: No

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

`QueueUrl`

Specify the queue URL associated with the `QueueArn` property.

Type: String

Required: Yes

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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
  FilterCriteria: FilterCriteria
  FunctionResponseTypes: List
  KmsKeyArn: String
  MaximumBatchingWindowInSeconds: Integer
  MetricsConfig: MetricsConfig
```

```
  ProvisionedPollerConfig: ProvisionedPollerConfig
  Queue: String
  ScalingConfig: ScalingConfig
```

Properties

`BatchSize`

The maximum number of items to retrieve in a single batch.

Type: Integer

Required: No

Default: 10

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

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

`FilterCriteria`

A object that defines the criteria to determine whether Lambda should process an event. For more information, see AWS Lambda event filtering in the *AWS Lambda Developer Guide*.

Type: FilterCriteria

Required: No

CloudFormation compatibility: This property is passed directly to the `FilterCriteria` 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

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

`KmsKeyArn`

The Amazon Resource Name (ARN) of the key to encrypt information related to this event.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `KmsKeyArn` 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

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

`MetricsConfig`

An opt-in configuration to get enhanced metrics for event source mappings that capture each stage of processing. For an example, see MetricsConfig event.

Type: MetricsConfig

Required: No

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

`ProvisionedPollerConfig`

Configuration to increase the amount of pollers used to compute event source mappings. This configuration allows for a minimum of 2 pollers and a maximum of 2000 pollers. For an example, refer to ProvisionedPollerConfig example.

Type: ProvisionedPollerConfig

Required: No

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

`Queue`

The ARN of the queue.

Type: String

Required: Yes

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

`ScalingConfig`

Scaling configuration of SQS pollers to control the invoke rate and set maximum concurrent invokes.

Type: `ScalingConfig`

Required: No

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

Examples

MetricsConfig event

The following is an example of a resource that uses the `MetricsConfig` property to capture each stage of processing for their event source mappings.

```
Resources:
  FilteredEventsFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: s3://sam-demo-bucket/metricsConfig.zip
      Handler: index.handler
      Runtime: nodejs16.x
      Events:
        KinesisStream:
          Type: Kinesis
          Properties:
            Stream: !GetAtt KinesisStream.Arn
            StartingPosition: LATEST
            MetricsConfig:
              Metrics:
              - EventCount
```

Basic SQS event

```
Events:
  SQSEvent:
    Type: SQS
    Properties:
      Queue: arn:aws:sqs:us-west-2:012345678901:my-queue
      BatchSize: 10
      Enabled: false
      FilterCriteria:
        Filters:
          - Pattern: '{"key": ["val1", "val2"]}'
```

Configure partial batch reporting for your SQS queue

```
Events:
  SQSEvent:
    Type: SQS
    Properties:
```

```
      Enabled: true
      FunctionResponseTypes:
        - ReportBatchItemFailures
      Queue: !GetAtt MySqsQueue.Arn
      BatchSize: 10
```

Lambda function with an SQS event that has scaling configured

```
MyFunction:
  Type: AWS::Serverless::Function
  Properties:
    ...
    Events:
      MySQSEvent:
        Type: SQS
        Properties:
          ...
          ScalingConfig:
            MaximumConcurrency: 10
```

ProvisionedPollerConfig example

```
MyFunction:
  Type: AWS::Serverless::Function
  Properties:
    Handler: index.handler
    Runtime: nodejs18.x
    Timeout: 30
    Events:
      SQSEvent:
        Type: SQS
        Properties:
          Queue: !GetAtt MyQueue.Arn
          BatchSize: 10
          Enabled: True
          ProvisionedPollerConfig:
            MaximumPollers: 300
            MinimumPollers: 10
```

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

```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

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

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

CloudFormation compatibility: This property is passed directly to the `S3ObjectVersion` property of the `AWS::Lambda::Function` `Code` data type.

Examples

FunctionCode

`CodeUri`: Function Code example

YAML

```
CodeUri:
  Bucket: sam-s3-demo-bucket-name
  Key: mykey-name
  Version: 121212
```

FunctionUrlConfig

Creates an AWS Lambda function URL with the specified configuration parameters. A Lambda function URL is an HTTPS endpoint that you can use to invoke your function.

By default, the function URL that you create uses the `$LATEST` version of your Lambda function. If you specify an `AutoPublishAlias` for your Lambda function, the endpoint connects to the specified function alias.

For more information, see Lambda function URLs 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

```
AuthType: String
Cors: Cors
InvokeMode: String
```

Properties

`AuthType`

The type of authorization for your function URL. To use AWS Identity and Access Management (IAM) to authorize requests, set to `AWS_IAM`. For open access, set to `NONE`.

Type: String

Required: Yes

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

`Cors`

The cross-origin resource sharing (CORS) settings for your function URL.

Type: Cors

Required: No

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

`InvokeMode`

The mode that your function URL will be invoked. To have your function return the response after invocation completes, set to `BUFFERED`. To have your function stream the response, set to `RESPONSE_STREAM`. The default value is `BUFFERED`.

Valid values: `BUFFERED` or `RESPONSE_STREAM`

Type: String

Required: No

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

Examples

Function URL

The following example creates a Lambda function with a function URL. The function URL uses IAM authorization.

YAML

```
HelloWorldFunction:
  Type: AWS::Serverless::Function
```

```
  Properties:
    CodeUri: hello_world/
    Handler: index.handler
    Runtime: nodejs20.x
    FunctionUrlConfig:
      AuthType: AWS_IAM
      InvokeMode: RESPONSE_STREAM

Outputs:
  MyFunctionUrlEndpoint:
      Description: "My Lambda Function URL Endpoint"
      Value:
        Fn::GetAtt: HelloWorldFunctionUrl.FunctionUrl
```

CapacityProviderConfig

Configures the capacity provider to which published versions of the function will be attached. This enables the function to run on customer-owned EC2 instances managed by Lambda.

> **Note**
>
> This configuration determines the compute type of a function and needs to be specified during the first function deployment. It can't be added or removed after the function resource has been created.

Syntax

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

YAML

```
Arn: String
ExecutionEnvironmentMemoryGiBPerVCpu: Float
PerExecutionEnvironmentMaxConcurrency: Integer
```

Properties

`Arn`

The ARN of the capacity provider to use for this function.

Type: String

Required: Yes

CloudFormation compatibility: This property is unique to SAM.

`ExecutionEnvironmentMemoryGiBPerVCpu`

The ratio of memory (in GiB) to vCPU for each execution environment.

> **Note**
> The memory ratio per CPU can't exceed function's total memory of 2048MB. The supported memory-to-CPU ratios are 2GB, 4GB, or 8GB per CPU.

Type: Float

Required: No

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

`PerExecutionEnvironmentMaxConcurrency`

The maximum number of concurrent executions per execution environment (sandbox).

Type: Integer

Required: No

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

Examples

Capacity provider configuration

The following example shows a capacity provider configuration that references a capacity provider resource.

```
CapacityProviderConfig:
  Arn: !GetAtt MyCapacityProvider.Arn
  ExecutionEnvironmentMemoryGiBPerVCpu: 4.0
  PerExecutionEnvironmentMaxConcurrency: 100
```

FunctionScalingConfig

Configures the scaling behavior for Lambda function versions, controlling the number of execution environments (sandboxes) that can be created. This configuration applies to both $LATEST.PUBLISHED and numeric function versions.

Syntax

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

YAML

```
MinExecutionEnvironments: Integer
MaxExecutionEnvironments: Integer
```

Properties

`MinExecutionEnvironments`

The minimum number of execution environments to maintain for the function version.

Type: Integer

Required: No

Default: 3

Minimum: `0`

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

`MaxExecutionEnvironments`

The maximum number of execution environments that can be created for the function version.

Type: Integer

Required: No

Default: 3

Minimum: 0

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

Examples

Function scaling configuration

The following example shows a function scaling configuration with minimum and maximum execution environments.

```
FunctionScalingConfig:
  MinExecutionEnvironments: 5
  MaxExecutionEnvironments: 100
```

AWS::Serverless::GraphQLApi

Use the AWS Serverless Application Model (AWS SAM) `AWS::Serverless::GraphQLApi` resource type to create and configure an AWS AppSync GraphQL API for your serverless application.

To learn more about AWS AppSync, see What is AWS AppSync? in the *AWS AppSync Developer Guide*.

Syntax

YAML

```
LogicalId:
  Type: AWS::Serverless::GraphQLApi
  Properties:
    ApiKeys: ApiKeys
    Auth: Auth
    Cache: AWS::AppSync::ApiCache
```

```
    DataSources: DataSource
    DomainName: AWS::AppSync::DomainName
    Functions: Function
    Logging: LogConfig
    Name: String
    Resolvers: Resolver
    SchemaInline: String
    SchemaUri: String
    Tags:
    - Tag
    XrayEnabled: Boolean
```

Properties

`ApiKeys`

Create a unique key that can be used to perform GraphQL operations requiring an API key.

Type: ApiKeys

Required: No

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

`Auth`

Configure authentication for your GraphQL API.

Type: Auth

Required: Yes

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

`Cache`

The input of a `CreateApiCache` operation.

Type: AWS::AppSync::ApiCache

Required: No

CloudFormation compatibility: This property is passed directly to the AWS::AppSync::ApiCache resource.

`DataSources`

Create data sources for functions in AWS AppSync to connect to. AWS SAM supports Amazon DynamoDB and AWS Lambda data sources.

Type: DataSource

Required: Yes

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

`DomainName`

Custom domain name for your GraphQL API.

Type: AWS::AppSync::DomainName

Required: No

CloudFormation compatibility: This property is passed directly to the AWS::AppSync::DomainName resource. AWS SAM automatically generates the AWS::AppSync::DomainNameApiAssociation resource.

`Functions`

Configure functions in GraphQL APIs to perform certain operations.

Type: Function

Required: Yes

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

`Logging`

Configures Amazon CloudWatch logging for your GraphQL API.

If you don't specify this property, AWS SAM will generate `CloudWatchLogsRoleArn` and set the following values:

- `ExcludeVerboseContent: true`
- `FieldLogLevel: ALL`

To opt out of logging, specify the following:

```
Logging: false
```

Type: LogConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `LogConfig` property of an `AWS::AppSync::GraphQLApi` resource.

`LogicalId`

The unique name of your GraphQL API.

Type: String

Required: Yes

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

`Name`

The name of your GraphQL API. Specify this property to override the `LogicalId` value.

Type: String

Required: No

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

`Resolvers`

Configure resolvers for the fields of your GraphQL API. AWS SAM supports JavaScript pipeline resolvers.

Type: Resolver

Required: Yes

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

`SchemaInline`

The text representation of a GraphQL schema in SDL format.

Type: String

Required: Conditional. You must specify `SchemaInline` or `SchemaUri`.

CloudFormation compatibility: This property is passed directly to the `Definition` property of an `AWS::AppSync::GraphQLSchema` resource.

`SchemaUri`

The schema's Amazon Simple Storage Service (Amazon S3) bucket URI or path to a local folder.

If you specify a path to a local folder, CloudFormation requires that the file is first uploaded to Amazon S3 before deployment. You can use the AWS SAM CLI to facilitate this process. For more information, see How AWS SAM uploads local files at deployment.

Type: String

Required: Conditional. You must specify `SchemaInline` or `SchemaUri`.

CloudFormation compatibility: This property is passed directly to the `DefinitionS3Location` property of an `AWS::AppSync::GraphQLSchema` resource.

`Tags`

Tags (key-value pairs) for this GraphQL API. Use tags to identify and categorize resources.

Type: List of Tag

Required: No

CloudFormation compatibility: This property is passed directly to the `Tag` property of an `AWS::AppSync::GraphQLApi` resource.

`XrayEnabled`

Indicate whether to use AWS X-Ray tracing for this resource.

Type: Boolean

Required: No

CloudFormation compatibility: This property is passed directly to the `XrayEnabled` property of an `AWS::AppSync::GraphQLApi` resource.

Return Values

For a list of return values, refer to AWS::Serverless::GraphQLApi in the CloudFormation User Guide.

Examples

GraphQL API with DynamoDB data source

In this example, we create a GraphQL API that uses a DynamoDB table as a data source.

schema.graphql

```
schema {
  query: Query
  mutation: Mutation
}

type Query {
  getPost(id: String!): Post
}

type Mutation {
  addPost(author: String!, title: String!, content: String!): Post!
}

type Post {
  id: String!
  author: String
  title: String
  content: String
  ups: Int!
  downs: Int!
  version: Int!
}
```

template.yaml

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  DynamoDBPostsTable:
    Type: AWS::Serverless::SimpleTable

  MyGraphQLAPI:
    Type: AWS::Serverless::GraphQLApi
    Properties:
      SchemaUri: ./sam_graphql_api/schema.graphql
      Auth:
        Type: AWS_IAM
      DataSources:
        DynamoDb:
          PostsDataSource:
            TableName: !Ref DynamoDBPostsTable
            TableArn: !GetAtt DynamoDBPostsTable.Arn
      Functions:
        preprocessPostItem:
          Runtime:
            Name: APPSYNC_JS
            Version: 1.0.0
          DataSource: NONE
          CodeUri: ./sam_graphql_api/preprocessPostItem.js
        createPostItem:
          Runtime:
            Name: APPSYNC_JS
            Version: "1.0.0"
          DataSource: PostsDataSource
          CodeUri: ./sam_graphql_api/createPostItem.js
        getPostFromTable:
          Runtime:
            Name: APPSYNC_JS
            Version: "1.0.0"
          DataSource: PostsDataSource
          CodeUri: ./sam_graphql_api/getPostFromTable.js
      Resolvers:
        Mutation:
          addPost:
            Runtime:
              Name: APPSYNC_JS
```

```
              Version: "1.0.0"
            Pipeline:
            - preprocessPostItem
            - createPostItem
        Query:
          getPost:
            CodeUri: ./sam_graphql_api/getPost.js
            Runtime:
              Name: APPSYNC_JS
              Version: "1.0.0"
            Pipeline:
            - getPostFromTable
```

createPostItem.js

```
import { util } from "@aws-appsync/utils";

export function request(ctx) {
  const { key, values } = ctx.prev.result;
  return {
    operation: "PutItem",
    key: util.dynamodb.toMapValues(key),
    attributeValues: util.dynamodb.toMapValues(values),
  };
}

export function response(ctx) {
  return ctx.result;
}
```

getPostFromTable.js

```
import { util } from "@aws-appsync/utils";

export function request(ctx) {
  return dynamoDBGetItemRequest({ id: ctx.args.id });
}

export function response(ctx) {
  return ctx.result;
}

/**
```

```
 * A helper function to get a DynamoDB item
 */
function dynamoDBGetItemRequest(key) {
  return {
    operation: "GetItem",
    key: util.dynamodb.toMapValues(key),
  };
}
```

preprocessPostItem.js

```
import { util } from "@aws-appsync/utils";

export function request(ctx) {
  const id = util.autoId();
  const { ...values } = ctx.args;
  values.ups = 1;
  values.downs = 0;
  values.version = 1;
  return { payload: { key: { id }, values: values } };
}

export function response(ctx) {
  return ctx.result;
}
```

Here is our resolver code:

getPost.js

```
export function request(ctx) {
  return {};
}

export function response(ctx) {
  return ctx.prev.result;
}
```

GraphQL API with a Lambda function as a data source

In this example, we create a GraphQL API that uses a Lambda function as a data source.

template.yaml

```yaml
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyLambdaFunction:
    Type: AWS::Serverless::Function
    Properties:
      Handler: index.handler
      Runtime: nodejs20.x
      CodeUri: ./lambda

  MyGraphQLAPI:
    Type: AWS::Serverless::GraphQLApi
    Properties:
      Name: MyApi
      SchemaUri: ./gql/schema.gql
      Auth:
        Type: API_KEY
      ApiKeys:
        MyApiKey:
          Description: my api key
      DataSources:
        Lambda:
          MyLambdaDataSource:
            FunctionArn: !GetAtt MyLambdaFunction.Arn
      Functions:
        lambdaInvoker:
          Runtime:
            Name: APPSYNC_JS
            Version: 1.0.0
          DataSource: MyLambdaDataSource
          CodeUri: ./gql/invoker.js
      Resolvers:
        Mutation:
          addPost:
            Runtime:
              Name: APPSYNC_JS
              Version: 1.0.0
            Pipeline:
            - lambdaInvoker
        Query:
          getPost:
            Runtime:
```

```
              Name: APPSYNC_JS
              Version: 1.0.0
            Pipeline:
            - lambdaInvoker

Outputs:
  MyGraphQLAPI:
    Description: AppSync API
    Value: !GetAtt MyGraphQLAPI.GraphQLUrl
  MyGraphQLAPIMyApiKey:
    Description: API Key for authentication
    Value: !GetAtt MyGraphQLAPIMyApiKey.ApiKey
```

schema.graphql

```
schema {
  query: Query
  mutation: Mutation
}
type Query {
  getPost(id: ID!): Post
}
type Mutation {
  addPost(id: ID!, author: String!, title: String, content: String): Post!
}
type Post {
  id: ID!
  author: String!
  title: String
  content: String
  ups: Int
  downs: Int
}
```

Here are our functions:

lambda/index.js

```
exports.handler = async (event) => {
  console.log("Received event {}", JSON.stringify(event, 3));

  const posts = {
    1: {
```

```
      id: "1",
      title: "First book",
      author: "Author1",
      content: "Book 1 has this content",
      ups: "100",
      downs: "10",
    },
  };

  console.log("Got an Invoke Request.");
  let result;
  switch (event.field) {
    case "getPost":
      return posts[event.arguments.id];
    case "addPost":
      // return the arguments back
      return event.arguments;
    default:
      throw new Error("Unknown field, unable to resolve " + event.field);
  }
};
```

invoker.js

```
import { util } from "@aws-appsync/utils";

export function request(ctx) {
  const { source, args } = ctx;
  return {
    operation: "Invoke",
    payload: { field: ctx.info.fieldName, arguments: args, source },
  };
}

export function response(ctx) {
  return ctx.result;
}
```

ApiKeys

Create a unique key that can be used to perform GraphQL operations requiring an API key.

Syntax

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

YAML

```
LogicalId:
  ApiKeyId: String
  Description: String
  ExpiresOn: Double
```

Properties

`ApiKeyId`

The unique name of your API key. Specify to override the `LogicalId` value.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `ApiKeyId` property of an `AWS::AppSync::ApiKey` resource.

`Description`

Description of your API key.

Type: String

Required: No

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

`ExpiresOn`

The time after which the API key expires. The date is represented as seconds since the epoch, rounded down to the nearest hour.

Type: Double

Required: No

CloudFormation compatibility: This property is passed directly to the `Expires` property of an `AWS::AppSync::ApiKey` resource.

`LogicalId`

The unique name of your API key.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `ApiKeyId` property of an `AWS::AppSync::ApiKey` resource.

Auth

Configure authorization for your GraphQL API.

Syntax

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

YAML

```
Additional:
- AuthProvider
LambdaAuthorizer: LambdaAuthorizerConfig
OpenIDConnect: OpenIDConnectConfig
Type: String
UserPool: UserPoolConfig
```

Properties

`Additional`

A list of additional authorization types for your GraphQL API.

Type: List of AuthProvider

Required: No

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

`LambdaAuthorizer`

Specify the optional authorization configuration for your Lambda function authorizer. You can configure this optional property when `Type` is specified as `AWS_LAMBDA`.

Type: LambdaAuthorizerConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `LambdaAuthorizerConfig` property of an `AWS::AppSync::GraphQLApi` resource.

`OpenIDConnect`

Specify the optional authorization configuration for your OpenID Connect compliant service. You can configure this optional property when `Type` is specified as `OPENID_CONNECT`.

Type: OpenIDConnectConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `OpenIDConnectConfig` property of an `AWS::AppSync::GraphQLApi` resource.

`Type`

The default authorization type between applications and your AWS AppSync GraphQL API.

For a list and description of allowed values, see Authorization and authentication in the *AWS AppSync Developer Guide*.

When you specify a Lambda authorizer (`AWS_LAMBDA`), AWS SAM creates an AWS Identity and Access Management (IAM) policy to provision permissions between your GraphQL API and Lambda function.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `AuthenticationType` property of an `AWS::AppSync::GraphQLApi` resource.

`UserPool`

Specify the optional authorization configuration for using Amazon Cognito user pools. You can configure this optional property when `Type` is specified as `AMAZON_COGNITO_USER_POOLS`.

Type: UserPoolConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `UserPoolConfig` property of an `AWS::AppSync::GraphQLApi` resource.

Examples

Configure a default and additional authorization type

In this example, we start by configuring a Lambda authorizer as the default authorization type for our GraphQL API.

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyGraphQLAPI:
    Type: AWS::Serverless::GraphQLApi
    Properties:
      Auth:
        Type: AWS_LAMBDA
        LambdaAuthorizer:
          AuthorizerUri: !GetAtt Authorizer1.Arn
          AuthorizerResultTtlInSeconds: 10
          IdentityValidationExpression: hello
```

Next, we configure additional authorization types for our GraphQL API by adding the following to our AWS SAM template:

```
        Additional:
        - Type: AWS_IAM
        - Type: API_KEY
        - Type: OPENID_CONNECT
          OpenIDConnect:
```

```
            AuthTTL: 10
            ClientId: myId
            IatTTL: 10
            Issuer: prod
```

This results in the following AWS SAM template:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyGraphQLAPI:
    Type: AWS::Serverless::GraphQLApi
    Properties:
      Auth:
        Type: AWS_LAMBDA
        LambdaAuthorizer:
          AuthorizerUri: !GetAtt Authorizer1.Arn
          AuthorizerResultTtlInSeconds: 10
          IdentityValidationExpression: hello
        Additional:
        - Type: AWS_IAM
        - Type: API_KEY
        - Type: OPENID_CONNECT
          OpenIDConnect:
            AuthTTL: 10
            ClientId: myId
            IatTTL: 10
            Issuer: prod
```

AuthProvider

Optional authorization configuration for your additional GraphQL API authorization types.

Syntax

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

YAML

```
LambdaAuthorizer: LambdaAuthorizerConfig
OpenIDConnect: OpenIDConnectConfig
```

```
Type: String
UserPool: UserPoolConfig
```

Properties

`LambdaAuthorizer`

Specify the optional authorization configuration for your AWS Lambda function authorizer. You can configure this optional property when `Type` is specified as `AWS_LAMBDA`.

Type: LambdaAuthorizerConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `LambdaAuthorizerConfig` property of an `AWS::AppSync::GraphQLApi` `AdditionalAuthenticationProvider` object.

`OpenIDConnect`

Specify the optional authorization configuration for your OpenID Connect compliant service. You can configure this optional property when `Type` is specified as `OPENID_CONNECT`.

Type: OpenIDConnectConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `OpenIDConnectConfig` property of an `AWS::AppSync::GraphQLApi` `AdditionalAuthenticationProvider` object.

`Type`

The default authorization type between applications and your AWS AppSync GraphQL API.

For a list and description of allowed values, see Authorization and authentication in the *AWS AppSync Developer Guide*.

When you specify a Lambda authorizer (`AWS_LAMBDA`), AWS SAM creates an AWS Identity and Access Management (IAM) policy to provision permissions between your GraphQL API and Lambda function.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `AuthenticationType` property of an `AWS::AppSync::GraphQLApi` `AdditionalAuthenticationProvider` object.

`UserPool`

Specify the optional authorization configuration for using Amazon Cognito user pools. You can configure this optional property when `Type` is specified as `AMAZON_COGNITO_USER_POOLS`.

Type: UserPoolConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `UserPoolConfig` property of an `AWS::AppSync::GraphQLApi` `AdditionalAuthenticationProvider` object.

DataSource

Configure a data source that your GraphQL API resolver can connect to. You can use AWS Serverless Application Model (AWS SAM) templates to configure connections to the following data sources:

- Amazon DynamoDB
- AWS Lambda

To learn more about data sources, see Attaching a data source in the *AWS AppSync Developer Guide*.

Syntax

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

YAML

```
DynamoDb: DynamoDb
Lambda: Lambda
```

Properties

`DynamoDb`

Configure a DynamoDB table as a data source for your GraphQL API resolver.

Type: DynamoDb

Required: No

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

`Lambda`

Configure a Lambda function as a data source for your GraphQL API resolver.

Type: Lambda

Required: No

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

DynamoDb

Configure an Amazon DynamoDB table as a data source for your GraphQL API resolver.

Syntax

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

YAML

```yaml
LogicalId:
  DeltaSync: DeltaSyncConfig
  Description: String
  Name: String
  Permissions: List
  Region: String
  ServiceRoleArn: String
  TableArn: String
  TableName: String
  UseCallerCredentials: Boolean
```

```
  Versioned: Boolean
```

Properties

`DeltaSync`

Describes a Delta Sync configuration.

Type: DeltaSyncConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `DeltaSyncConfig` property of an `AWS::AppSync::DataSource DynamoDBConfig` object.

`Description`

The description of your data source.

Type: String

Required: No

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

`LogicalId`

The unique name of your data source.

Type: String

Required: Yes

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

`Name`

The name of your data source. Specify this property to override the `LogicalId` value.

Type: String

Required: No

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

`Permissions`

Provision permissions to your data source using AWS SAM connectors. You can provide any of the following values in a list:

- `Read` – Allow your resolver to read your data source.
- `Write` – Allow your resolver to write to your data source.

AWS SAM uses an `AWS::Serverless::Connector` resource which is transformed at deployment to provision your permissions. To learn about generated resources, see CloudFormation resources generated when you specify AWS::Serverless::Connector.

> **Note**
>
> You can specify `Permissions` or `ServiceRoleArn`, but not both. If neither are specified, AWS SAM will generate default values of `Read` and `Write`. To revoke access to your data source, remove the DynamoDB object from your AWS SAM template.

Type: List

Required: No

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an CloudFormation equivalent. It is similar to the `Permissions` property of an `AWS::Serverless::Connector` resource.

`Region`

The AWS Region of your DynamoDB table. If you don't specify it, AWS SAM uses `AWS::Region`.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `AwsRegion` property of an `AWS::AppSync::DataSource DynamoDBConfig` object.

`ServiceRoleArn`

The AWS Identity and Access Management (IAM) service role ARN for the data source. The system assumes this role when accessing the data source.

You can specify `Permissions` or `ServiceRoleArn`, but not both.

Type: String

Required: No. If not specified, AWS SAM applies the default value for `Permissions`.

CloudFormation compatibility: This property is passed directly to the `ServiceRoleArn` property of an `AWS::AppSync::DataSource` resource.

`TableArn`

The ARN for the DynamoDB table.

Type: String

Required: Conditional. If you don't specify `ServiceRoleArn`, `TableArn` is required.

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

`TableName`

The table name.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `TableName` property of an `AWS::AppSync::DataSource DynamoDBConfig` object.

`UseCallerCredentials`

Set to `true` to use IAM with this data source.

Type: Boolean

Required: No

CloudFormation compatibility: This property is passed directly to the `UseCallerCredentials` property of an `AWS::AppSync::DataSource DynamoDBConfig` object.

`Versioned`

Set to `true` to use Conflict Detection, Conflict Resolution, and Sync with this data source.

Type: Boolean

Required: No

CloudFormation compatibility: This property is passed directly to the `Versioned` property of an `AWS::AppSync::DataSource DynamoDBConfig` object.

Lambda

Configure an AWS Lambda function as a data source for your GraphQL API resolver.

Syntax

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

YAML

```
LogicalId:
  Description: String
  FunctionArn: String
  Name: String
  ServiceRoleArn: String
```

Properties

`Description`

The description of your data source.

Type: String

Required: No

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

`FunctionArn`

The ARN for the Lambda function.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `LambdaFunctionArn` property of an `AWS::AppSync::DataSource LambdaConfig` object.

`LogicalId`

The unique name of your data source.

Type: String

Required: Yes

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

`Name`

The name of your data source. Specify this property to override the `LogicalId` value.

Type: String

Required: No

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

`ServiceRoleArn`

The AWS Identity and Access Management (IAM) service role ARN for the data source. The system assumes this role when accessing the data source.

> **Note**
>
> To revoke access to your data source, remove the Lambda object from your AWS SAM template.

Type: String

Required: No. If not specified, AWS SAM will provision `Write` permissions using AWS SAM connectors.

CloudFormation compatibility: This property is passed directly to the `ServiceRoleArn` property of an `AWS::AppSync::DataSource` resource.

Function

Configure functions in GraphQL APIs to perform certain operations.

Syntax

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

YAML

```yaml
LogicalId:
  CodeUri: String
  DataSource: String
  Description: String
  Id: String
  InlineCode: String
  MaxBatchSize: Integer
  Name: String
  Runtime: Runtime
  Sync: SyncConfig
```

Properties

`CodeUri`

The function code's Amazon Simple Storage Service (Amazon S3) URI or path to local folder.

If you specify a path to a local folder, CloudFormation requires that the file is first uploaded to Amazon S3 before deployment. You can use the AWS SAM CLI to facilitate this process. For more information, see How AWS SAM uploads local files at deployment.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `CodeS3Location` property of an `AWS::AppSync::FunctionConfiguration` resource.

`DataSource`

The name of the data source that this function will attach to.

- To reference a data source within the `AWS::Serverless::GraphQLApi` resource, specify its logical ID.
- To reference a data source outside of the `AWS::Serverless::GraphQLApi` resource, provide its `Name` attribute using the `Fn::GetAtt` intrinsic function. For example, `!GetAtt MyLambdaDataSource.Name`.

- To reference a data source from a different stack, use `Fn::ImportValue`.

If a variation of `[NONE | None | none]` is specified, AWS SAM will generate a `None` value for the `AWS::AppSync::DataSource` `Type` object.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `DataSourceName` property of an `AWS::AppSync::FunctionConfiguration` resource.

`Description`

The description of your function.

Type: String

Required: No

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

`Id`

The Function ID for a function located outside of the `AWS::Serverless::GraphQLApi` resource.

- To reference a function within the same AWS SAM template, use the `Fn::GetAtt` intrinsic function. For example `Id: !GetAtt createPostItemFunc.FunctionId`.
- To reference a function from a different stack, use `Fn::ImportValue`.

When using `Id`, all other properties are not allowed. AWS SAM will automatically pass the Function ID of your referenced function.

Type: String

Required: No

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

`InlineCode`

The function code that contains the request and response functions.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the Code property of an `AWS::AppSync::FunctionConfiguration` resource.

`LogicalId`

The unique name of your function.

Type: String

Required: Yes

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

`MaxBatchSize`

The maximum number of resolver request inputs that will be sent to a single AWS Lambda function in a `BatchInvoke` operation.

Type: Integer

Required: No

CloudFormation compatibility: This property is passed directly to the MaxBatchSize property of an `AWS::AppSync::FunctionConfiguration` resource.

`Name`

The name of the function. Specify to override the `LogicalId` value.

Type: String

Required: No

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

`Runtime`

Describes a runtime used by an AWS AppSync pipeline resolver or AWS AppSync function. Specifies the name and version of the runtime to use.

Type: Runtime

Required: Yes

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an CloudFormation equivalent. It is similar to the `Runtime` property of an `AWS::AppSync::FunctionConfiguration` resource.

`Sync`

Describes a Sync configuration for a function.

Specifies which Conflict Detection strategy and Resolution strategy to use when the function is invoked.

Type: SyncConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `SyncConfig` property of an `AWS::AppSync::FunctionConfiguration` resource.

Runtime

The runtime of your pipeline resolver or function. Specifies the name and version to use.

Syntax

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

YAML

```
Name: String
Version: String
```

Properties

`Name`

The name of the runtime to use. Currently, the only allowed value is `APPSYNC_JS`.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `Name` property of an `AWS::AppSync::FunctionConfiguration AppSyncRuntime` object.

`Version`

The version of the runtime to use. Currently, the only allowed version is `1.0.0`.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `RuntimeVersion` property of an `AWS::AppSync::FunctionConfiguration AppSyncRuntime` object.

Resolver

Configure resolvers for the fields of your GraphQL API. AWS Serverless Application Model (AWS SAM) supports JavaScript pipeline resolvers.

Syntax

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

YAML

```yaml
OperationType:
  LogicalId:
    Caching: CachingConfig
    CodeUri: String
    FieldName: String
    InlineCode: String
    MaxBatchSize: Integer
    Pipeline: List
    Runtime: Runtime
    Sync: SyncConfig
```

Properties

`Caching`

The caching configuration for the resolver that has caching activated.

Type: CachingConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `CachingConfig` property of an `AWS::AppSync::Resolver` resource.

`CodeUri`

The resolver function code's Amazon Simple Storage Service (Amazon S3) URI or path to a local folder.

If you specify a path to a local folder, CloudFormation requires that the file is first uploaded to Amazon S3 before deployment. You can use the AWS SAM CLI to facilitate this process. For more information, see How AWS SAM uploads local files at deployment.

If neither `CodeUri` or `InlineCode` are provided, AWS SAM will generate `InlineCode` that redirects the request to the first pipeline function and receives the response from the last pipeline function.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `CodeS3Location` property of an `AWS::AppSync::Resolver` resource.

`FieldName`

The name of your resolver. Specify this property to override the `LogicalId` value.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `FieldName` property of an `AWS::AppSync::Resolver` resource.

`InlineCode`

The resolver code that contains the request and response functions.

If neither `CodeUri` or `InlineCode` are provided, AWS SAM will generate `InlineCode` that redirects the request to the first pipeline function and receives the response from the last pipeline function.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `Code` property of an `AWS::AppSync::Resolver` resource.

`LogicalId`

The unique name for your resolver. In a GraphQL schema, your resolver name should match the field name that its used for. Use that same field name for `LogicalId`.

Type: String

Required: Yes

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

`MaxBatchSize`

The maximum number of resolver request inputs that will be sent to a single AWS Lambda function in a `BatchInvoke` operation.

Type: Integer

Required: No

CloudFormation compatibility: This property is passed directly to the `MaxBatchSize` property of an `AWS::AppSync::Resolver` resource.

`OperationType`

The GraphQL operation type that is associated with your resolver. For example, `Query`, `Mutation`, or `Subscription`. You can nest multiple resolvers by `LogicalId` within a single `OperationType`.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `TypeName` property of an `AWS::AppSync::Resolver` resource.

`Pipeline`

Functions linked with the pipeline resolver. Specify functions by logical ID in a list.

Type: List

Required: Yes

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an CloudFormation equivalent. It is similar to the `PipelineConfig` property of an `AWS::AppSync::Resolver` resource.

`Runtime`

The runtime of your pipeline resolver or function. Specifies the name and version to use.

Type: Runtime

Required: Yes

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an CloudFormation equivalent. It is similar to the `Runtime` property of an `AWS::AppSync::Resolver` resource.

`Sync`

Describes a Sync configuration for a resolver.

Specifies which Conflict Detection strategy and Resolution strategy to use when the resolver is invoked.

Type: SyncConfig

Required: No

CloudFormation compatibility: This property is passed directly to the `SyncConfig` property of an `AWS::AppSync::Resolver` resource.

Examples

Use the AWS SAM generated resolver function code and save fields as variables

Here is the GraphQL schema for our example:

```
schema {
```

```
  query: Query
  mutation: Mutation
}

type Query {
  getPost(id: ID!): Post
}

type Mutation {
  addPost(author: String!, title: String!, content: String!): Post!
}

type Post {
  id: ID!
  author: String
  title: String
  content: String
}
```

Here is a snippet of our AWS SAM template:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyGraphQLApi:
    Type: AWS::Serverless::GraphQLApi
    Properties:
      ...
      Functions:
        preprocessPostItem:
          ...
        createPostItem:
          ...
      Resolvers:
        Mutation:
          addPost:
            Runtime:
              Name: APPSYNC_JS
              Version: 1.0.0
            Pipeline:
            - preprocessPostItem
            - createPostItem
```

In our AWS SAM template, we don't specify `CodeUri` or `InlineCode`. At deployment, AWS SAM automatically generates the following inline code for our resolver:

```
export function request(ctx) {
  return {};
}

export function response(ctx) {
  return ctx.prev.result;
}
```

This default resolver code redirects the request to the first pipeline function and receives the response from the last pipeline function.

In our first pipeline function, we can use the provided `args` field to parse the request object and create our variables. We can then use these variables within our function. Here is an example of our `preprocessPostItem` function:

```
import { util } from "@aws-appsync/utils";

export function request(ctx) {
  const author = ctx.args.author;
  const title = ctx.args.title;
  const content = ctx.args.content;

  // Use variables to process data

}

export function response(ctx) {
  return ctx.result;
}
```

Runtime

The runtime of your pipeline resolver or function. Specifies the name and version to use.

Syntax

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

YAML

```yaml
Name: String
Version: String
```

Properties

`Name`

The name of the runtime to use. Currently, the only allowed value is `APPSYNC_JS`.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `Name` property of an `AWS::AppSync::Resolver AppSyncRuntime` object.

`Version`

The version of the runtime to use. Currently, the only allowed version is `1.0.0`.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `RuntimeVersion` property of an `AWS::AppSync::Resolver AppSyncRuntime` object.

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*.

We recommend that you use CloudFormation hooks or IAM policies to verify that API Gateway resources have authorizers attached to them to control access to them.

For more information about using CloudFormation hooks, see Registering hooks in the *CloudFormation CLI user guide* and the apigw-enforce-authorizer GitHub repository.

For more information about using IAM policies, see Require that API routes have authorization in the *API Gateway Developer Guide*.

> **Note**
>
> When you deploy to AWS CloudFormation, AWS SAM transforms your AWS SAM resources into CloudFormation resources. For more information, see Generated CloudFormation resources for AWS SAM.

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
  CorsConfiguration: String | HttpApiCorsConfiguration
  DefaultRouteSettings: RouteSettings
  DefinitionBody: JSON
  DefinitionUri: String | HttpApiDefinition
  Description: String
  DisableExecuteApiEndpoint: Boolean
  Domain: HttpApiDomainConfiguration
  FailOnWarnings: Boolean
  Name: String
  PropagateTags: Boolean
  RouteSettings: RouteSettings
  StageName: String
  StageVariables: Json
  Tags: Map
```

Properties

`AccessLogSettings`

The settings for access logging in a stage.

Type: AccessLogSettings

Required: No

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

Required: No

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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. If this property is set to `true`, then all origins are allowed.

Type: String | HttpApiCorsConfiguration

Required: No

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

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: JSON

Required: No

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 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

Required: No

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`

The description of the HTTP API resource.

When you specify `Description`, AWS SAM will modify the HTTP API resource's OpenApi definition by setting the `description` field. The following scenarios will result in an error:

- The `DefinitionBody` property is specified with the `description` field set in the Open API definition – This results in a conflict of the `description` field that AWS SAM won't resolve.
- The `DefinitionUri` property is specified – AWS SAM won't modify an Open API definition that is retrieved from Amazon S3.

Type: String

Required: No

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

To use this property, you must specify the `DefinitionBody` property instead of the `DefinitionUri` property or define `x-amazon-apigateway-endpoint-configuration` with `disableExecuteApiEndpoint` in your OpenAPI definition.

Type: Boolean

Required: No

CloudFormation compatibility: This property is similar to the `DisableExecuteApiEndpoint` property of an `AWS::ApiGatewayV2::Api` resource. It is passed directly to the `disableExecuteApiEndpoint` property of an `x-amazon-apigateway-endpoint-configuration` extension, which gets added to the `Body` property of an `AWS::ApiGatewayV2::Api` resource.

`Domain`

Configures a custom domain for this API Gateway HTTP API.

Type: HttpApiDomainConfiguration

Required: No

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

CloudFormation compatibility: This property is passed directly to the `FailOnWarnings` property of an `AWS::ApiGatewayV2::Api` resource.

`Name`

The name of the HTTP API resource.

When you specify `Name`, AWS SAM will modify the HTTP API resource's OpenAPI definition by setting the `title` field. The following scenarios will result in an error:

- The `DefinitionBody` property is specified with the `title` field set in the Open API definition – This results in a conflict of the `title` field that AWS SAM won't resolve.
- The `DefinitionUri` property is specified – AWS SAM won't modify an Open API definition that is retrieved from Amazon S3.

Type: String

Required: No

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

`PropagateTags`

Indicate whether or not to pass tags from the `Tags` property to your AWS::Serverless::HttpApi generated resources. Specify `True` to propagate tags in your generated resources.

Type: Boolean

Required: No

Default: `False`

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

`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

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

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

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

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

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 | LambdaAuthorizer
  DefaultAuthorizer: String
  EnableIamAuthorizer: Boolean
```

Properties

`Authorizers`

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

Type: OAuth2Authorizer | LambdaAuthorizer

Required: No

Default: None

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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. You can specify `AWS_IAM` as a default authorizer if `EnableIamAuthorizer` is set to `true`. Otherwise, specify an authorizer that you've defined in `Authorizers`.

Type: String

Required: No

Default: None

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

`EnableIamAuthorizer`

Specify whether to use IAM authorization for the API route.

Type: Boolean

Required: No

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

IAM authorizer

IAM authorizer example

YAML

```
Auth:
  EnableIamAuthorizer: true
  DefaultAuthorizer: AWS_IAM
```

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

```yaml
AuthorizerPayloadFormatVersion: String
EnableFunctionDefaultPermissions: Boolean
EnableSimpleResponses: Boolean
FunctionArn: String
FunctionInvokeRole: String
Identity: LambdaAuthorizationIdentity
```

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

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

`EnableFunctionDefaultPermissions`

By default, the HTTP API resource is not granted permission to invoke the Lambda authorizer. Specify this property as `true` to automatically create permissions between your HTTP API resource and your Lambda authorizer.

Type: Boolean

Required: No

Default value: `false`

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

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

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

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

Required: No

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

```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

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

`Headers`

Converts the headers to a list of mapping expressions in the format `$request.header.name`.

Type: List

Required: No

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

`QueryStrings`

Converts the given query strings to a list of mapping expressions in the format `$request.querystring.queryString`.

Type: List

Required: No

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

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

`StageVariables`

Converts the given stage variables to a list of mapping expressions in the format `$stageVariables.stageVariable`.

Type: List

Required: No

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

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

`IdentitySource`

Identity source expression for this authorizer.

Type: String

Required: No

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

> **Note**
>
> Properties `issuer` and `audience` are case insensitive and can be used either lowercase as in OpenAPI or uppercase `Issuer` and `Audience` as in AWS::ApiGatewayV2::Authorizer.

Type: Map

Required: No

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

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

`AllowHeaders`

Represents a collection of allowed headers.

Type: List

Required: No

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

`AllowMethods`

Represents a collection of allowed HTTP methods.

Type: List

Required: No

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

`AllowOrigins`

Represents a collection of allowed origins.

Type: List

Required: No

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

`ExposeHeaders`

Represents a collection of exposed headers.

Type: List

Required: No

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

`MaxAge`

The number of seconds that the browser should cache preflight request results.

Type: Integer

Required: No

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

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

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

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: sam-s3-demo-bucket-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
  OwnershipVerificationCertificateArn: String
  Route53: Route53Configuration
  SecurityPolicy: String
```

Properties

`BasePath`

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

Type: List

Required: No

Default: /

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

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. For information about generated CloudFormation resources, see Generated CloudFormation resources for AWS SAM.

Type: String

Required: Yes

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 CloudFormation.

The only valid value for HTTP APIs is `REGIONAL`.

Type: String

Required: No

Default: `REGIONAL`

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

`MutualTlsAuthentication`

The mutual transport layer security (TLS) authentication configuration for a custom domain name.

Type: MutualTlsAuthentication

Required: No

CloudFormation compatibility: This property is passed directly to the `MutualTlsAuthentication` property of an `AWS::ApiGatewayV2::DomainName` resource.

`OwnershipVerificationCertificateArn`

The ARN of the public certificate issued by ACM to validate ownership of your custom domain. Required only when you configure mutual TLS and you specify an ACM imported or private CA certificate ARN for the `CertificateArn`.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `OwnershipVerificationCertificateArn` property of the `AWS::ApiGatewayV2::DomainName DomainNameConfiguration` data type.

`Route53`

Defines an Amazon Route 53 configuration.

Type: Route53Configuration

Required: No

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

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
  Region: String
  SetIdentifier: String
```

Properties

`DistributionDomainName`

Configures a custom distribution of the API custom domain name.

Type: String

Required: No

Default: Use the API Gateway distribution.

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

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

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. You must include a trailing dot (for example, `www.example.com.`) as part of the `HostedZoneName`.

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

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

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

`Region`

Latency-based resource record sets only: The Amazon EC2 Region where you created the resource that this resource record set refers to. The resource typically is an AWS resource, such as an EC2 instance or an ELB load balancer, and is referred to by an IP address or a DNS domain name, depending on the record type.

When Amazon Route 53 receives a DNS query for a domain name and type for which you have created latency resource record sets, Route 53 selects the latency resource record set that has the lowest latency between the end user and the associated Amazon EC2 Region. Route 53 then returns the value that is associated with the selected resource record set.

Note the following:

- You can only specify one `ResourceRecord` per latency resource record set.
- You can only create one latency resource record set for each Amazon EC2 Region.
- You aren't required to create latency resource record sets for all Amazon EC2 Regions. Route 53 will choose the region with the best latency from among the regions that you create latency resource record sets for.

- You can't create non-latency resource record sets that have the same values for the `Name` and `Type` elements as latency resource record sets.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `Region` property of an `AWS::Route53::RecordSetGroup` `RecordSet` data type.

`SetIdentifier`

Resource record sets that have a routing policy other than simple: An identifier that differentiates among multiple resource record sets that have the same combination of name and type, such as multiple weighted resource record sets named acme.example.com that have a type of A. In a group of resource record sets that have the same name and type, the value of `SetIdentifier` must be unique for each resource record set.

For information about routing policies, see Choosing a routing policy in the *Amazon Route 53 Developer Guide*.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `SetIdentifier` property of an `AWS::Route53::RecordSetGroup` `RecordSet` data type.

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 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 Lambda layers in AWS SAM.

Important Note: Since the release of the UpdateReplacePolicy resource attribute in CloudFormation, AWS::Lambda::LayerVersion (recommended) offers the same benefits as AWS::Serverless::LayerVersion.

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.

> **Note**
>
> When you deploy to AWS CloudFormation, AWS SAM transforms your AWS SAM resources into CloudFormation resources. For more information, see Generated CloudFormation resources for AWS SAM.

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
  Description: String
  LayerName: String
```

```
  LicenseInfo: String
  PublishLambdaVersion: Boolean
  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`

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

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 followed by either sam deploy or

sam package. By default, relative paths are resolved with respect to the AWS SAM template's location.

Type: String | LayerContent

Required: Yes

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

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

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

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

`PublishLambdaVersion`

An opt-in property that creates a new Lambda version whenever there is a change in the referenced `LayerVersion` resource. When enabled with `AutoPublishAlias` and `AutoPublishAliasAllProperties` in the connected Lambda function, there will be a new Lambda version created for every change made to the `LayerVersion` resource.

Type: Boolean

Required: No

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

`RetentionPolicy`

This property specifies whether old versions of your `LayerVersion` are retained or deleted when you delete a resource. If you need to retain old versions of your `LayerVersion` when updating or replacing a resource, you must have the `UpdateReplacePolicy` attribute enabled. For information on doing this, refer to `UpdateReplacePolicy` attribute in the *AWS CloudFormation User Guide*.

Valid values: `Retain` or `Delete`

Type: String

Required: No

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

Additional notes: When you specify `Retain`, AWS SAM adds a Resource attributes supported by AWS SAM 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://sam-s3-demo-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

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

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

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: amzn-s3-demo-bucket-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.

For more advanced features, use an AWS::DynamoDB::Table resource in CloudFormation. These resouces can be used in AWS SAM. They are comprehensive and provide further customization, including key schema and resource policy customization.

> **Note**
>
> When you deploy to AWS CloudFormation, AWS SAM transforms your AWS SAM resources into CloudFormation resources. For more information, see Generated CloudFormation resources for AWS SAM.

Syntax

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

YAML

```
Type: AWS::Serverless::SimpleTable
Properties:
  PointInTimeRecoverySpecification: PointInTimeRecoverySpecification
  PrimaryKey: PrimaryKeyObject
  ProvisionedThroughput: ProvisionedThroughputObject
  SSESpecification: SSESpecification
  TableName: String
  Tags: Map
```

Properties

`PointInTimeRecoverySpecification`

The settings used to enable point in time recovery.

Type: PointInTimeRecoverySpecification

Required: No

CloudFormation compatibility: This property is passed directly to the `PointInTimeRecoverySpecification` property of an `AWS::DynamoDB::Table` resource.

`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

Required: No

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

`ProvisionedThroughput`

Read and write throughput provisioning information.

If `ProvisionedThroughput` is not specified `BillingMode` will be specified as `PAY_PER_REQUEST`.

Type: ProvisionedThroughputObject

Required: No

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

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

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

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
  PrimaryKey:
    Name: MyPrimaryKey
    Type: String
  ProvisionedThroughput:
    ReadCapacityUnits: 5
    WriteCapacityUnits: 5
  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

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

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
```

ProvisionedThroughputObject

The object describing the properties of a provisioned throughput.

Syntax

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

YAML

```
  ReadCapacityUnits: Integer
  WriteCapacityUnits: Integer
```

Properties

`ReadCapacityUnits`

The maximum number of strongly consistent reads consumed per second before DynamoDB returns a `ThrottlingException`.

Type: Integer

Required: Yes

CloudFormation compatibility: This property is passed directly to the `ReadCapacityUnits` property of the `AWS::DynamoDB::Table` `ProvisionedThroughput` data type.

`WriteCapacityUnits`

The maximum number of writes consumed per second before DynamoDB returns a `ThrottlingException`.

Type: Integer

Required: Yes

CloudFormation compatibility: This property is passed directly to the `WriteCapacityUnits` property of the `AWS::DynamoDB::Table` `ProvisionedThroughput` data type.

Examples

ProvisionedThroughput

Provisioned throughput example.

YAML

```
Properties:
   ProvisionedThroughput:
     ReadCapacityUnits: 5
     WriteCapacityUnits: 5
```

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**
>
> When you deploy to AWS CloudFormation, AWS SAM transforms your AWS SAM resources into CloudFormation resources. For more information, see Generated CloudFormation resources for AWS SAM.

Syntax

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

YAML

```
Type: AWS::Serverless::StateMachine
Properties:
  AutoPublishAlias: String
  UseAliasAsEventTarget: Boolean
  Definition: Map
  DefinitionSubstitutions: Map
  DefinitionUri: String | S3Location
  DeploymentPreference: DeploymentPreference
  Events: EventSource
  Logging: LoggingConfiguration
  Name: String
  PermissionsBoundary: String
  Policies: String | List | Map
  PropagateTags: Boolean
  RolePath: String
  Role: String
  Tags: Map
  Tracing: TracingConfiguration
  Type: String
```

Properties

`AutoPublishAlias`

The name of the state machine alias. To learn more about using Step Functions state machine aliases, see Manage continuous deployments with versions and aliases in the *AWS Step Functions Developer Guide*.

Use `DeploymentPreference` to configure deployment preferences for your alias. If you don't specify `DeploymentPreference`, AWS SAM will configure traffic to shift to the newer state machine version all at once.

AWS SAM sets the version's `DeletionPolicy` and `UpdateReplacePolicy` to `Retain` by default. Previous versions will not be deleted automatically.

Type: String

Required: No

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

`UseAliasAsEventTarget`

Indicate whether or not to pass the alias, created by using the `AutoPublishAlias` property, to the events source's target defined with Events.

Specify `True` to use the alias as the events' target.

Type: Boolean

Required: No

Default: `False`

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

`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.

You must provide either a `Definition` or a `DefinitionUri`.

Type: Map

Required: Conditional

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

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

CloudFormation compatibility: This property is passed directly to the `DefinitionS3Location` property of an `AWS::StepFunctions::StateMachine` resource.

`DeploymentPreference`

The settings that enable and configure gradual state machine deployments. To learn more about Step Functions gradual deployments, see Manage continuous deployments with versions and aliases in the *AWS Step Functions Developer Guide*.

Specify `AutoPublishAlias` before configuring this property. Your `DeploymentPreference` settings will be applied to the alias specified with `AutoPublishAlias`.

When you specify `DeploymentPreference`, AWS SAM generates the `StateMachineVersionArn` sub-property value automatically.

Type: DeploymentPreference

Required: No

CloudFormation compatibility: AWS SAM generates and attaches the `StateMachineVersionArn` property value to `DeploymentPreference` and passes `DeploymentPreference` to the `DeploymentPreference` property of an `AWS::StepFunctions::StateMachineAlias` 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

Required: No

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

`Logging`

Defines which execution history events are logged and where they are logged.

Type: LoggingConfiguration

Required: No

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

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

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

`Policies`

Permission policies for this state machine. Policies will be appended to the state machine's default AWS Identity and Access Management (IAM) execution role.

This property accepts a single value or list of values. Allowed values include:

- AWS SAM policy templates.
- The ARN of an AWS managed policy or customer managed policy.
- The name of an AWS managed policy from the following list.
- An inline IAM policy formatted in YAML as a map.

> **Note**
>
> If you set the `Role` property, this property is ignored.

Type: String | List | Map

Required: No

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

`PropagateTags`

Indicate whether or not to pass tags from the `Tags` property to your AWS::Serverless::StateMachine generated resources. Specify `True` to propagate tags in your generated resources.

Type: Boolean

Required: No

Default: `False`

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

`Role`

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

Type: String

Required: Conditional

CloudFormation compatibility: This property is passed directly to the `RoleArn` property of an `AWS::StepFunctions::StateMachine` resource.

`RolePath`

The path to the state machine's IAM execution role.

Use this property when the role is generated for you. Do not use when the role is specified with the `Role` property.

Type: String

Required: Conditional

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

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

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`

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 an inline state machine definition that allows a lambda function to invoke state machine. Note that this example expects the `Role` property to configure proper policy to allow invocation. 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 | ScheduleV2 | CloudWatchEvent | EventBridgeRule | Api
  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 | ScheduleV2 | CloudWatchEvent | EventBridgeRule | Api

Required: Yes

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

`Type`

The event type.

Valid values: `Api`, `Schedule`, `ScheduleV2`, `CloudWatchEvent`, `EventBridgeRule`

Type: String

Required: Yes

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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 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
Method: String
Path: String
RestApiId: String
UnescapeMappingTemplate: Boolean
```

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

Required: No

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

`Method`

The HTTP method for which this function is invoked.

Type: String

Required: Yes

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

`Path`

The URI path for which this function is invoked. The value must start with `/`.

Type: String

Required: Yes

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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 resource that is defined in this template.

If you don't define this property, AWS SAM creates a default AWS::Serverless::Api 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 resource that is defined in another template.

Type: String

Required: No

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

`UnescapeMappingTemplate`

Unescapes single quotes, by replacing `\'` with `'`, on the input that is passed to the state machine. Use when your input contains single quotes.

> **Note**
>
> If set to `False` and your input contains single quotes, an error will occur.

Type: Boolean

Required: No

Default: False

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

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
```

Properties

`ApiKeyRequired`

Requires an API key for this API, path, and method.

Type: Boolean

Required: No

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

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

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

`ResourcePolicy`

Configure the resource policy for this API and path.

Type: ResourcePolicyStatement

Required: No

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

Required: No

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

Required: No

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

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

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

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

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

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

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

`IpRangeWhitelist`

The IP addresses or address ranges to allow.

Type: List

Required: No

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

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

CloudFormation compatibility: This property is unique to AWS SAM and doesn't have an 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 is the preferred event source type to use, instead of `CloudWatchEvent`. `EventBridgeRule` and `CloudWatchEvent` use the same underlying service, API, and 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

```
  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

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

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

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

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:
          - running
```

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

```yaml
DeadLetterConfig: DeadLetterConfig
EventBusName: String
Input: String
InputPath: String
InputTransformer: InputTransformer
Pattern: EventPattern
RetryPolicy: RetryPolicy
RuleName: String
State: String
Target: Target
```

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

Required: No

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

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

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

CloudFormation compatibility: This property is passed directly to the `InputPath` property of an `AWS::Events::Rule Target` resource.

`InputTransformer`

Settings to enable you to provide custom input to a target based on certain event data. You can extract one or more key-value pairs from the event and then use that data to send customized input to the target. For more information, see Amazon EventBridge input transformation in the *Amazon EventBridge User Guide*.

Type: InputTransformer

Required: No

CloudFormation compatibility: This property is passed directly to the `InputTransformer` property of an `AWS::Events::Rule Target` data type.

`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

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

CloudFormation compatibility: This property is passed directly to the `RetryPolicy` property of the `AWS::Events::Rule Target` data type.

`RuleName`

The name of the rule.

Type: String

Required: No

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

`State`

The state of the rule.

Valid values: `[ DISABLED | ENABLED ]`

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `State` property of an `AWS::Events::Rule` resource.

`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

Required: No

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
```

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

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

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

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

CloudFormation compatibility: This property is passed directly to the `Id` property of the `AWS::Events::Rule Target` data type.

Examples

Target

YAML

```
EBRule:
  Type: EventBridgeRule
  Properties:
    Target:
      Id: MyTarget
```

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

```yaml
DeadLetterConfig: DeadLetterConfig
Description: String
Enabled: Boolean
Input: String
Name: String
RetryPolicy: RetryPolicy
RoleArn: String
Schedule: String
State: String
Target: Target
```

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

Required: No

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

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`.

> **Note**
>
> Specify either the `Enabled` or `State` property, but not both.

Type: Boolean

Required: No

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

CloudFormation compatibility: This property is passed directly to the `Input` property of an `AWS::Events::Rule Target` resource.

`Name`

The name of the rule. If you don't specify a name, CloudFormation generates a unique physical ID and uses that ID for the rule name.

Type: String

Required: No

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

CloudFormation compatibility: This property is passed directly to the `RetryPolicy` property of the `AWS::Events::Rule Target` data type.

`RoleArn`

The ARN of the IAM role that EventBridge Scheduler will use for the target when the schedule is invoked.

Type: RoleArn

Required: No. If not provided, a new role will be created and used.

CloudFormation compatibility: This property is passed directly to the `RoleArn` property of the `AWS::Scheduler::Schedule 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

CloudFormation compatibility: This property is passed directly to the `ScheduleExpression` property of an `AWS::Events::Rule` resource.

`State`

The state of the rule.

Accepted values: `DISABLED | ENABLED`

> **Note**
>
> Specify either the `Enabled` or `State` property, but not both.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `State` property of an `AWS::Events::Rule` resource.

`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

Required: No

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

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

```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

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

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

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

CloudFormation compatibility: This property is passed directly to the `Id` property of the `AWS::Events::Rule Target` data type.

Examples

Target

YAML

```
EBRule:
  Type: Schedule
  Properties:
    Target:
```

```
      Id: MyTarget
```

ScheduleV2

The object describing a `ScheduleV2` event source type, which sets your state machine as the target of an Amazon EventBridge Scheduler event that triggers on a schedule. For more information, see What is Amazon EventBridge Scheduler? in the *EventBridge Scheduler User Guide*.

AWS Serverless Application Model (AWS SAM) generates an AWS::Scheduler::Schedule 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
Description: String
EndDate: String
FlexibleTimeWindow: FlexibleTimeWindow
GroupName: String
Input: String
KmsKeyArn: String
Name: String
OmitName: Boolean
PermissionsBoundary: String
RetryPolicy: RetryPolicy
RoleArn: String
ScheduleExpression: String
ScheduleExpressionTimezone: String
StartDate: String
State: 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 Configuring a dead-letter queue for EventBridge Scheduler in the *EventBridge Scheduler User Guide*.

Type: DeadLetterConfig

Required: No

CloudFormation compatibility: This property is similar to the `DeadLetterConfig` property of the `AWS::Scheduler::Schedule 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 schedule.

Type: String

Required: No

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

`EndDate`

The date, in UTC, before which the schedule can invoke its target. Depending on the schedule's recurrence expression, invocations might stop on, or before, the **EndDate** you specify.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `EndDate` property of an `AWS::Scheduler::Schedule` resource.

`FlexibleTimeWindow`

Allows configuration of a window within which a schedule can be invoked.

Type: FlexibleTimeWindow

Required: No

CloudFormation compatibility: This property is passed directly to the `FlexibleTimeWindow` property of an `AWS::Scheduler::Schedule` resource.

`GroupName`

The name of the schedule group to associate with this schedule. If not defined, the default group is used.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `GroupName` property of an `AWS::Scheduler::Schedule` 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

CloudFormation compatibility: This property is passed directly to the `Input` property of an `AWS::Scheduler::Schedule Target` resource.

`KmsKeyArn`

The ARN for a KMS Key that will be used to encrypt customer data.

Type: String

Required: No

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

`Name`

The name of the schedule. If you don't specify a name, AWS SAM generates a name in the format *`StateMachine-Logical-IDEvent-Source-Name`* and uses that ID for the schedule name.

Type: String

Required: No

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

`OmitName`

By default, AWS SAM generates and uses a schedule name in the format of *`<State-machine-logical-ID><event-source-name>`*. Set this property to `true` to have CloudFormation generate a unique physical ID and use that for the schedule name instead.

Type: Boolean

Required: No

Default: `false`

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

`PermissionsBoundary`

The ARN of the policy used to set the permissions boundary for the role.

> **Note**
>
> If `PermissionsBoundary` is defined, AWS SAM will apply the same boundaries to the scheduler schedule's target IAM role.

Type: String

Required: No

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

`RetryPolicy`

A `RetryPolicy` object that includes information about the retry policy settings.

Type: RetryPolicy

Required: No

CloudFormation compatibility: This property is passed directly to the `RetryPolicy` property of the `AWS::Scheduler::Schedule Target` data type.

`RoleArn`

The ARN of the IAM role that EventBridge Scheduler will use for the target when the schedule is invoked.

Type: RoleArn

Required: No

CloudFormation compatibility: This property is passed directly to the `RoleArn` property of the `AWS::Scheduler::Schedule Target` data type.

`ScheduleExpression`

The scheduling expression that determines when and how often the schedule runs.

Type: String

Required: Yes

CloudFormation compatibility: This property is passed directly to the `ScheduleExpression` property of an `AWS::Scheduler::Schedule` resource.

`ScheduleExpressionTimezone`

The timezone in which the scheduling expression is evaluated.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `ScheduleExpressionTimezone` property of an `AWS::Scheduler::Schedule` resource.

`StartDate`

The date, in UTC, after which the schedule can begin invoking a target. Depending on the schedule's recurrence expression, invocations might occur on, or after, the **StartDate** you specify.

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `StartDate` property of an `AWS::Scheduler::Schedule` resource.

`State`

The state of the schedule.

Accepted values: `DISABLED | ENABLED`

Type: String

Required: No

CloudFormation compatibility: This property is passed directly to the `State` property of an `AWS::Scheduler::Schedule` resource.

Examples

Basic example of defining a ScheduleV2 resource

```
StateMachine:
  Type: AWS::Serverless::StateMachine
  Properties:
    Name: MyStateMachine
    Events:
      ScheduleEvent:
        Type: ScheduleV2
        Properties:
          ScheduleExpression: "rate(1 minute)"
      ComplexScheduleEvent:
        Type: ScheduleV2
        Properties:
          ScheduleExpression: rate(1 minute)
          FlexibleTimeWindow:
            Mode: FLEXIBLE
            MaximumWindowInMinutes: 5
          StartDate: '2022-12-28T12:00:00.000Z'
          EndDate: '2023-01-28T12:00:00.000Z'
          ScheduleExpressionTimezone: UTC
          RetryPolicy:
            MaximumRetryAttempts: 5
            MaximumEventAgeInSeconds: 300
          DeadLetterConfig:
            Type: SQS
    DefinitionUri:
      Bucket: sam-sam-s3-demo-bucket
```

```
      Key: my-state-machine.asl.json
      Version: 3
    Policies:
      - LambdaInvokePolicy:
          FunctionName: !Ref MyFunction
```

Generated CloudFormation resources for AWS SAM

This section provides details on the CloudFormation resources that are created when AWS SAM processes your AWS template. The set of CloudFormation resources that AWS SAM generates differs depending on the scenarios you specify. A *scenario* is the combination of AWS SAM resources and properties specified in your template file. You can reference the generated 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 CloudFormation resources that they generate, and shows how to reference the generated CloudFormation resources in your AWS SAM template file.

Referencing generated CloudFormation resources

You have two options for referencing generated CloudFormation resources within your AWS SAM template file, by `LogicalId` or by referenceable property.

Referencing generated CloudFormation resources by LogicalId

The 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 CloudFormation resources it generates. You can use the `LogicalId` of a generated CloudFormation resource to access properties of that resource within your template file, just like you would for an CloudFormation resource that you have explicitly declared. For more information about `LogicalIds` in 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 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 CloudFormation resource and its properties within your AWS SAM template file.

> **Note**
>
> Not all generated CloudFormation resources have referenceable properties. For those resources, you must use the `LogicalId`.

Generated CloudFormation resource scenarios

The following table summarizes the AWS SAM resources and properties that make up the scenarios that generate CloudFormation resources. The topics in the **Scenarios** column provide details about the additional CloudFormation resources that AWS SAM generates for that scenario.

AWS SAM resource	Base CloudFormation resource	Scenarios
`AWS::Serverless::Api`	`AWS::ApiGateway::RestApi`	• DomainName property is specified • UsagePlan property is specified

AWS SAM resource	Base CloudFormation resource	Scenarios
AWS::Serverless::Application	AWS::CloudFormation::Stack	• Other than generating the base CloudFormation resource, there are no additional scenarios for this serverless resource.
AWS::Serverless::CapacityProvider	AWS::Lambda::CapacityProvider	• OperatorRole property is not specified
AWS::Serverless::Function	AWS::Lambda::Function	• AutoPublishAlias property is specified • Role property is not specified • DeploymentPreference property is specified • An Api event source is specified • An HttpApi event source is specified • A streaming event source is specified • An event bridge (or event bus) event source is specified • An IotRule event source is specified • OnSuccess (or OnFailure) property is specified for Amazon SNS events • OnSuccess (or OnFailure) property is specified for Amazon SQS events

AWS SAM resource	Base CloudFormation resource	Scenarios
AWS::Serverless::HttpApi	AWS::ApiGatewayV2::Api	• StageName property is specified • StageName property is *not* specified • DomainName property is specified
AWS::Serverless::LayerVersion	AWS::Lambda::LayerVersion	• Other than generating the base CloudFormation resource, there are no additional scenarios for this serverless resource.
AWS::Serverless::SimpleTable	AWS::DynamoDB::Table	• Other than generating the base CloudFormation resource, there are no additional scenarios for this serverless resource.
AWS::Serverless::StateMachine	AWS::StepFunctions::StateMachine	• Role property is not specified • An API event source is specified • An event bridge (or event bus) event source is specified

Topics

- CloudFormation resources generated when AWS::Serverless::Api is specified
- CloudFormation resources generated when AWS::Serverless::Application is specified
- CloudFormation resources generated when AWS::Serverless::CapacityProvider is specified
- CloudFormation resources generated when you specify AWS::Serverless::Connector
- CloudFormation resources generated when AWS::Serverless::Function is specified
- CloudFormation resources generated when AWS::Serverless::GraphQLApi is specified
- CloudFormation resources generated when AWS::Serverless::HttpApi is specified

- CloudFormation resources generated when AWS::Serverless::LayerVersion is specified
- CloudFormation resources generated when AWS::Serverless::SimpleTable is specified
- CloudFormation resources generated when AWS::Serverless::StateMachine is specified

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 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 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 CloudFormation resources, when `AWS::Serverless::Api` is specified, AWS SAM generates additional CloudFormation resources for the following scenarios.

Scenarios

- DomainName property is specified
- UsagePlan property is specified

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` 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 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`

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 CloudFormation resource.

`AWS::CloudFormation::Stack`

`LogicalId`: `<application-LogicalId>`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

CloudFormation resources generated when AWS::Serverless::CapacityProvider is specified

When an `AWS::Serverless::CapacityProvider` is specified, AWS Serverless Application Model (AWS SAM) generates an `AWS::Lambda::CapacityProvider` base CloudFormation resource.

`AWS::Lambda::CapacityProvider`

`LogicalId`: `<capacityprovider-LogicalId>`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

In addition to this CloudFormation resource, when `AWS::Serverless::CapacityProvider` is specified, AWS SAM also generates CloudFormation resources for the following scenarios:

Scenarios

- OperatorRole property is not specified

OperatorRole property is not specified

When the `OperatorRole` property of an `AWS::Serverless::CapacityProvider` is *not* specified, AWS SAM generates an `AWS::IAM::Role` CloudFormation resource with the `AWSLambdaManagedEC2ResourceOperator` managed policy attached.

`AWS::IAM::Role`

`LogicalId:` `<capacityprovider-LogicalId>OperatorRole`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

CloudFormation resources generated when you specify AWS::Serverless::Connector

> **Note**
>
> When you define connectors through the embedded `Connectors` property, it is first transformed into an `AWS::Serverless::Connector` resource before generating these resources.

When you specify an `AWS::Serverless::Connector` resource in an AWS SAM template, AWS SAM generates the following AWS CloudFormation resources as needed.

`AWS::IAM::ManagedPolicy`

`LogicalId:` `<connector-LogicalId>Policy`

Referenceable property: N/A (To reference this CloudFormation resource, you must use the `LogicalId`.)

`AWS::SNS::TopicPolicy`

`LogicalId:` `<connector-LogicalId>TopicPolicy`

Referenceable property: N/A (To reference this CloudFormation resource, you must use the `LogicalId`.)

`AWS::SQS::QueuePolicy`

`LogicalId:` `<connector-LogicalId>QueuePolicy`

Referenceable property: N/A (To reference this CloudFormation resource, you must use the `LogicalId`.)

`AWS::Lambda::Permission`

`LogicalId:<connector-LogicalId><permission>``LambdaPermission`

`<permission>` is a permission specified by the `Permissions` property. For example, `Write`.

Referenceable property: N/A (To reference this CloudFormation resource, you must use the `LogicalId`.)

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 CloudFormation resource.

`AWS::Lambda::Function`

`LogicalId: <function-LogicalId>`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

In addition to this CloudFormation resource, when `AWS::Serverless::Function` is specified, AWS SAM also generates CloudFormation resources for the following scenarios.

Scenarios

- Core function properties
- Event sources
- Event configuration

Core function properties

The following scenarios generate CloudFormation resources based on core function properties:

Role property is not specified

When the `Role` property of an `AWS::Serverless::Function` is *not* specified, AWS SAM generates an `AWS::IAM::Role` CloudFormation resource.

`AWS::IAM::Role`

`LogicalId`: `<function-LogicalId>Role`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

AutoPublishAlias property is specified

When the `AutoPublishAlias` property of an `AWS::Serverless::Function` is specified, AWS SAM generates the following 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`

For additional information on the `AutoPublishAlias` property, see the Properties section of AWS::Serverless::Function.

DeploymentPreference property is specified

When the `DeploymentPreference` property of an `AWS::Serverless::Function` is specified, AWS SAM generates the following resources 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` CloudFormation resource.

`AWS::CodeDeploy::Application`

`LogicalId:` `ServerlessDeploymentApplication`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

`AWS::CodeDeploy::DeploymentGroup`

`LogicalId:` `<function-LogicalId>DeploymentGroup`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

`AWS::IAM::Role`

`LogicalId:` `CodeDeployServiceRole`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

FunctionUrlConfig property is specified

When the `FunctionUrlConfig` property is specified, AWS SAM generates different CloudFormation resources based on the `AuthType`.

When `AuthType: NONE` is specified, AWS SAM generates the following CloudFormation resources:

`AWS::Lambda::Permission` (Invoke Access)

`LogicalId:` `<function-LogicalId>URLInvokeAllowPublicAccess`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

`AWS::Lambda::Permission` (Public Access)

`LogicalId:` `<function-LogicalId>UrlPublicPermissions`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

`AWS::Lambda::Url`

`LogicalId:` `<function-LogicalId>Url`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

When `AuthType: AWS_IAM` is specified, AWS SAM generates only:

`AWS::Lambda::Url`

`LogicalId:` `<function-LogicalId>Url`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

For additional information on the `FunctionUrlConfig` property, see FunctionUrlConfig.

Event sources

The following scenarios generate CloudFormation resources based on event sources:

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` CloudFormation resource.

`AWS::ApiGateway::RestApi`

`LogicalId:` `ServerlessRestApi`

Referenceable property: N/A (you must use the `LogicalId` to reference this 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` CloudFormation resource.

`AWS::ApiGatewayV2::Api`

`LogicalId:` `ServerlessHttpApi`

Referenceable property: N/A (you must use the `LogicalId` to reference this 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` 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 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` 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 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` CloudFormation resource.

`AWS::IoT::TopicRule`

`LogicalId:` *`<function-LogicalId><event-LogicalId>`*

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

Event configuration

The following scenarios generate CloudFormation resources based on event configuration:

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 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 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 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 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`.

CloudFormation resources generated when AWS::Serverless::GraphQLApi is specified

When you specify an `AWS::Serverless::GraphQLApi` resource in an AWS Serverless Application Model (AWS SAM) template, AWS SAM always creates the following base AWS CloudFormation resources.

`AWS::AppSync::DataSource`

`LogicalId`: *`<graphqlapi-LogicalId><datasource-RelativeId><datasource-Type>`*`DataSource`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

`AWS::AppSync::FunctionConfiguration`

`LogicalId`: *`<graphqlapi-LogicalId><function-RelativeId>`*

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

`AWS::AppSync::GraphQLApi`

`LogicalId`: *`<graphqlapi-LogicalId>`*

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

`AWS::AppSync::GraphQLSchema`

`LogicalId`: `<graphqlapi-LogicalId>Schema`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

`AWS::AppSync::Resolver`

`LogicalId`: `<graphqlapi-LogicalId><OperationType><resolver-RelativeId>`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

In addition to these CloudFormation resources, when `AWS::Serverless::GraphQLApi` is specified, AWS SAM may also generate the following CloudFormation resources.

`AWS::AppSync::ApiCache`

`LogicalId`: `<graphqlapi-LogicalId>ApiCache`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

`AWS::AppSync::ApiKey`

`LogicalId`: `<graphqlapi-LogicalId><apikey-RelativeId>`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

`AWS::AppSync::DomainName`

`LogicalId`: `<graphqlapi-LogicalId>DomainName`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

`AWS::AppSync::DomainNameApiAssociation`

`LogicalId`: `<graphqlapi-LogicalId>DomainNameApiAssociation`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

AWS SAM may also use the `AWS::Serverless::Connector` resource to provision permissions. For more information, see CloudFormation resources generated when you specify AWS::Serverless::Connector.

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 CloudFormation resource.

`AWS::ApiGatewayV2::Api`

`LogicalId`: `<httpapi-LogicalId>`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

In addition to this CloudFormation resource, when `AWS::Serverless::HttpApi` is specified, AWS SAM also generates CloudFormation resources for the following scenarios:

Scenarios

- StageName property is specified
- StageName property is not specified
- DomainName property is specified

StageName property is specified

When the `StageName` property of an `AWS::Serverless::HttpApi` is specified, AWS SAM generates the `AWS::ApiGatewayV2::Stage` 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` 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` CloudFormation resource.

`AWS::ApiGatewayV2::DomainName`

`LogicalId:` `ApiGatewayDomainNameV2<sha>`

`<sha>` is a unique hash value that is generated when the stack is created. For example, `ApiGatewayDomainNameV2926eeb5ff1`.

Referenceable property: `<httpapi-LogicalId>.DomainName`

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 CloudFormation resource.

`AWS::Lambda::LayerVersion`

`LogicalId:` `<layerversion-LogicalId>`

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

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 CloudFormation resource.

`AWS::DynamoDB::Table`

`LogicalId`: *`<simpletable-LogicalId>`*

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

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 CloudFormation resource.

`AWS::StepFunctions::StateMachine`

`LogicalId`: *`<statemachine-LogicalId>`*

Referenceable property: N/A (you must use the `LogicalId` to reference this CloudFormation resource)

In addition to this CloudFormation resource, when `AWS::Serverless::StateMachine` is specified, AWS SAM also generates CloudFormation resources for the following scenarios:

Scenarios

- Role property is not specified
- An API event source is specified
- An event bridge (or event bus) event source is specified

Role property is not specified

When the `Role` property of an `AWS::Serverless::StateMachine` is *not* specified, AWS SAM generates an `AWS::IAM::Role` CloudFormation resource.

`AWS::IAM::Role`

`LogicalId`: `<statemachine-LogicalId>Role`

Referenceable property: N/A (you must use the `LogicalId` to reference this 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` CloudFormation resource.

`AWS::ApiGateway::RestApi`

`LogicalId`: `ServerlessRestApi`

Referenceable property: N/A (you must use the `LogicalId` to reference this 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` 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 CloudFormation resource)

Resource attributes supported by AWS SAM

Resource attributes are attributes that you can add to AWS SAM and 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 CloudFormation. Of the supported resource attributes, some are copied to only the base generated CloudFormation resource of the corresponding AWS SAM resource, and some are copied to all generated CloudFormation resources resulting from the corresponding AWS SAM resource. For more information about CloudFormation resources generated from corresponding AWS SAM resources, see Generated CloudFormation resources for AWS SAM.

The following table summarizes resource attribute support by AWS SAM, subject to the Exceptions listed below.

Resource attributes	Destination generated resource(s)
DependsOn **Metadata** [1, 2]	Base CloudFormation generated resource only. For information about the mapping between AWS SAM resources and base CloudFormation resources, see Generated CloudFormation resource scenarios.
Condition **DeletionPolicy** **UpdateReplacePolicy**	All generated CloudFormation resources from the corresponding AWS SAM resource. For information about scenarios for generated CloudFormation resources, see Generated CloudFormation resource scenarios.

Notes:

1. For more information about using the `Metadata` resource attribute with the `AWS::Serverless::Function` resource type, see Building Lambda functions with custom runtimes in AWS SAM.
2. For more information about using the `Metadata` resource attribute with the `AWS::Serverless::LayerVersion` resource type, see Building Lambda layers in AWS SAM.

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 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 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`

API Gateway extensions for AWS SAM

API Gateway extensions, specifically designed for AWS, provide additional customizations and functionality for designing and managing APIs. 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, refer to 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, refer to 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

Intrinsic functions for AWS SAM

Intrinsic functions are built-in functions that enable you to assign values to properties that are only available at runtime. AWS SAM has limited support for certain intrinsic function properties, so it is unable to resolve some intrinsic functions. Consequently, we recommend adding the `AWS::LanguageExtensions` transform to resolve this. The `AWS::LanguageExtensions` is a macro hosted by CloudFormation that lets you use intrinsic functions and other functionalities that are by default not included in CloudFormation.

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

> **Note**
>
> If you use intrinsic functions in CodeUri property, AWS SAM will not be able to correctly parse the values. Consider using `AWS::LanguageExtensions` transform instead.
> For more information, refer to Properties section of AWS::Serverless::Function.

For more information about intrinsic functions, see Intrinsic Function Reference in the *AWS CloudFormation User Guide*.

Example serverless applications for AWS SAM

This section includes two example applications: one that processes DynamoDB events and another that processes Amazon S3 events. Each example takes you through a step-by-step process of creating an application. Additionally, both include details on configuring event sources and AWS resources. Both start by identifying what must be done before you start and follow with steps for initializing, testing, packaging, and deploying your application.

Topics

- Process DynamoDB events with AWS SAM
- Process Amazon S3 events with AWS SAM

Process DynamoDB events with AWS SAM

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 Install the AWS SAM CLI.

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.

CloudFormation creates the AWS resources that are defined in the template. You can access the names of these resources in the 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

To continue learning about AWS SAM, see the following resources:

- **AWS SAM example applications** – The AWS SAM GitHub repository contains additional example applications for you to download and experiment with.
- **Serverless Land** – Site that brings together serverless patterns, code examples, and learning resources specifically for AWS SAM applications.

Process Amazon S3 events with AWS SAM

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 are going to leverage 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 Install the AWS SAM CLI.

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 CloudFormation to create an IAM role.

CloudFormation creates the AWS resources that are defined in the template. You can access the names of these resources in the 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 CloudFormation.

- Retrieve the Amazon S3 key name and bucket name from 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 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

To continue learning about AWS SAM, see the following resources:

- **AWS SAM example applications** – The AWS SAM GitHub repository contains additional example applications for you to download and experiment with.
- **Serverless Land** – Site that brings together serverless patterns, code examples, and learning resources specifically for AWS SAM applications.

Develop your serverless application with AWS SAM

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. The three major milestones you need to complete to develop your application are listed below.

Topics

- Create your application in AWS SAM
- Define your infrastructure with AWS SAM
- Build your application with AWS SAM

Create your application in AWS SAM

After completing Getting started and reading How to use AWS Serverless Application Model (AWS SAM), you will be ready to create an AWS SAM project in your developer environment. Your AWS SAM project will serve as the starting point for writing your serverless application. For a list of AWS SAM CLI `sam init` command options, see sam init.

The AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam init` command provides options to initialize a new serverless application that consists of:

- An AWS SAM template to define your infrastructure code.
- A folder structure that organizes your application.
- Configuration for your AWS Lambda functions.

To create an AWS SAM project, refer to the topics in this sections.

> **Note**
>
> `sam init` includes project templates for durable functions in supported runtimes (TypeScript, Python, Java). These templates provide starter code and configuration for building stateful serverless applications.

Topics

- Initialize a new serverless application
- Options for sam init
- Troubleshooting
- Examples
- Learn more
- Next steps

Initialize a new serverless application

To initialize a new serverless application using the AWS SAM CLI

1. cd to a starting directory.
2. Run the following at the command line:

```
$ sam init
```

3. The AWS SAM CLI will guide you through an interactive flow to create a new serverless application.

> **Note**
>
> As detailed in Tutorial: Deploy a Hello World application with AWS SAM, this command initializes your serverless application, creating your project directory. This directory will contain several files and folders. The most important file is `template.yaml`. This is your AWS SAM template. Your version of python must match the version of python listed in the `template.yaml` file that the **sam init** command created.

Choose a starting template

A *template* consists of the following:

1. An AWS SAM template for your infrastructure code.
2. A starting project directory that organizes your project files. For example, this may include:
   a. A structure for your Lambda function code and their dependencies.

b. An `events` folder that contains test events for local testing.

c. A `tests` folder to support unit testing.

d. A `samconfig.toml` file to configure project settings.

e. A `ReadMe` file and other basic starting project files.

The following is an example of a starting project directory:

```
sam-app
### README.md
### __init__.py
### events
#   ### event.json
### hello_world
#   ### __init__.py
#   ### app.py
#   ### requirements.txt
### samconfig.toml
### template.yaml
### tests
    ### __init__.py
    ### integration
    #   ### __init__.py
    #   ### test_api_gateway.py
    ### requirements.txt
    ### unit
        ### __init__.py
        ### test_handler.py
```

You can select from a list of available *AWS Quick Start Templates* or provide your own *Custom Template Location*.

To choose an AWS Quick Start Template

1. When prompted, select **AWS Quick Start Templates**.
2. Select an AWS Quick Start template to begin with. The following is an example:

```
Which template source would you like to use?
    1 - AWS Quick Start Templates
    2 - Custom Template Location
Choice: 1
```

```
Choose an AWS Quick Start application template
    1 - Hello World Example
    2 - Multi-step workflow
    3 - Serverless API
    4 - Scheduled task
    5 - Standalone function
    6 - Data processing
    7 - Hello World Example With Powertools
    8 - Infrastructure event management
    9 - Serverless Connector Hello World Example
    10 - Multi-step workflow with Connectors
    11 - Lambda EFS example
    12 - DynamoDB Example
    13 - Machine Learning
Template: 4
```

To choose your own custom template location

1. When prompted, select the **Custom Template Location**.

```
Which template source would you like to use?
    1 - AWS Quick Start Templates
    2 - Custom Template Location
Choice: 2
```

2. The AWS SAM CLI will prompt you to provide a template location.

```
Template location (git, mercurial, http(s), zip, path):
```

   Provide any of the following locations to your template .zip file archive:

   - **GitHub repository** – The path to the .zip file in your GitHub repository. The file must be in the root of your repository.
   - **Mercurial repository** – The path to the .zip file in your Mercurial repository. The file must be in the root of your repository.
   - **.zip path** – An HTTPS or local path to your .zip file.

3. The AWS SAM CLI will initialize your serverless application using your custom template.

Choose a runtime

When you choose an *AWS Quick Start Template*, the AWS SAM CLI prompts you to select a runtime for your Lambda functions. The list of options displayed by the AWS SAM CLI are the runtimes supported natively by Lambda.

- The runtime provides a language-specific environment that runs in an execution environment.
- When deployed to the AWS Cloud, the Lambda service invokes your function in an execution environment.

You can use any other programming language with a custom runtime. To do this, you need to manually create your starting application structure. You can then use `sam init` to quickly initialize your application by configuring a custom template location.

From your selection, the AWS SAM CLI creates the starting directory for your Lambda function code and dependencies.

If Lambda supports multiple dependency managers for your runtime, you will be prompted to choose your preferred dependency manager.

Choose a package type

When you choose an *AWS Quick Start Template* and a *runtime*, the AWS SAM CLI prompts you to select a *package type*. The package type determines how your Lambda functions are deployed to use with the Lambda service. The two supported package types are:

1. **Container image** – Contains the base operating system, the runtime, Lambda extensions, your application code, and its dependencies.
2. **.zip file archive** – Contains your application code and its dependencies.

To learn more about deployment package types, see Lambda deployment packages in the *AWS Lambda Developer Guide*.

The following is an example directory structure of an application with a Lambda function packaged as a container image. The AWS SAM CLI downloads the image and creates a `Dockerfile` in the function's directory to specify the image.

```
sam-app
```

```
### README.md
### __init__.py
### events
#   ### event.json
### hello_world
#   ### Dockerfile
#   ### __init__.py
#   ### app.py
#   ### requirements.txt
### samconfig.toml
### template.yaml
### tests
    ### __init__.py
    ### unit
        ### __init__.py
        ### test_handler.py
```

The following is an example directory structure of an application with a function packaged as a .zip file archive.

```
sam-app
### README.md
### __init__.py
### events
#   ### event.json
### hello_world
#   ### __init__.py
#   ### app.py
#   ### requirements.txt
### samconfig.toml
### template.yaml
### tests
    ### __init__.py
    ### integration
    #   ### __init__.py
    #   ### test_api_gateway.py
    ### requirements.txt
    ### unit
        ### __init__.py
        ### test_handler.py
```

Configure AWS X-Ray tracing

You can choose to activate AWS X-Ray tracing. To learn more, see What is AWS X-Ray? in the *AWS X-Ray Developer Guide*.

If you activate, the AWS SAM CLI configures your AWS SAM template. The following is an example:

```
Globals:
  Function:
    ...
    Tracing: Active
  Api:
    TracingEnabled: True
```

Configure monitoring with Amazon CloudWatch Application Insights

You can choose to activate monitoring using Amazon CloudWatch Application Insights. To learn more, see Amazon CloudWatch Application Insights in the *Amazon CloudWatch User Guide*.

If you activate, the AWS SAM CLI configures your AWS SAM template. The following is an example:

```
Resources:
  ApplicationResourceGroup:
    Type: AWS::ResourceGroups::Group
    Properties:
      Name:
        Fn::Join:
        - ''
        - - ApplicationInsights-SAM-
          - Ref: AWS::StackName
      ResourceQuery:
        Type: CLOUDFORMATION_STACK_1_0
  ApplicationInsightsMonitoring:
    Type: AWS::ApplicationInsights::Application
    Properties:
      ResourceGroupName:
        Fn::Join:
        - ''
        - - ApplicationInsights-SAM-
          - Ref: AWS::StackName
      AutoConfigurationEnabled: 'true'
    DependsOn: ApplicationResourceGroup
```

Name your application

Provide a name for your application. The AWS SAM CLI creates a top-level folder for your application using this name.

Options for sam init

The following are some of the main options you can use with the `sam init` command. For a list of all options, see sam init.

Initialize an application using a custom template location

Use the `--location` option and provide a supported custom template location. The following is an example:

```
$ sam init --location https://github.com/aws-samples/sessions-with-aws-sam/raw/master/
starter-templates/web-app.zip
```

Initialize an application without the interactive flow

Use the `--no-interactive` option and provide your configuration choices at the command line to skip the interactive flow. The following is an example:

```
$ sam init --no-interactive --runtime go1.x --name go-demo --dependency-manager mod --
app-template hello-world
```

Troubleshooting

To troubleshoot the AWS SAM CLI, see AWS SAM CLI troubleshooting.

Examples

Initialize a new serverless application using the Hello World AWS Starter Template

For this example, see Step 1: Initialize the sample Hello World application in *Tutorial: Deploying a Hello World application*.

Initialize a new serverless application with a custom template location

The following are examples of providing a GitHub location to your custom template:

```
$ sam init --location gh:aws-samples/cookiecutter-aws-sam-python
$ sam init --location git+sh://git@github.com/aws-samples/cookiecutter-aws-sam-
python.git
$ sam init --location hg+ssh://hg@bitbucket.org/repo/template-name
```

The following is an example of a local file path:

```
$ sam init --location /path/to/template.zip
```

The following is an example of a path reachable by HTTPS:

```
$ sam init --location https://github.com/aws-samples/sessions-with-aws-sam/raw/master/
starter-templates/web-app.zip
```

Learn more

To learn more about using the `sam init` command, see the following:

- **Learning AWS SAM: sam init** – Serverless Land "Learning AWS SAM" series on YouTube.
- **Structuring serverless applications for use with the AWS SAM CLI (Sessions with SAM S2E7)** – Sessions with AWS SAM series on YouTube.

Next steps

Now that you have created your AWS SAM project, you are ready to start authoring your application. See Define your infrastructure with AWS SAM for detailed instructions on the tasks you need to complete to do this.

Define your infrastructure with AWS SAM

Now that you have created your project, you are ready to define your application infrastructure with AWS SAM. Do this by configuring your AWS SAM template to define your application's resources and properties, which is the `template.yaml` file in your AWS SAM project.

The topics in this section provide content on defining your infrastructure in your AWS SAM template (your `template.yaml` file). It also contains topics on defining resources for specific use cases, such as working with Lambda layers, using nested applications, controlling access to API

Gateway APIs, orchestrating AWS resources with Step Functions, code signing your applications, and validating your AWS SAM template.

Topics

- Define application resources in your AWS SAM template
- Set up and manage resource access in your AWS SAM template
- Control API access with your AWS SAM template
- Increase efficiency using Lambda layers with AWS SAM
- Reuse code and resources using nested applications in AWS SAM
- Manage time-based events with EventBridge Scheduler in AWS SAM
- Orchestrating AWS SAM resources with AWS Step Functions
- Set up code signing for your AWS SAM application
- Validate AWS SAM template files

Define application resources in your AWS SAM template

You define the AWS resources your serverless application uses in the `Resources` section of your AWS SAM template. When you define a resource, you identify what the resource is, how it interacts with other resources, and how it can be accessed (that is, the permissions of the resource).

The `Resources` section of your AWS SAM template can contain a combination of CloudFormation resources and AWS SAM resources. Additionally, you can use AWS SAM's short-hand syntax for the following resources:

AWS SAM short-hand syntax	What it does with a related AWS resource
AWS::Serverless::Api	Creates a collection of API Gateway resources and methods that can be invoked through HTTPS endpoints.
AWS::Serverless::Application	Embeds a serverless application from the AWS Serverless Application Repository or from an Amazon S3 bucket as a nested application.
AWS::Serverless::Connector	Configures permissions between two resources . For an introduction to connectors, see

AWS SAM short-hand syntax	What it does with a related AWS resource
	Managing resource permissions with AWS SAM connectors.
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.
AWS::Serverless::GraphQLApi	creates and configures an AWS AppSync GraphQL API for your serverless application.
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.
AWS::Serverless::LayerVersion	Creates a Lambda LayerVersion that contains library or runtime code needed by a Lambda Function.
AWS::Serverless::SimpleTable	Creates a DynamoDB table with a single attribute primary key.
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.

The above resources are also listed in AWS SAM resources and properties.

For reference information for all the AWS resource and property types CloudFormation and AWS SAM support, see AWS resource and property types reference in the *AWS CloudFormation User Guide*.

Set up and manage resource access in your AWS SAM template

For your AWS resources to interact with one another, the proper access and permissions must be configured between your resources. Doing this requires the configuration of AWS Identity and

Access Management (IAM) users, roles, and policies to accomplish your interaction in a secure manner.

The topics in this section are all related to setting up access to the resources defined in your template. This section starts with general best practices. The next two topics review two options you have for setting up access and permissions between the resources referenced in your serverless application: AWS SAM connectors and AWS SAM policy templates. The last topic provides details for managing user access using the same mechanics CloudFormation uses for managing users.

To learn more, see Controlling access with AWS Identity and Access Management in the *AWS CloudFormation User Guide*.

The AWS Serverless Application Model (AWS SAM) provides two options that simplify management of access and permissions for your serverless applcations.

1. AWS SAM connectors
2. AWS SAM policy templates

AWS SAM connectors

Connectors are a way of provisioning permissions between two resources. You do this by describing how they should interact with each other in your AWS SAM template. They can be defined using either the `Connectors` resource attribute or `AWS::Serverless::Connector` resource type. Connectors support the provisioning of `Read` and `Write` access of data and events between a combination of AWS resources. To learn more about AWS SAM connectors, see Managing resource permissions with AWS SAM connectors.

AWS SAM policy templates

AWS SAM policy templates are pre-defined sets of permissions that you can add to your AWS SAM templates to manage access and permissions between your AWS Lambda functions, AWS Step Functions state machines and the resources they interact with. To learn more about AWS SAM policy templates, see AWS SAM policy templates.

AWS CloudFormation mechanisms

CloudFormation mechanisms include the configuring of IAM users, roles, and policies to manage permissions between your AWS resources. To learn more, see Managing AWS SAM permissions with CloudFormation mechanisms.

Best practices

Throughout your serverless applications, you can use multiple methods to configure permissions between your resources. Therefore, you can select the best option for each scenario and use multiple options together throughout your applications. Here are a few things to consider when choosing the best option for you:

- AWS SAM connectors and policy templates both reduce the IAM expertise required to facilitate secure interactions between your AWS resources. Use connectors and policy templates when supported.
- AWS SAM connectors provide a simple and intuitive short-hand syntax to define permissions in your AWS SAM templates and require the least amount of IAM expertise. When both AWS SAM connectors and policy templates are supported, use AWS SAM connectors.
- AWS SAM connectors can provision `Read` and `Write` access of data and events between supported AWS SAM source and destination resources. For a list of supported resources, see AWS SAM connector reference. When supported, use AWS SAM connectors.
- While AWS SAM policy templates are limited to permissions between your Lambda functions, Step Functions state machines and the AWS resources they interact with, policy templates do support all CRUD operations. When supported, and when an AWS SAM policy template for your scenario is available, use AWS SAM policy templates. For a list of available policy templates, see AWS SAM policy templates.
- For all other scenarios, or when granularity is required, use CloudFormation mechanisms.

Managing resource permissions with AWS SAM connectors

Connectors are an AWS Serverless Application Model (AWS SAM) abstract resource type, identified as `AWS::Serverless::Connector`, that provides simple and well-scoped permissions between your serverless application resources.

Benefits of AWS SAM connectors

By automatically composing the appropriate access policies between resources, connectors give you the ability to author your serverless applications and focus on your application architecture without needing expertise in AWS authorization capabilities, policy language, and service-specific security settings. Therefore, connectors are a great benefit to developers who may be new to serverless development, or seasoned developers looking to increase their development velocity.

Using AWS SAM connectors

Use the `Connectors` resource attribute by embedding it within a **source** resource. Then, define your **destination** resource and describe how data or events should flow between those resources. AWS SAM then composes the access policies necessary to facilitate the required interactions.

The following outlines how this resource attribute is written:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  <source-resource-logical-id>:
    Type: <resource-type>
    ...
    Connectors:
      <connector-name>:
        Properties:
          Destination:
            <properties-that-identify-destination-resource>
          Permissions:
            <permission-types-to-provision>
  ...
```

How connectors work

> **Note**
>
> This section explains how connectors provision the necessary resources behind the scenes. This happens for you automatically when using connectors.

First, the embedded `Connectors` resource attribute is transformed into an `AWS::Serverless::Connector` resource type. Its logical ID is automatically created as *`<source-resource-logical-id><embedded-connector-logical-id>`*.

For example, here is an embedded connector:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
```

```
...
Resources:
  MyFunction:
    Type: AWS::Lambda::Function
    Connectors:
      MyConn:
        Properties:
          Destination:
            Id: MyTable
          Permissions:
            - Read
            - Write
  MyTable:
    Type: AWS::DynamoDB::Table
```

This will generate the following `AWS::Serverless::Connector` resource:

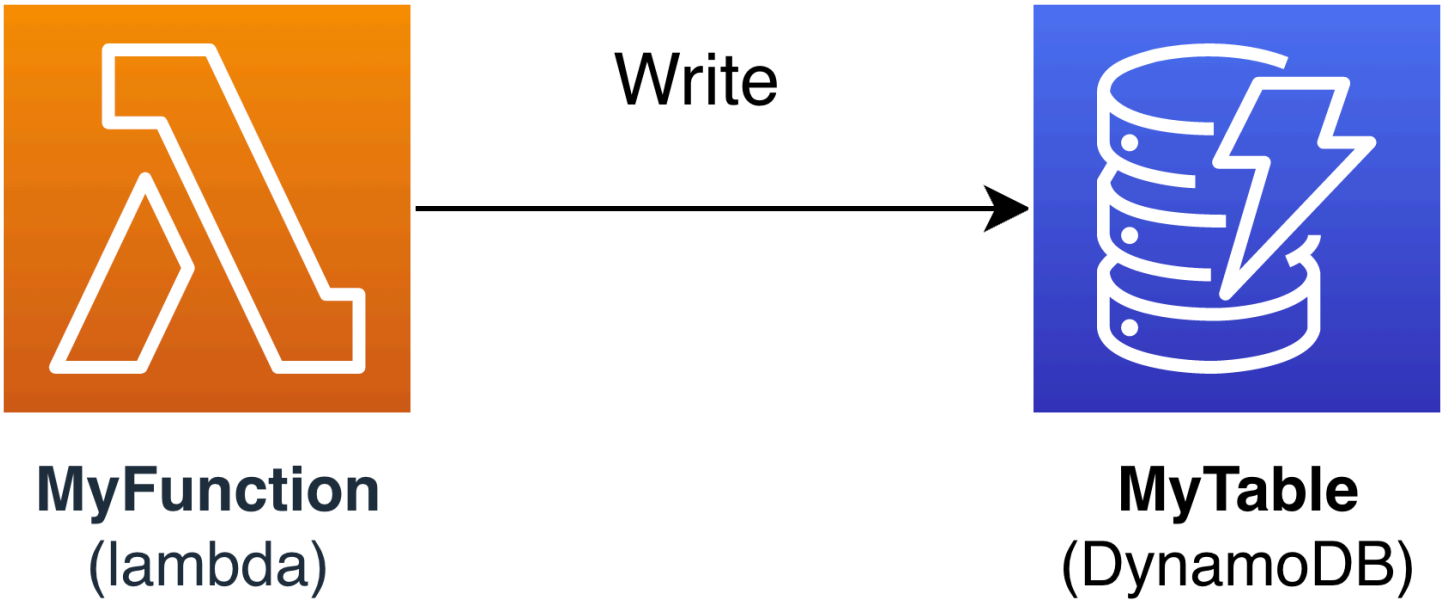
```
Transform: AWS::Serverless-2016-10-31
Resources:
  ...
  MyFunctionMyConn:
    Type: AWS::Serverless::Connector
    Properties:
      Source:
        Id: MyFunction
      Destination:
        Id: MyTable
      Permissions:
        - Read
        - Write
```

> **Note**
>
> You can also define connectors in your AWS SAM template by using this syntax. This is recommended when your source resource is defined on a separate template from your connector.

Next, the necessary access policies for this connection are automatically composed. For more information about the resources generated by connectors, see CloudFormation resources generated when you specify AWS::Serverless::Connector.

Example of connectors

The following example shows how you can use connectors to write data from an AWS Lambda function to an Amazon DynamoDB table.




```
Transform: AWS::Serverless-2016-10-31
Resources:
  MyTable:
    Type: AWS::Serverless::SimpleTable
  MyFunction:
    Type: AWS::Serverless::Function
    Connectors:
      MyConn:
        Properties:
          Destination:
            Id: MyTable
          Permissions:
            - Write
    Properties:
      Runtime: nodejs16.x
      Handler: index.handler
      InlineCode: |
        const AWS = require("aws-sdk");
        const docClient = new AWS.DynamoDB.DocumentClient();
        exports.handler = async (event, context) => {
          await docClient.put({
            TableName: process.env.TABLE_NAME,
            Item: {
```

```
              id: context.awsRequestId,
              event: JSON.stringify(event)
            }
          }).promise();
        }
      Environment:
        Variables:
          TABLE_NAME: !Ref MyTable
```

The `Connectors` resource attribute is embedded within the Lambda function source resource. The DynamoDB table is defined as the destination resource using the `Id` property. Connectors will provision `Write` permissions between these two resources.

When you deploy your AWS SAM template to CloudFormation, AWS SAM will automatically compose the necessary access policies required for this connection to work.

Supported connections between source and destination resources

Connectors support `Read` and `Write` data and event permission types between a select combination of source and destination resource connections. For example, connectors support a `Write` connection between an `AWS::ApiGateway::RestApi` source resource and an `AWS::Lambda::Function` destination resource.

Source and destination resources can be defined by using a combination of supported properties. Property requirements will depend on the connection you are making and where the resources are defined.

> **Note**
>
> Connectors can provision permissions between supported serverless and non-serverless resource types.

For a list of supported resource connections and their property requirements, see Supported source and destination resource types for connectors.

Define Read and Write permissions in AWS SAM

In AWS SAM, `Read` and `Write` permissions can be provisioned within a single connector:

```
AWSTemplateFormatVersion: '2010-09-09'
```

```
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyFunction:
    Type: AWS::Lambda::Function
    Connectors:
      MyTableConn:
        Properties:
          Destination:
            Id: MyTable
          Permissions:
            - Read
            - Write
  MyTable:
    Type: AWS::DynamoDB::Table
```

For more information on using connectors, refer to AWS SAM connector reference.

Define resources by using other supported properties in AWS SAM

For both source and destination resources, when defined within the same template, use the `Id` property. Optionally, a `Qualifier` can be added to narrow the scope of your defined resource. When the resource is not within the same template, use a combination of supported properties.

- For a list of supported property combinations for source and destination resources, see Supported source and destination resource types for connectors.
- For a description of properties that you can use with connectors, see AWS::Serverless::Connector.

When you define a source resource with a property other than `Id`, use the `SourceReference` property.

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  <source-resource-logical-id>:
    Type: <resource-type>
    ...
    Connectors:
      <connector-name>:
        Properties:
          SourceReference:
```

```
            Qualifier: <optional-qualifier>
            <other-supported-properties>
          Destination:
            <properties-that-identify-destination-resource>
          Permissions:
            <permission-types-to-provision>
```

Here's an example, using a `Qualifier` to narrow the scope of an Amazon API Gateway resource:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Connectors:
      ApiToLambdaConn:
        Properties:
          SourceReference:
            Qualifier: Prod/GET/foobar
          Destination:
            Id: MyFunction
          Permissions:
            - Write
  ...
```

Here's an example, using a supported combination of `Arn` and `Type` to define a destination resource from another template:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyFunction:
    Type: AWS::Serverless::Function
    Connectors:
      TableConn:
        Properties:
          Destination:
            Type: AWS::DynamoDB::Table
            Arn: !GetAtt MyTable.Arn
  ...
```

For more information on using connectors, refer to AWS SAM connector reference.

Create multiple connectors from a single source in AWS SAM

Within a source resource, you can define multiple connectors, each with a different destination resource.

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyFunction:
    Type: AWS::Serverless::Function
    Connectors:
      BucketConn:
        Properties:
          Destination:
            Id: amzn-s3-demo-bucket
          Permissions:
            - Read
            - Write
      SQSConn:
        Properties:
          Destination:
            Id: MyQueue
          Permissions:
            - Read
            - Write
      TableConn:
        Properties:
          Destination:
            Id: MyTable
          Permissions:
            - Read
            - Write
      TableConnWithTableArn:
        Properties:
          Destination:
            Type: AWS::DynamoDB::Table
            Arn: !GetAtt MyTable.Arn
          Permissions:
            - Read
            - Write
```

```
...
```

For more information on using connectors, refer to AWS SAM connector reference.

Create multi-destination connectors in AWS SAM

Within a source resource, you can define a single connector with multiple destination resources. Here's an example of a Lambda function source resource connecting to an Amazon Simple Storage Service (Amazon S3) bucket and DynamoDB table:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyFunction:
    Type: AWS::Serverless::Function
    Connectors:
      WriteAccessConn:
        Properties:
          Destination:
            - Id: OutputBucket
            - Id: CredentialTable
          Permissions:
            - Write
  ...
  OutputBucket:
    Type: AWS::S3::Bucket
  CredentialTable:
    Type: AWS::DynamoDB::Table
```

For more information on using connectors, refer to AWS SAM connector reference.

Define resource attributes with connectors in AWS SAM

Resource attributes can be defined for resources to specify additional behaviors and relationships. To learn more about resource attributes, see Resource attribute reference in the *AWS CloudFormation User Guide*.

You can add resource attributes to your embedded connector by defining them on the same level as your connector properties. When your AWS SAM template is transformed at deployment, attributes will pass through to the generated resources.

```
AWSTemplateFormatVersion: '2010-09-09'
```

```
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyFunction:
    Type: AWS::Serverless::Function
    Connectors:
      MyConn:
        DeletionPolicy: Retain
        DependsOn: AnotherFunction
        Properties:
          ...
```

For more information on using connectors, refer to AWS SAM connector reference.

Learn more

For more information about using AWS SAM connectors, see the following topics:

- AWS::Serverless::Connector
- Define Read and Write permissions in AWS SAM
- Define resources by using other supported properties in AWS SAM
- Create multiple connectors from a single source in AWS SAM
- Create multi-destination connectors in AWS SAM
- Define Read and Write permissions in AWS SAM
- Define resource attributes with connectors in AWS SAM

Provide feedback

To provide feedback on connectors, submit a new issue at the *serverless-application-model AWS GitHub repository*.

AWS SAM policy templates

The AWS Serverless Application Model (AWS SAM) allows you to choose from a list of policy templates to scope the permissions of your Lambda functions and AWS Step Functions state machines 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
```

> **Note**
>
> If you have set up a regular IAM policy or have managed policies through Lambda, the policy template could be set without using an empty object.

Examples

Example 1: Policy template with placeholder values

The following example shows that the SQSPollerPolicy 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 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: {}
```

Example 3: Policy template with placeholder values and a regular IAM policy

The following example contains the AmazonSQSFullAcess policy and DynamoDBCrudPolicy policy template. The AmazonSQSFullAccess policy is an IAM policy and not a AWS SAM policy, so you don't have to specify an empty object as the policy would be directly passed to the CloudFormation.

```
MyFunction:
  Type: 'AWS::Serverless::Function'
```

```
  Properties:
    CodeUri: ${codeuri}
    Handler: hello.handler
    Runtime: python2.7
    Policies:
      - AmazonSQSFullAccess // IAM policy could be set without passing an empty object
      - DynamoDBCrudPolicy: // SAM specific policy, has a defined structure
          TableName:
            !Ref SampleTable
```

Policy template table

The following is a table of the available policy templates.

Policy Template	Description		
AcmGetCertificatePolicy	Gives a permission to read a certificate from AWS Certificate Manager.		
AMIDescribePolicy	Gives permission to describe Amazon Machine Images (AMIs).		
AthenaQueryPolicy	Gives permissions to execute Athena queries.		
AWSSecretsManagerGetSecretValuePolicy	Gives permission to get the secret value for the specified AWS Secrets Manager secret.		
AWSSecretsManagerRotationPolicy	Gives permission to rotate a secret in AWS Secrets Manager.		
CloudFormationDescribeStacksPolicy	Gives permission to describe CloudFormation stacks.		

Policy Template	Description		
CloudWatchDashboardPolicy	Gives permissions to put metrics to operate on CloudWatch dashboards.		
CloudWatchDescribeAlarmHistoryPolicy	Gives permission to describe CloudWatch alarm history.		
CloudWatchPutMetricPolicy	Gives permission to send metrics to CloudWatch.		
CodeCommitCrudPolicy	Gives permissions to create/read/update/delete objects within a specific CodeCommit repository.		
CodeCommitReadPolicy	Gives permissions to read objects within a specific CodeCommit repository.		
CodePipelineLambdaExecutionPolicy	Gives permission for a Lambda function invoked by CodePipeline to report the status of the job.		
CodePipelineReadOnlyPolicy	Gives read permission to get details about a CodePipeline pipeline.		
ComprehendBasicAccessPolicy	Gives permission for detecting entities, key phrases, languages, and sentiments.		
CostExplorerReadOnlyPolicy	Gives read-only permission to the read-only Cost Explorer APIs for billing history.		

Policy Template	Description
DynamoDBBackupFullAccessPolicy	Gives read and write permission to DynamoDB on-demand backups for a table.
DynamoDBCrudPolicy	Gives create, read, update, and delete permissions to an Amazon DynamoDB table.
DynamoDBReadPolicy	Gives read-only permission to a DynamoDB table.
DynamoDBReconfigurePolicy	Gives permission to reconfigure a DynamoDB table.
DynamoDBRestoreFromBackupPolicy	Gives permission to restore a DynamoDB table from backup.
DynamoDBStreamReadPolicy	Gives permission to describe and read DynamoDB streams and records.
DynamoDBWritePolicy	Gives write-only permission to a DynamoDB table.
EC2CopyImagePolicy	Gives permission to copy Amazon EC2 images.
EC2DescribePolicy	Gives permission to describe Amazon Elastic Compute Cloud (Amazon EC2) instances.
EcsRunTaskPolicy	Gives permission to start a new task for a task definition.

Policy Template	Description		
EFSWriteAccessPolicy	Gives permission to mount an Amazon EFS file system with write access.		
EKSDescribePolicy	Gives permission to describe or list Amazon EKS clusters.		
ElasticMapReduceAddJobFlowStepsPolicy	Gives permission to add new steps to a running cluster.		
ElasticMapReduceCancelStepsPolicy	Gives permission to cancel a pending step or steps in a running cluster.		
ElasticMapReduceModifyInstanceFleetPolicy	Gives permission to list details and modify capacities for instance fleets within a cluster.		
ElasticMapReduceModifyInstanceGroupsPolicy	Gives permission to list details and modify settings for instance groups within a cluster.		
ElasticMapReduceSetTerminationProtectionPolicy	Gives permission to set termination protection for a cluster.		

Policy Template	Description		
ElasticMapReduceTerminateJobFlowsPolicy	Gives permission to shut down a cluster.		
ElasticsearchHttpPostPolicy	Gives POST permission to Amazon OpenSearch Service.		
EventBridgePutEventsPolicy	Gives permissions to send events to EventBridge.		
FilterLogEventsPolicy	Gives permission to filter CloudWatch Logs events from a specified log group.		
FirehoseCrudPolicy	Gives permission to create, write, update, and delete a Firehose delivery stream.		
FirehoseWritePolicy	Gives permission to write to a Firehose delivery stream.		
KinesisCrudPolicy	Gives permission to create, publish, and delete an Amazon Kinesis stream.		
KinesisStreamReadPolicy	Gives permission to list and read an Amazon Kinesis stream.		
KMSDecryptPolicy	Gives permission to decrypt with an AWS Key Management Service (AWS KMS) key.		
KMSEncryptPolicy	Gives permission to encrypt with an AWS Key Management Service (AWS KMS) key.		

Policy Template	Description		
LambdaInvokePolicy	Gives permission to invoke an AWS Lambda function, alias, or version.		
MobileAnalyticsWriteOnlyAccessPolicy	Gives write-only permission to put event data for all application resources.		
OrganizationsListAccountsPolicy	Gives read-only permission to list child account names and IDs.		
PinpointEndpointAccessPolicy	Gives permission to get and update endpoints for an Amazon Pinpoint application.		
PollyFullAccessPolicy	Gives full access permission to Amazon Polly lexicon resources.		
RekognitionDetectOnlyPolicy	Gives permission to detect faces, labels, and text.		
RekognitionFacesManagementPolicy	Gives permission to add, delete, and search faces in an Amazon Rekognition collection.		
RekognitionFacesPolicy	Gives permission to compare and detect faces and labels.		
RekognitionLabelsPolicy	Gives permission to detect object and moderation labels.		

Policy Template	Description		
RekognitionNoDataAccessPolicy	Gives permission to compare and detect faces and labels.		
RekognitionReadPolicy	Gives permission to list and search faces.		
RekognitionWriteOnlyAccessPolicy	Gives permission to create collection and index faces.		
Route53ChangeResourceRecordSetsPolicy	Gives permission to change resource record sets in Route 53.		
S3CrudPolicy	Gives create, read, update, and delete permission to act on the objects in an Amazon S3 bucket.		
S3FullAccessPolicy	Gives full access permission to act on the objects in an Amazon S3 bucket.		
S3ReadPolicy	Gives read-only permission to read objects in an Amazon Simple Storage Service (Amazon S3) bucket.		
S3WritePolicy	Gives write permission to write objects into an Amazon S3 bucket.		
SageMakerCreateEndpointConfigPolicy	Gives permission to create an endpoint configuration in SageMaker AI.		

Policy Template	Description		
SageMakerCreateEndpointPolicy	Gives permission to create an endpoint in SageMaker AI.		
ServerlessRepoReadWriteAccessPolicy	Gives permission to create and list applications in the AWS Serverless Application Repository service.		
SESBulkTemplatedCrudPolicy	Gives permission to send email, templated email, templated bulk emails and verify identity.		
SESBulkTemplatedCrudPolicy_v2	Gives permission to send Amazon SES email, templated email, and templated bulk emails and to verify identity.		
SESCrudPolicy	Gives permission to send email and verify identity.		
SESEmailTemplateCrudPolicy	Gives permission to create, get, list, update and delete Amazon SES email templates.		
SESSendBouncePolicy	Gives SendBounce permission to an Amazon Simple Email Service (Amazon SES) identity.		
SNSCrudPolicy	Gives permission to create, publish, and subscribe to Amazon SNS topics.		
SNSPublishMessagePolicy	Gives permission to publish a message to an Amazon Simple Notification Service (Amazon SNS) topic.		

Policy Template	Description
SQSPollerPolicy	Gives permission to poll an Amazon Simple Queue Service (Amazon SQS) queue.
SQSSendMessagePolicy	Gives permission to send message to an Amazon SQS queue.
SSMParameterReadPolicy	Gives permission to access a parameter from an Amazon EC2 Systems Manager (SSM) parameter store to load secrets in this account. Use when parameter name doesn't have slash prefix.
SSMParameterWithSlashPrefixReadPolicy	Gives permission to access a parameter from an Amazon EC2 Systems Manager (SSM) parameter store to load secrets in this account. Use when parameter name has slash prefix.
StepFunctionsExecutionPolicy	Gives permission to start a Step Functions state machine execution.
TextractDetectAnalyzePolicy	Gives access to detect and analyze documents with Amazon Textract.
TextractGetResultPolicy	Gives access to get detected and analyzed documents from Amazon Textract.
TextractPolicy	Gives full access to Amazon Textract.
VPCAccessPolicy	Gives access to create, delete, describe, and detach elastic network interfaces.

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.

```
MyFunction:
  Policies:
    - CloudWatchPutMetricPolicy: {}
```

AWS SAM 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.

Topics

- AcmGetCertificatePolicy
- AMIDescribePolicy
- AthenaQueryPolicy
- AWSSecretsManagerGetSecretValuePolicy
- AWSSecretsManagerRotationPolicy
- CloudFormationDescribeStacksPolicy
- CloudWatchDashboardPolicy
- CloudWatchDescribeAlarmHistoryPolicy
- CloudWatchPutMetricPolicy
- CodePipelineLambdaExecutionPolicy
- CodePipelineReadOnlyPolicy

- CodeCommitCrudPolicy
- CodeCommitReadPolicy
- ComprehendBasicAccessPolicy
- CostExplorerReadOnlyPolicy
- DynamoDBBackupFullAccessPolicy
- DynamoDBCrudPolicy
- DynamoDBReadPolicy
- DynamoDBReconfigurePolicy
- DynamoDBRestoreFromBackupPolicy
- DynamoDBStreamReadPolicy
- DynamoDBWritePolicy
- EC2CopyImagePolicy
- EC2DescribePolicy
- EcsRunTaskPolicy
- EFSWriteAccessPolicy
- EKSDescribePolicy
- ElasticMapReduceAddJobFlowStepsPolicy
- ElasticMapReduceCancelStepsPolicy
- ElasticMapReduceModifyInstanceFleetPolicy
- ElasticMapReduceModifyInstanceGroupsPolicy
- ElasticMapReduceSetTerminationProtectionPolicy
- ElasticMapReduceTerminateJobFlowsPolicy
- ElasticsearchHttpPostPolicy
- EventBridgePutEventsPolicy
- FilterLogEventsPolicy
- FirehoseCrudPolicy
- FirehoseWritePolicy
- KinesisCrudPolicy
- KinesisStreamReadPolicy
- KMSDecryptPolicy

- KMSEncryptPolicy
- LambdaInvokePolicy
- MobileAnalyticsWriteOnlyAccessPolicy
- OrganizationsListAccountsPolicy
- PinpointEndpointAccessPolicy
- PollyFullAccessPolicy
- RekognitionDetectOnlyPolicy
- RekognitionFacesManagementPolicy
- RekognitionFacesPolicy
- RekognitionLabelsPolicy
- RekognitionNoDataAccessPolicy
- RekognitionReadPolicy
- RekognitionWriteOnlyAccessPolicy
- Route53ChangeResourceRecordSetsPolicy
- S3CrudPolicy
- S3FullAccessPolicy
- S3ReadPolicy
- S3WritePolicy
- SageMakerCreateEndpointConfigPolicy
- SageMakerCreateEndpointPolicy
- ServerlessRepoReadWriteAccessPolicy
- SESBulkTemplatedCrudPolicy
- SESBulkTemplatedCrudPolicy_v2
- SESCrudPolicy
- SESEmailTemplateCrudPolicy
- SESSendBouncePolicy
- SNSCrudPolicy
- SNSPublishMessagePolicy
- SQSPollerPolicy
- SQSSendMessagePolicy

- SSMParameterReadPolicy
- SSMParameterWithSlashPrefixReadPolicy
- StepFunctionsExecutionPolicy
- TextractDetectAnalyzePolicy
- TextractGetResultPolicy
- TextractPolicy
- VPCAccessPolicy

AcmGetCertificatePolicy

Gives a permission to read a certificate from AWS Certificate Manager.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "acm:GetCertificate"
    ],
    "Resource": {
      "Fn::Sub": [
        "${certificateArn}",
        {
          "certificateArn": {
            "Ref": "CertificateArn"
          }
        }
      ]
    }
  }
]
```

AMIDescribePolicy

Gives permission to describe Amazon Machine Images (AMIs).

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
```

```
      "ec2:DescribeImages"
    ],
    "Resource": "*"
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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": "*"
  }
]
```

CloudFormationDescribeStacksPolicy

Gives permission to describe CloudFormation stacks.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "cloudformation:DescribeStacks"
    ],
```

```
    "Resource": {
      "Fn::Sub": "arn:${AWS::Partition}:cloudformation:${AWS::Region}:
${AWS::AccountId}:stack/*"
    }
  }
]
```

CloudWatchDashboardPolicy

Gives permissions to put metrics to operate on CloudWatch dashboards.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "cloudwatch:GetDashboard",
      "cloudwatch:ListDashboards",
      "cloudwatch:PutDashboard",
      "cloudwatch:ListMetrics"
    ],
    "Resource": "*"
  }
]
```

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": "*"
  }
]
```

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": "*"
  }
]
```

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"
          }
```

```
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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": "*"
  }
]
```

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": "*"
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
            }
          }
        ]
      }
    ]
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
```

```
]
```

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"
            }
          }
        ]
      }
    ]
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

EC2DescribePolicy

Gives permission to describe Amazon Elastic Compute Cloud (Amazon EC2) instances.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "ec2:DescribeRegions",
      "ec2:DescribeInstances"
    ],
    "Resource": "*"
  }
]
```

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"
              }
            }
          ]
        }
      }
    }
  }
]
```

EKSDescribePolicy

Gives permission to describe or list Amazon Elastic Kubernetes Service (Amazon EKS) clusters.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "eks:DescribeCluster",
      "eks:ListClusters"
    ],
    "Resource": "*"
  }
]
```

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"
  }
]
```

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"
  }
]
```

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"
  }
]
```

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"
  }
]
```

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"
  }
]
```

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"
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

FirehoseCrudPolicy

Gives permission to create, write, update, and delete a 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"
          }
        }
      ]
    }
  }
]
```

FirehoseWritePolicy

Gives permission to write to a 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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
```

```
      ]
    }
  }
]
```

MobileAnalyticsWriteOnlyAccessPolicy

Gives write-only permission to put event data for all application resources.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "mobileanalytics:PutEvents"
    ],
    "Resource": "*"
  }
]
```

OrganizationsListAccountsPolicy

Gives read-only permission to list child account names and IDs.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "organizations:ListAccounts"
    ],
    "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"
          }
        }
      ]
    }
  }
]
```

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/*"
      }
    ]
  }
]
```

RekognitionDetectOnlyPolicy

Gives permission to detect faces, labels, and text.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "rekognition:DetectFaces",
      "rekognition:DetectLabels",
      "rekognition:DetectModerationLabels",
      "rekognition:DetectText"
    ],
    "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": "*"
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
            }
          }
        ]
      }
    ]
  }
]
```

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"
            }
          }
        ]
      }
    ]
  }
]
```

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"
            }
          }
        ]
      }
    ]
  }
]
```

SageMakerCreateEndpointConfigPolicy

Gives permission to create an endpoint configuration in SageMaker AI.

```
"Statement": [
  {
    "Action": [
      "sagemaker:CreateEndpointConfig"
    ],
    "Resource": {
      "Fn::Sub": [
        "arn:${AWS::Partition}:sagemaker:${AWS::Region}:${AWS::AccountId}:endpoint-
config/${endpointConfigName}",
        {
          "endpointConfigName": {
            "Ref": "EndpointConfigName"
          }
        }
      ]
    },
    "Effect": "Allow"
  }
```

```
]
```

SageMakerCreateEndpointPolicy

Gives permission to create an endpoint in SageMaker AI.

```
"Statement": [
  {
    "Action": [
      "sagemaker:CreateEndpoint"
    ],
    "Resource": {
      "Fn::Sub": [
        "arn:${AWS::Partition}:sagemaker:${AWS::Region}:${AWS::AccountId}:endpoint/
${endpointName}",
        {
          "endpointName": {
            "Ref": "EndpointName"
          }
        }
      ]
    },
    "Effect": "Allow"
  }
]
```

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/*"
      }
    ]
  }
]
```

SESBulkTemplatedCrudPolicy

Gives permission to send Amazon SES email, templated email, and templated bulk emails and to verify identity.

> **Note**
>
> The `ses:SendTemplatedEmail` action requires a template ARN. Use `SESBulkTemplatedCrudPolicy_v2` instead.

```
"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"
          }
        }
      ]
    }
  }
```

```
]
```

SESBulkTemplatedCrudPolicy_v2

Gives permission to send Amazon SES email, templated email, and templated bulk emails and to verify identity.

```
"Statement": [
  {
    "Action": [
      "ses:SendEmail",
      "ses:SendRawEmail",
      "ses:SendTemplatedEmail",
      "ses:SendBulkTemplatedEmail"
    ],
    "Effect": "Allow",
    "Resource": [
      {
        "Fn::Sub": [
          "arn:${AWS::Partition}:ses:${AWS::Region}:${AWS::AccountId}:identity/
${identityName}",
          {
            "identityName": {
              "Ref": "IdentityName"
            }
          }
        ]
      },
      {
        "Fn::Sub": [
          "arn:${AWS::Partition}:ses:${AWS::Region}:${AWS::AccountId}:template/
${templateName}",
          {
            "templateName": {
              "Ref": "TemplateName"
            }
          }
        ]
      }
    ]
  },
  {
    "Action": [
```

```
      "ses:GetIdentityVerificationAttributes",
      "ses:VerifyEmailIdentity"
    ],
    "Effect": "Allow",
    "Resource": "*"
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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": "*"
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

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"
          }
        }
      ]
    }
  }
]
```

SSMParameterReadPolicy

Gives permission to access a parameter from an Amazon EC2 Systems Manager (SSM) parameter store to load secrets in this account. Use when parameter name doesn't have slash prefix.

> **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"
          }
        }
```

```
      ]
    }
  }
]
```

SSMParameterWithSlashPrefixReadPolicy

Gives permission to access a parameter from an Amazon EC2 Systems Manager (SSM) parameter store to load secrets in this account. Use when parameter name has slash prefix.

> **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"
          }
        }
      ]
    }
  }
]
```

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": "*"
  }
]
```

TextractPolicy

Gives full access to Amazon Textract.

```
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "textract:*"
    ],
    "Resource": "*"
  }
]
```

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": "*"
```

```
  }
]
```

Managing AWS SAM permissions with CloudFormation mechanisms

To control access to AWS resources, the AWS Serverless Application Model (AWS SAM) can use the same mechanisms as 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:

- 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 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:

> **Note**
>
> The example policy statement in this section grants sufficient permission for you to deploy, update, and delete the the sample Hello World application. If you add additional resource types to your application, you need to update the policy statement to include the following:

1. Permission for your application to call the service's actions.
2. The service principal, if needed for the service's actions.

For example, if you add a Step Functions workflow, you may need to add permissions for actions listed here, and the `states.amazonaws.com` service principal.

For more information about IAM policies, see Managing IAM policies in the *IAM User Guide*.

Control API access with your AWS SAM template

Controlling access to your API Gateway APIs helps ensure your serverless application is secure and can only be accessed through the authorization you enable. You can enable authorization in your AWS SAM template to control who can access your API Gateway APIs.

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	✓	✓
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 for AWS SAM.

- **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 for AWS SAM.

- **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 for AWS SAM.

- **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 for AWS SAM.

- **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 for AWS SAM.

- **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 for AWS SAM.

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 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 for AWS SAM.

Examples

- Lambda authorizer examples for AWS SAM
- IAM permission example for AWS SAM
- Amazon Cognito user pool example for AWS SAM
- API key example for AWS SAM
- Resource policy example for AWS SAM
- OAuth 2.0/JWT authorizer example for AWS SAM
- Customized response example for AWS SAM

Lambda authorizer examples for AWS SAM

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 data type.

The following is an example AWS SAM template section for a Lambda `TOKEN` authorizer:

> **Note**
>
> In the following example, the SAM `FunctionRole` is implicitly generated.

```
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 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 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 for AWS SAM

You can control access to your APIs by defining IAM permissions within your AWS SAM template. To do this, you use the ApiAuth data type.

The following is an example AWS SAM template that uses for IAM permissions:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      Description: 'API with IAM authorization'
      Auth:
        DefaultAuthorizer: AWS_IAM #sets AWS_IAM auth for all methods in this API
  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      Handler: index.handler
      Runtime: python3.10
      Events:
        GetRoot:
          Type: Api
          Properties:
            RestApiId: !Ref MyApi
            Path: /
            Method: get
      InlineCode: |
        def handler(event, context):
          return {'body': 'Hello World!', 'statusCode': 200}
```

For more information about IAM permissions, see Control access for invoking an API in the *API Gateway Developer Guide*.

Amazon Cognito user pool example for AWS SAM

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 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 for AWS SAM

You can control access to your APIs by requiring API keys within your AWS SAM template. To do this, you use the ApiAuth 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 for AWS SAM

You can control access to your APIs by attaching a resource policy within your AWS SAM template. To do this, you use the ApiAuth data type.

The following is an example AWS SAM template for a private API. A private API must have a resource policy to deploy.

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
Resources:
  MyPrivateApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      EndpointConfiguration: PRIVATE  # Creates a private API. Resource policies are
 required for all private APIs.
      Auth:
        ResourcePolicy:
          CustomStatements:
            - Effect: 'Allow'
              Action: 'execute-api:Invoke'
              Resource: ['execute-api:/*/*/*']
              Principal: '*'
            - Effect: 'Deny'
              Action: 'execute-api:Invoke'
              Resource: ['execute-api:/*/*/*']
              Principal: '*'
  MyFunction:
    Type: 'AWS::Serverless::Function'
    Properties:
      InlineCode: |
        def handler(event, context):
          return {'body': 'Hello World!', 'statusCode': 200}
      Handler: index.handler
      Runtime: python3.10
      Events:
        AddItem:
```

```
          Type: Api
          Properties:
            RestApiId:
              Ref: MyPrivateApi
            Path: /
            Method: get
```

For more information about resource policies, see Controlling access to an API with API Gateway resource policies in the *API Gateway Developer Guide*. For more information about private APIs, see Creating a private API in Amazon API Gateway in the *API Gateway Developer Guide*.

OAuth 2.0/JWT authorizer example for AWS SAM

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 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 for AWS SAM

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 that creates a customized response for the `DEFAULT_5XX` error.

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
Resources:
  MyApi:
    Type: AWS::Serverless::Api
    Properties:
      StageName: Prod
      GatewayResponses:
        DEFAULT_5XX:
          ResponseParameters:
            Headers:
              Access-Control-Expose-Headers: "'WWW-Authenticate'"
              Access-Control-Allow-Origin: "'*'"
              ErrorHeader: "'MyCustomErrorHeader'"
          ResponseTemplates:
            application/json: "{\"message\": \"Error on the $context.resourcePath
 resource\" }"

  GetFunction:
    Type: AWS::Serverless::Function
    Properties:
      Runtime: python3.10
      Handler: index.handler
      InlineCode: |
        def handler(event, context):
```

```
          raise Exception('Check out the new response!')
      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*.

Increase efficiency using Lambda layers with AWS SAM

Using AWS SAM, you can include layers in your serverless applications. AWS Lambda layers allow you to extract code from a Lambda function into a Lambda layer which can then be used across several Lambda functions. Doing this allows you to reduce the size of your deployment packages, separate core function logic from dependencies, and share dependencies across multiple functions. For more information about layers, see 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 Lambda layers in AWS SAM.

Including layers in your application

To include layers in your application, use the `Layers` property of the AWS::Serverless::Function 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
```

Reuse code and resources using nested applications in AWS SAM

A serverless application can include one or more **nested applications**. A nested application is a part of a larger application and can be packaged and deployed either as a stand-alone artifact or as a component of the larger application. Nested applications allow you to turn frequently used

code and into its own application that can then be reused across a larger serverless application or multiple serverless applications.

As your serverless architectures grows, common patterns typically emerge in which the same components are defined in multiple application templates. Nested applications allow you to reuse common code, functionality, resources, and configurations in separate AWS SAM templates, allowing you to only maintain code from a single source. This reduces duplicated code and configurations. Additionally, this modular approach streamlines development, enhances code organization, and facilitates consistency across serverless applications. 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 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 Deploy your application and resources with AWS SAM.

> **Note**
>
> When you deploy an application that contains nested applications, you must acknowledge it contains nested applications. 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*.

Manage time-based events with EventBridge Scheduler in AWS SAM

The content in this topic provides details on what Amazon EventBridge Scheduler is, what support AWS SAM offers, how you can create Scheduler events, and examples you can reference when creating Scheduler events.

What is Amazon EventBridge Scheduler?

Use EventBridge Scheduler to schedule events in your AWS SAM templates. Amazon EventBridge Scheduler is a scheduling service that lets you create, initiate, and manage tens of millions of events and tasks across all AWS services. This service is particularly useful for time-related events. You can use it to schedule events and recurring time-based invocations. It also supports one-time events as well as rate and chron expressions with a start and end time.

To learn more about Amazon EventBridge Scheduler, see What is Amazon EventBridge Scheduler? in the *EventBridge Scheduler User Guide*.

Topics

- EventBridge Scheduler support in AWS SAM
- Creating EventBridge Scheduler events in AWS SAM
- Examples
- Learn more

EventBridge Scheduler support in AWS SAM

The AWS Serverless Application Model (AWS SAM) template specification provides a simple, short-hand syntax that you can use to schedule events with EventBridge Scheduler for AWS Lambda and AWS Step Functions.

Creating EventBridge Scheduler events in AWS SAM

Set the `ScheduleV2` property as the event type in your AWS SAM template to define your EventBridge Scheduler event. This property supports the `AWS::Serverless::Function` and `AWS::Serverless::StateMachine` resource types.

```
MyFunction:
  Type: AWS::Serverless::Function
  Properties:
    Events:
      CWSchedule:
        Type: ScheduleV2
        Properties:
          ScheduleExpression: 'rate(1 minute)'
          Name: TestScheduleV2Function
          Description: Test schedule event

MyStateMachine:
  Type: AWS::Serverless::StateMachine
  Properties:
    Events:
      CWSchedule:
        Type: ScheduleV2
        Properties:
          ScheduleExpression: 'rate(1 minute)'
          Name: TestScheduleV2StateMachine
          Description: Test schedule event
```

EventBridge Scheduler event scheduling also supports *dead-letter queues (DLQ)* for unprocessed events. For more information on dead-letter queues, see Configuring a dead-letter queue for EventBridge Scheduler in the *EventBridge Scheduler User Guide*.

When a DLQ ARN is specified, AWS SAM configures permissions for the Scheduler schedule to send messages to the DLQ. When a DLQ ARN is not specified, AWS SAM will create the DLQ resource.

Examples

Basic example of defining an EventBridge Scheduler event with AWS SAM

```
Transform: AWS::Serverless-2016-10-31
Resources:
  MyLambdaFunction:
    Type: AWS::Serverless::Function
    Properties:
      Handler: index.handler
      Runtime: python3.8
      InlineCode: |
        def handler(event, context):
            print(event)
            return {'body': 'Hello World!', 'statusCode': 200}
      MemorySize: 128
      Events:
        Schedule:
          Type: ScheduleV2
          Properties:
            ScheduleExpression: rate(1 minute)
            Input: '{"hello": "simple"}'

  MySFNFunction:
    Type: AWS::Serverless::Function
    Properties:
      Handler: index.handler
      Runtime: python3.8
      InlineCode: |
        def handler(event, context):
            print(event)
            return {'body': 'Hello World!', 'statusCode': 200}
      MemorySize: 128

  StateMachine:
    Type: AWS::Serverless::StateMachine
    Properties:
      Type: STANDARD
      Definition:
        StartAt: MyLambdaState
        States:
          MyLambdaState:
            Type: Task
            Resource: !GetAtt MySFNFunction.Arn
```

```
            End: true
      Policies:
        - LambdaInvokePolicy:
            FunctionName: !Ref MySFNFunction
      Events:
        Schedule:
          Type: ScheduleV2
          Properties:
            ScheduleExpression: rate(1 minute)
            Input: '{"hello": "simple"}'
```

Learn more

To learn more about defining the `ScheduleV2` EventBridge Scheduler property, see:

- ScheduleV2 for `AWS::Serverless::Function`.
- ScheduleV2 for `AWS::Serverless::StateMachine`.

Orchestrating AWS SAM 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. Step Functions to tell your application when and under what conditions your AWS resources, like AWS Lambda functions, are used. This simplifies the process of forming complex and robust workflows. Using AWS::Serverless::StateMachine, you define the individual steps in your workflow, associate resources in each step, and then sequence these steps together. You also add transitions and conditions where they are needed. This simplifies the process of making a complex and robust workflow.

> **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

Set up code signing for your AWS SAM application

To ensure that only trusted code is deployed, you can use AWS SAM to enable code signing with your serverless applications. Signing your code helps ensure that code has not been altered since signing and that only signed code packages from trusted publishers run in your Lambda functions. This helps free up organizations from the burden of building gatekeeper components in their deployment pipelines.

For more information about code signing, 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 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 amzn-s3-demo-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 amzn-s3-demo-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 amzn-s3-demo-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 in the AWS SAM CLI command reference.

Validate AWS SAM template files

Validate your templates with `sam validate`. 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-template>/template.yaml is a valid SAM Template
```

> **Note**
>
> The `sam validate` command requires AWS credentials to be configured. For more information, see Configuring the AWS SAM CLI.

Build your application with AWS SAM

After you have added your infrastructure as code (IaC) to your AWS SAM template, you'll be ready to start building your application using the **sam build** command. This command creates build artifacts from the files in your application project directory (that is, your AWS SAM template file, application code, and any applicable language-specific files and dependencies). These build artifacts prepare your serverless application for later steps of your application's development, such as local testing and deploying to the AWS Cloud. Both testing and deploying use build artifacts as inputs.

You can use **sam build** to build your entire serverless application. Additionally, you can create customized builds, like one's with specific functions, layers, or custom runtimes. To read more on how and why you use **sam build**, see the topics in this section. For an introduction to using the `sam build` command, see Introduction to building with AWS SAM.

Topics

- Introduction to building with AWS SAM
- Default build with AWS SAM
- Customize builds with AWS SAM

Introduction to building with AWS SAM

Use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam build` command to prepare your serverless application for subsequent steps in your development workflow, such as local testing or deploying to the AWS Cloud. This command creates a `.aws-sam` directory that structures your application in a format and location that `sam local` and `sam deploy` require.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?.
- For a list of `sam build` command options, see sam build.
- For an example of using `sam build` during a typical development workflow, see Step 2: Build your application.

> **Note**
>
> Using `sam build` requires that you start with the basic components of a serverless application on your development machine. This includes an AWS SAM template, AWS Lambda function code, and any language-specific files and dependencies. To learn more, see Create your application in AWS SAM.

Topics

- Building applications with sam build
- Local testing and deployment
- Best practices
- Options for sam build
- Troubleshooting
- Examples

- Learn more

Building applications with sam build

Before using `sam build`, consider configuring the following:

1. **Lambda functions and layers** – The `sam build` command can build Lambda functions and layers. To learn more about Lambda layers, see Building Lambda layers in AWS SAM.
2. **Lambda runtime** – The *runtime* provides a language-specific environment that runs your function in an execution environment when invoked. You can configure native and custom runtimes.
   a. **Native runtime** – Author your Lambda functions in a supported Lambda runtime and build you functions to use a native Lambda runtime in the AWS Cloud.
   b. **Custom runtime** – Author your Lambda functions using any programming language and build your runtime using a custom process defined in a makefile or third-party builder such as esbuild. To learn more, see Building Lambda functions with custom runtimes in AWS SAM.
3. **Lambda package type** – Lambda functions can be packaged in the following Lambda deployment package types:
   a. **.zip file archive** – Contains your application code and its dependencies.
   b. **Container image** – Contains the base operating system, the runtime, Lambda extensions, your application code and its dependencies.

These application settings can be configured when initializing an application using `sam init`.

- To learn more about using `sam init`, see Create your application in AWS SAM.
- To learn more about configuring these settings in your application, see Default build with AWS SAM.

To build an application

1. `cd` to the root of your project. This is the same location as your AWS SAM template.

```
$ cd sam-app
```

2. Run the following:

```
sam-app $ sam build <arguments> <options>
```

> **Note**
>
> A commonly used option is `--use-container`. To learn more, see Building a Lambda function inside of a provided container.

The following is an example of the AWS SAM CLI output:

```
sam-app $ sam build
Starting Build use cache
Manifest file is changed (new hash: 3298f1304...d4d421) or dependency folder (.aws-
sam/deps/4d3dfad6-a267-47a6-a6cd-e07d6fae318c) is missing for (HelloWorldFunction),
 downloading dependencies and copying/building source
Building codeuri: /Users/.../sam-app/hello_world runtime: python3.12 metadata: {}
 architecture: x86_64 functions: HelloWorldFunction
Running PythonPipBuilder:CleanUp
Running PythonPipBuilder:ResolveDependencies
Running PythonPipBuilder:CopySource
Running PythonPipBuilder:CopySource

Build Succeeded

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

Commands you can use next
=========================
[*] Validate SAM template: sam validate
[*] Invoke Function: sam local invoke
[*] Test Function in the Cloud: sam sync --stack-name {{stack-name}} --watch
[*] Deploy: sam deploy --guided
```

3. The AWS SAM CLI creates a `.aws-sam` build directory. The following is an example:

```
.aws-sam
### build
#   ### HelloWorldFunction
#   #   ### __init__.py
```

```
#   #   ### app.py
#   #   ### requirements.txt
#   ### template.yaml
### build.toml
```

Depending on how your application is configured, the AWS SAM CLI does the following:

1. Downloads, installs, and organizes dependencies in the `.aws-sam/build` directory.
2. Prepares your Lambda code. This can include compiling your code, creating executable binaries, and building container images.
3. Copies build artifacts to the `.aws-sam` directory. The format will vary based on your application package type.
   a. For .zip package types, the artifacts are not zipped yet so that they can be used for local testing. The AWS SAM CLI zips your application when using `sam deploy`.
   b. For container image package types, a container image is created locally and referenced in the `.aws-sam/build.toml` file.
4. Copies the AWS SAM template over to the `.aws-sam` directory and modifies it with new file paths when necessary.

The following are the major components that make up your build artifacts in the `.aws-sam` directory:

- **The build directory** – Contains your Lambda functions and layers structured independently of each other. This results in a unique structure for each function or layer in the `.aws-sam/build` directory.
- **The AWS SAM template** – Modified with updated values based on changes during the build process.
- **The build.toml file** – A configuration file that contains build settings used by the AWS SAM CLI.

Local testing and deployment

When performing local testing with `sam local` or deployment with `sam deploy`, the AWS SAM CLI does the following:

1. It first checks to see if an `.aws-sam` directory exists and if an AWS SAM template is located within that directory. If these conditions are met, the AWS SAM CLI considers this as the root directory of your application.
2. If these conditions are not met, the AWS SAM CLI considers the original location of your AWS SAM template as the root directory of your application.

When developing, if changes are made to your original application files, run `sam build` to update the `.aws-sam` directory before testing locally.

Best practices

- Don't edit any code under the `.aws-sam/build` directory. Instead, update your original source code in your project folder and run `sam build` to update the `.aws-sam/build` directory.
- When you modify your original files, run `sam build` to update the `.aws-sam/build` directory.
- You may want the AWS SAM CLI to reference your project's original root directory instead of the `.aws-sam` directory, such as when developing and testing with `sam local`. Delete the `.aws-sam` directory or the AWS SAM template in the `.aws-sam` directory to have the AWS SAM CLI recognize your original project directory as the root project directory. When ready, run `sam build` again to create the `.aws-sam` directory.
- When you run `sam build`, the `.aws-sam/build` directory gets overwritten each time. The `.aws-sam` directory does not. If you want to store files, such as logs, store them in `.aws-sam` to prevent them from being overwritten.

Options for sam build

Building a single resource

Provide the resource's logical ID to build only that resource. The following is an example:

```
$ sam build HelloWorldFunction
```

To build a resource of a nested application or stack, provide the application or stack logical ID along with the resource logical ID using the format *<stack-logical-id>*/*<resource-logical-id>*:

```
$ sam build MyNestedStack/MyFunction
```

Building a Lambda function inside of a provided container

The `--use-container` option downloads a container image and uses it to build your Lambda functions. The local container is then referenced in your `.aws-sam/build.toml` file.

This option requires Docker to be installed. For instructions, see Installing Docker.

The following is an example of this command:

```
$ sam build --use-container
```

You can specify the container image to use with the `--build-image` option. The following is an example:

```
$ sam build --use-container --build-image amazon/aws-sam-cli-build-image-nodejs20.x
```

To specify the container image to use for a single function, provide the function logical ID. The following is an example:

```
$ sam build --use-container --build-image Function1=amazon/aws-sam-cli-build-image-
python3.12
```

Pass environment variables to the build container

Use the `--container-env-var` to pass environment variables to the build container. The following is an example:

```
$ sam build --use-container --container-env-var Function1.GITHUB_TOKEN=<token1> --
container-env-var GLOBAL_ENV_VAR=<global-token>
```

To pass environment variables from a file, use the `--container-env-var-file` option. The following is an example:

```
$ sam build --use-container --container-env-var-file <env.json>
```

Example of the `env.json` file:

```
{
  "MyFunction1": {
    "GITHUB_TOKEN": "TOKEN1"
  },
```

```
  "MyFunction2": {
    "GITHUB_TOKEN": "TOKEN2"
  }
}
```

Speed up the building of applications that contain multiple functions

When you run `sam build` on an application with multiple functions, the AWS SAM CLI builds each function one at a time. To speed up the build process, use the `--parallel` option. This builds all of your functions and layers at the same time.

The following is an example of this command:

```
$ sam build —-parallel
```

Speed up build times by building your project in the source folder

For supported runtimes and build methods, you can use the `--build-in-source` option to build your project directly in the source folder. By default, the AWS SAM CLI builds in a temporary directory, which involves copying over source code and project files. With `--build-in-source`, the AWS SAM CLI builds directly in your source folder, which speeds up the build process by removing the need to copy files to a temporary directory.

For a list of supported runtimes and build methods, see `--build-in-source`.

Troubleshooting

To troubleshoot the AWS SAM CLI, see AWS SAM CLI troubleshooting.

Examples

Building an application that uses a native runtime and .zip package type

For this example, see Tutorial: Deploy a Hello World application with AWS SAM.

Building an application that uses a native runtime and image package type

First, we run `sam init` to initialize a new application. During the interactive flow, we select the `Image` package type. The following is an example:

```
$ sam init
...
Which template source would you like to use?
```

```
        1 - AWS Quick Start Templates
        2 - Custom Template Location
Choice: 1

Choose an AWS Quick Start application template
        1 - Hello World Example
        2 - Multi-step workflow
        3 - Serverless API
        4 - Scheduled task
        5 - Standalone function
        6 - Data processing
        7 - Hello World Example With Powertools
        8 - Infrastructure event management
        9 - Serverless Connector Hello World Example
        10 - Multi-step workflow with Connectors
        11 - Lambda EFS example
        12 - DynamoDB Example
        13 - Machine Learning
Template: 1

Use the most popular runtime and package type? (Python and zip) [y/N]: ENTER

Which runtime would you like to use?
        ...
        10 - java8
        11 - nodejs20.x
        12 - nodejs18.x
        13 - nodejs16.x
        ...
Runtime: 12

What package type would you like to use?
        1 - Zip
        2 - Image
Package type: 2

Based on your selections, the only dependency manager available is npm.
We will proceed copying the template using npm.

Would you like to enable X-Ray tracing on the function(s) in your application?  [y/
N]: ENTER

Would you like to enable monitoring using CloudWatch Application Insights?
```

```
For more info, please view https://docs.aws.amazon.com/AmazonCloudWatch/latest/
monitoring/cloudwatch-application-insights.html [y/N]: ENTER

Project name [sam-app]: ENTER

Cloning from https://github.com/aws/aws-sam-cli-app-templates (process may take a
 moment)

    -----------------------
    Generating application:
    -----------------------
    Name: sam-app
    Base Image: amazon/nodejs18.x-base
    Architectures: x86_64
    Dependency Manager: npm
    Output Directory: .
    Configuration file: sam-app/samconfig.toml

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

...
```

The AWS SAM CLI initializes an application and creates the following project directory:

```
sam-app
### README.md
### events
#   ### event.json
### hello-world
#   ### Dockerfile
#   ### app.mjs
#   ### package.json
#   ### tests
#       ### unit
#           ### test-handler.mjs
### samconfig.toml
### template.yaml
```

Next, we run `sam build` to build our application:

```
sam-app $ sam build
```

```
Building codeuri: /Users/.../build-demo/sam-app runtime: None metadata: {'DockerTag':
 'nodejs18.x-v1', 'DockerContext': '/Users/.../build-demo/sam-app/hello-world',
 'Dockerfile': 'Dockerfile'} architecture: arm64 functions: HelloWorldFunction
Building image for HelloWorldFunction function
Setting DockerBuildArgs: {} for HelloWorldFunction function
Step 1/4 : FROM public.ecr.aws/lambda/nodejs:18
 ---> f5b68038c080
Step 2/4 : COPY app.mjs package*.json ./
 ---> Using cache
 ---> 834e565aae80
Step 3/4 : RUN npm install
 ---> Using cache
 ---> 31c2209dd7b5
Step 4/4 : CMD ["app.lambdaHandler"]
 ---> Using cache
 ---> 2ce2a438e89d
Successfully built 2ce2a438e89d
Successfully tagged helloworldfunction:nodejs18.x-v1

Build Succeeded

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

Commands you can use next
=========================
[*] Validate SAM template: sam validate
[*] Invoke Function: sam local invoke
[*] Test Function in the Cloud: sam sync --stack-name {{stack-name}} --watch
[*] Deploy: sam deploy --guided
```

Building an application that includes a compiled programming language

In this example, we build an application that contains a Lambda function using the Go runtime.

First, we initialize a new application using `sam init` and configure our application to use Go:

```
$ sam init

...

Which template source would you like to use?
        1 - AWS Quick Start Templates
        2 - Custom Template Location
```

```
Choice: 1

Choose an AWS Quick Start application template
        1 - Hello World Example
        2 - Multi-step workflow
        3 - Serverless API
        ...
Template: 1

Use the most popular runtime and package type? (Python and zip) [y/N]: ENTER

Which runtime would you like to use?
        ...
        4 - dotnetcore3.1
        5 - go1.x
        6 - go (provided.al2)
        ...
Runtime: 5

What package type would you like to use?
        1 - Zip
        2 - Image
Package type: 1

Based on your selections, the only dependency manager available is mod.
We will proceed copying the template using mod.

Would you like to enable X-Ray tracing on the function(s) in your application?  [y/
N]: ENTER

Would you like to enable monitoring using CloudWatch Application Insights?
For more info, please view https://docs.aws.amazon.com/AmazonCloudWatch/latest/
monitoring/cloudwatch-application-insights.html [y/N]: ENTER

Project name [sam-app]: ENTER

Cloning from https://github.com/aws/aws-sam-cli-app-templates (process may take a
 moment)

    -----------------------
    Generating application:
    -----------------------
    Name: sam-app
    Runtime: go1.x
```

```
    Architectures: x86_64
    Dependency Manager: mod
    Application Template: hello-world
    Output Directory: .
    Configuration file: sam-app/samconfig.toml

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

...
```

The AWS SAM CLI initializes the application. The following is an example of the application directory structure:

```
sam-app
### Makefile
### README.md
### events
#   ### event.json
### hello-world
#   ### go.mod
#   ### go.sum
#   ### main.go
#   ### main_test.go
### samconfig.toml
### template.yaml
```

We reference the `README.md` file for this application's requirements.

```
...
## Requirements
* AWS CLI already configured with Administrator permission
* [Docker installed](https://www.docker.com/community-edition)
* [Golang](https://golang.org)
* SAM CLI - [Install the SAM CLI](https://docs.aws.amazon.com/serverless-application-
model/latest/developerguide/serverless-sam-cli-install.html)
...
```

Next, we run `sam local invoke` to test our function. This command errors since Go is not installed on our local machine:

```
sam-app $ sam local invoke
Invoking hello-world (go1.x)
```

```
Local image was not found.
Removing rapid images for repo public.ecr.aws/sam/emulation-go1.x
Building
 image.....................................................................................
Using local image: public.ecr.aws/lambda/go:1-rapid-x86_64.

Mounting /Users/.../Playground/build/sam-app/hello-world as /var/task:ro,delegated
 inside runtime container
START RequestId: c6c5eddf-042b-4e1e-ba66-745f7c86dd31 Version: $LATEST
fork/exec /var/task/hello-world: no such file or directory: PathError
null
END RequestId: c6c5eddf-042b-4e1e-ba66-745f7c86dd31
REPORT RequestId: c6c5eddf-042b-4e1e-ba66-745f7c86dd31  Init Duration: 0.88 ms
 Duration: 175.75 ms Billed Duration: 176 ms Memory Size: 128 MB     Max Memory Used:
 128 MB
{"errorMessage":"fork/exec /var/task/hello-world: no such file or
 directory","errorType":"PathError"}%
```

Next, we run `sam build` to build our application. We encounter an error since Go is not installed on our local machine:

```
sam-app $ sam build
Starting Build use cache
Cache is invalid, running build and copying resources for following functions
 (HelloWorldFunction)
Building codeuri: /Users/.../Playground/build/sam-app/hello-world runtime: go1.x
 metadata: {} architecture: x86_64 functions: HelloWorldFunction

Build Failed
Error: GoModulesBuilder:Resolver - Path resolution for runtime: go1.x of binary: go was
 not successful
```

While we could configure our local machine to properly build our function, we instead use the `--use-container` option with `sam build`. The AWS SAM CLI downloads a container image, builds our function using the native GoModulesBuilder, and copies the resulting binary to our `.aws-sam/build/HelloWorldFunction` directory.

```
sam-app $ sam build --use-container
Starting Build use cache
Starting Build inside a container
Cache is invalid, running build and copying resources for following functions
 (HelloWorldFunction)
```

```
Building codeuri: /Users/.../build/sam-app/hello-world runtime: go1.x metadata: {}
 architecture: x86_64 functions: HelloWorldFunction

Fetching public.ecr.aws/sam/build-go1.x:latest-x86_64 Docker container
 image.....................................................................................
Mounting /Users/.../build/sam-app/hello-world as /tmp/samcli/source:ro,delegated inside
 runtime container
Running GoModulesBuilder:Build

Build Succeeded

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

Commands you can use next
=========================
[*] Validate SAM template: sam validate
[*] Invoke Function: sam local invoke
[*] Test Function in the Cloud: sam sync --stack-name {{stack-name}} --watch
[*] Deploy: sam deploy --guided
```

The following is an example of the `.aws-sam` directory:

```
.aws-sam
### build
#   ### HelloWorldFunction
#   #   ### hello-world
#   ### template.yaml
### build.toml
### cache
#   ### c860d011-4147-4010-addb-2eaa289f4d95
#       ### hello-world
### deps
```

Next, we run `sam local invoke`. Our function is successfully invoked:

```
sam-app $ sam local invoke
Invoking hello-world (go1.x)
Local image is up-to-date
Using local image: public.ecr.aws/lambda/go:1-rapid-x86_64.

Mounting /Users/.../Playground/build/sam-app/.aws-sam/build/HelloWorldFunction as /var/
task:ro,delegated inside runtime container
```

```
START RequestId: cfc8ffa8-29f2-49d4-b461-45e8c7c80479 Version: $LATEST
END RequestId: cfc8ffa8-29f2-49d4-b461-45e8c7c80479
REPORT RequestId: cfc8ffa8-29f2-49d4-b461-45e8c7c80479  Init Duration: 1.20 ms
 Duration: 1782.46 ms        Billed Duration: 1783 ms        Memory Size: 128 MB
 Max Memory Used: 128 MB
{"statusCode":200,"headers":null,"multiValueHeaders":null,"body":"Hello,
 72.21.198.67\n"}%
```

Learn more

To learn more about using the `sam build` command, see the following:

- **Learning AWS SAM: sam build** – Serverless Land "Learning AWS SAM" series on YouTube.
- **Learning AWS SAM | sam build | E3** – Serverless Land "Learning AWS SAM" series on YouTube.
- **AWS SAM build: how it provides artifacts for deployment (Sessions With SAM S2E8)** – Sessions with AWS SAM series on YouTube.
- **AWS SAM custom builds: How to use Makefiles to customize builds in SAM (S2E9)** – Sessions with AWS SAM series on YouTube.

Default build with AWS SAM

To build your serverless application, use the `sam build` 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*.

Topics

- Building a .zip file archive
- Building a container image
- Container environment variable file
- Speed up build times by building your project in the source folder
- Examples
- Building functions outside of AWS SAM

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 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 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 or for a specific version of AWS SAM CLI, 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 a specific version of AWS SAM CLI:

```
# Build a Node.js 20 application using a container image for a specific version of AWS
 SAM CLI (1.136.0)
sam build --use-container --build-image public.ecr.aws/sam/build-nodejs22.x:1.136.0

# Build a function resource using the Python 3.13 container image from a specific
 version of AWS SAM CLI (1.136.0)(
sam build --use-container --build-image Function1=public.ecr.aws/sam/build-
python3.13:1.136.0
```

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.

> **Important**
>
> The AWS SAM CLI doesn't redact or obfuscate any information you include in `DockerBuildArgs` arguments. We strongly recommend you don't use this section to store sensitive information, such as passwords or secrets.

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 Tutorial: Deploy a Hello World application with AWS SAM. 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.

Speed up build times by building your project in the source folder

For supported runtimes and build methods, you can use the `--build-in-source` option to build your project directly in the source folder. By default, the AWS SAM CLI builds in a temporary directory, which involves copying over source code and project files. With `--build-in-source`, the AWS SAM CLI builds directly in your source folder, which speeds up the build process by removing the need to copy files to a temporary directory.

For a list of supported runtimes and build methods, see `--build-in-source`.

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 20 application using a container image for a specific version of AWS
 SAM CLI (1.136.0)
sam build --use-container --build-image public.ecr.aws/sam/build-nodejs22.x:1.136.0
```

```
# Build a function resource using the Python 3.13 container image from a specific
 version of AWS SAM CLI (1.136.0)(
sam build --use-container --build-image Function1=public.ecr.aws/sam/build-
python3.13:1.136.0

# 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:3.12

COPY app.py requirements.txt ./

RUN python3.12 -m pip install -r requirements.txt

# Overwrite the command by providing a different command directly in the template.
CMD ["app.lambda_handler"]
```

Example 3: npm ci

For Node.js applications, you can use `npm ci` instead of `npm install` to install dependencies. To use `npm ci`, specify `UseNpmCi: True` under `BuildProperties` in your Lambda function's

`Metadata` resource attribute. To use `npm ci`, your application must have a `package-lock.json` or `npm-shrinkwrap.json` file present in the `CodeUri` for your Lambda function.

The following example uses `npm ci` to install dependencies when you run `sam build`:

```
Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: hello-world/
      Handler: app.handler
      Runtime: nodejs20.x
      Architectures:
        - x86_64
      Events:
        HelloWorld:
          Type: Api
          Properties:
            Path: /hello
            Method: get
    Metadata:
      BuildProperties:
        UseNpmCi: True
```

Python parent packages

For Python applications, you can preserve your package structure during the build process to enable absolute imports. To preserve package structure, specify `ParentPackageMode` under `BuildProperties` in your Lambda function's `Metadata` resource attribute.

The following example preserves the `app` package structure when you run `sam build`:

```
Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: hello-world/
      Handler: app.main.handler
      Runtime: python3.12
      Architectures:
        - x86_64
    Metadata:
      BuildProperties:
```

```
        ParentPackageMode: explicit
        ParentPackages: app
```

With this configuration, your code can use absolute imports like `from app.utils import logger` instead of relative imports like `from .utils import logger`.

Building functions outside of AWS SAM

By default, when you run **sam build**, AWS SAM builds all of your function resources. Other options include:

- **Build all function resources outside of AWS SAM** – If you build all of your function resources manually or through another tool, **sam build** is not required. You can skip **sam build** and move on to the next step in your process, such as performing local testing or deploying your application.
- **Build some function resources outside of AWS SAM** – If you want AWS SAM to build some of your function resources while having other function resources built outside of AWS SAM, you can specify this in your AWS SAM template.

Build some function resources outside of AWS SAM

To have AWS SAM skip a function when using **sam build**, configure the following in your AWS SAM template:

1. Add the `SkipBuild: True` metadata property to your function.
2. Specify the path to your built function resources.

Here is an example, with `TestFunction` configured to be skipped. Its built resources are located at `built-resources/TestFunction.zip`.

```
TestFunction:
  Type: AWS::Serverless::Function
  Properties:
    CodeUri: built-resources/TestFunction.zip
    Handler: TimeHandler::handleRequest
    Runtime: java11
  Metadata:
    SkipBuild: True
```

Now, when you run **sam build**, AWS SAM will do the following:

1. AWS SAM will skip functions configured with `SkipBuild: True`.
2. AWS SAM will build all other function resources and cache them in the `.aws-sam` build directory.
3. For skipped functions, their template in the `.aws-sam` build directory will automatically be updated to reference the specified path to your built function resources.

   Here is an example of the cached template for `TestFunction` in the `.aws-sam` build directory:

```
TestFunction:
  Type: AWS::Serverless::Function
  Properties:
    CodeUri: ../../built-resources/TestFunction.zip
    Handler: TimeHandler::handleRequest
    Runtime: java11
  Metadata:
    SkipBuild: True
```

Customize builds with AWS SAM

You can customize your build to include specific Lambda functions or Lambda layers. A function is a resource that you can invoke to run your code in Lambda. A Lambda layer allows you to extract code from a Lambda function that can then be re-used across several Lambda functions. You may choose to customize your build with specific Lambda functions when you want to focus on developing and deploying individual serverless functions without the complexity of managing shared dependencies or resources. Additionally, you may choose to build a Lambda layer to help you reduce the size of your deployment packages, separate core function logic from dependencies, and allow you to share dependencies across multiple functions.

The topics in this section explore some of the different ways you can build Lambda functions with AWS SAM. This includes building Lambda functions with customer runtimes and building Lambda layers. Custom runtimes let you install and use a language not listed in Lambda runtimes in the AWS Lambda Developer Guide. This allows you to create a specialized execution environment for running serverless functions and applications. Building only Lambda layers (instead of building your entire application) can benefit you in a few ways. It can help you reduce the size of your deployment packages, separate core function logic from dependencies, and allow you to share dependencies across multiple functions.

For more information on functions, see Lambda concepts in the *AWS Lambda Developer Guide*.

Topics

- Building Node.js Lambda functions with esbuild in AWS SAM
- Building .NET Lambda functions with Native AOT compilation in AWS SAM
- Building Rust Lambda functions with Cargo Lambda in AWS SAM
- Building Python Lambda functions with uv in AWS SAM
- Building Lambda functions with custom runtimes in AWS SAM
- Building Lambda layers in AWS SAM

Building Node.js Lambda functions with esbuild in AWS SAM

To build and package Node.js AWS Lambda functions, you can use the AWS SAM CLI with the esbuild JavaScript bundler. The esbuild bundler supports Lambda functions that you write in TypeScript.

To build a Node.js Lambda function with esbuild, add a `Metadata` object to your `AWS:Serverless::Function` resource and specify `esbuild` for the `BuildMethod`. When you run the **sam build** command, AWS SAM uses esbuild to bundle your Lambda function code.

Metadata properties

The `Metadata` object supports the following properties for esbuild.

BuildMethod

Specifies the bundler for your application. The only supported value is `esbuild`.

BuildProperties

Specifies the build properties for your Lambda function code.

The `BuildProperties` object supports the following properties for esbuild. All of the properties are optional. By default, AWS SAM uses your Lambda function handler for the entry point.

EntryPoints

Specifies entry points for your application.

External

Specifies the list of packages to omit from the build. For more information, see External in the *esbuild website*.

Format

Specifies the output format of the generated JavaScript files in your application. For more information, see Format in the *esbuild website*.

Loader

Specifies the list of configurations for loading data for a given file type.

MainFields

Specifies which `package.json` fields to try to import when resolving a package. The default value is `main,module`.

Minify

Specifies whether to minify the bundled output code. The default value is `true`.

OutExtension

Customize the file extension of the files that esbuild generates. For more information, see Out extension in the *esbuild website*.

Sourcemap

Specifies whether the bundler produces a source map file. The default value is `false`.

When set to `true`, `NODE_OPTIONS: --enable-source-maps` is appended to the Lambda function's environment variables, and a source map is generated and included in the function.

Alternatively, when `NODE_OPTIONS: --enable-source-maps` is included in the function's environment variables, `Sourcemap` is automatically set to `true`.

When conflicting, `Sourcemap: false` takes precedence over `NODE_OPTIONS: --enable-source-maps`.

> **Note**
>
> By default, Lambda encrypts all environment variables at rest with AWS Key Management Service (AWS KMS). When using source maps, for the deployment

to succeed, your function's execution role must have permission to perform the `kms:Encrypt` action.

SourcesContent

Specifies whether to include your source code in your source map file. Configure this property when `Sourcemap` is set to `'true'`.

- Specify `SourcesContent: 'true'` to include all source code.
- Specify `SourcesContent: 'false'` to exclude all source code. This results in smaller source maps file sizes, which is useful in production by reducing start-up times. However, source code won't be available in the debugger.

The default value is `SourcesContent: true`.

For more information, see Sources content in the *esbuild website*.

Target

Specifies the target ECMAScript version. The default value is `es2020`.

TypeScript Lambda function example

The following example AWS SAM template snippet uses esbuild to create a Node.js Lambda function from TypeScript code in `hello-world/app.ts`.

```
Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: hello-world/
      Handler: app.handler
      Runtime: nodejs20.x
      Architectures:
        - x86_64
      Events:
        HelloWorld:
          Type: Api
          Properties:
            Path: /hello
```

```
            Method: get
      Environment:
        Variables:
          NODE_OPTIONS: --enable-source-maps
    Metadata:
      BuildMethod: esbuild
      BuildProperties:
        Format: esm
        Minify: false
        OutExtension:
          - .js=.mjs
        Target: "es2020"
        Sourcemap: true
        EntryPoints:
          - app.ts
        External:
          - "<package-to-exclude>"
```

Building .NET Lambda functions with Native AOT compilation in AWS SAM

Build and package your .NET 8 AWS Lambda functions with the AWS Serverless Application Model (AWS SAM), utilizing Native Ahead-of-Time (AOT) compilation to improve AWS Lambda cold-start times.

Topics

- .NET 8 Native AOT overview
- Using AWS SAM with your .NET 8 Lambda functions
- Install prerequisites
- Define .NET 8 Lambda functions in your AWS SAM template
- Build your application with the AWS SAM CLI
- Learn more

.NET 8 Native AOT overview

Historically, .NET Lambda functions have cold-start times which impact user experience, system latency, and usage costs of your serverless applications. With .NET Native AOT compilation, you can improve cold-start times of your Lambda functions. To learn more about Native AOT for .NET 8, see Using Native AOT in the *Dotnet GitHub repository*.

Using AWS SAM with your .NET 8 Lambda functions

Do the following to configure your .NET 8 Lambda functions with the AWS Serverless Application Model (AWS SAM):

- Install prerequisites on your development machine.
- Define .NET 8 Lambda functions in your AWS SAM template.
- Build your application with the AWS SAM CLI.

Install prerequisites

The following are required prerequisites:

- The AWS SAM CLI
- The .NET Core CLI
- The Amazon.Lambda.Tools .NET Core Global Tool
- Docker

Install the AWS SAM CLI

1. To check if you already have the AWS SAM CLI installed, run the following:

   ```
   sam --version
   ```

2. To install the AWS SAM CLI, see Install the AWS SAM CLI.
3. To upgrade an installed version of the AWS SAM CLI, see Upgrading the AWS SAM CLI.

Install the .NET Core CLI

1. To download and install the .NET Core CLI, see Download .NET from Microsoft's website.
2. For more information on the .NET Core CLI, see .NET Core CLI in the *AWS Lambda Developer Guide*.

Install the Amazon.Lambda.Tools .NET Core Global Tool

1. Run the following command:

```
dotnet tool install -g Amazon.Lambda.Tools
```

2. If you already have the tool installed, you can make sure that it is the latest version using the following command:

```
dotnet tool update -g Amazon.Lambda.Tools
```

3. For more information about the Amazon.Lambda.Tools .NET Core Global Tool, see the AWS Extensions for .NET CLI repository on GitHub.

Install Docker

- Building with Native AOT, requires Docker to be installed. For installation instructions, see Installing Docker to use with the AWS SAM CLI.

Define .NET 8 Lambda functions in your AWS SAM template

To define a .NET8 Lambda function in your AWS SAM template, do the following:

1. Run the following command from a starting directory of your choice::

```
sam init
```

2. Select `AWS Quick Start Templates` to choose a starting template.
3. Choose the `Hello World Example` template.
4. Choose to not use the most popular runtime and package type by entering n.
5. For runtime, choose `dotnet8`.
6. For package type, choose `Zip`.
7. For your starter template, choose `Hello World Example using native AOT`.

Install Docker

- Building with Native AOT, requires Docker to be installed. For installation instructions, see Installing Docker to use with the AWS SAM CLI.

```
Resources:
```

```
HelloWorldFunction:
  Type: AWS::Serverless::Function
  Properties:
    CodeUri: ./src/HelloWorldAot/
    Handler: bootstrap
    Runtime: dotnet8
    Architectures:
      - x86_64
    Events:
      HelloWorldAot:
        Type: Api
        Properties:
          Path: /hello
          Method: get
```

> **Note**
>
> 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` CloudFormation resource.

Build your application with the AWS SAM CLI

From your project's root directory, run the `sam build` command to begin building your application. If the `PublishAot` property has been defined in your .NET 8 project file, the AWS SAM CLI will build with Native AOT compilation. To learn more about the `PublishAot` property, see Native AOT Deployment in Microsoft's *.NET documentation*.

To build your function, the AWS SAM CLI invokes the .NET Core CLI which uses the Amazon.Lambda.Tools .NET Core Global Tool.

> **Note**
>
> When building, if a `.sln` file exists in the same or parent directory of your project, the directory containing the `.sln` file will be mounted to the container. If a `.sln` file is not found, only the project folder is mounted. Therefore, if you are building a multi-project application, ensure the `.sln` file is property located.

Learn more

For more information on building .NET 8 Lambda functions, see Introducing the .NET 8 runtime for AWS Lambda.

For a reference of the **sam build** command, see sam build.

Building Rust Lambda functions with Cargo Lambda in AWS SAM

This feature is in preview release for AWS SAM and is subject to change.

Use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) with your Rust AWS Lambda functions.

Topics

- Prerequisites
- Configuring AWS SAM to use with Rust Lambda functions
- Examples

Prerequisites

Rust language

To install Rust, see Install Rust in the *Rust language website*.

Cargo Lambda

The AWS SAM CLI requires installation of Cargo Lambda, a subcommand for Cargo. For installation instructions, see Installation in the *Cargo Lambda documentation*.

Docker

Building and testing Rust Lambda functions requires Docker. For installation instructions, see Installing Docker.

Opt in to AWS SAM CLI beta feature

Since this feature is in preview, you must opt in using one of the following methods:

1. Use the environment variable: `SAM_CLI_BETA_RUST_CARGO_LAMBDA=1`.
2. Add the following to your `samconfig.toml` file:

```
[default.build.parameters]
beta_features = true
[default.sync.parameters]
beta_features = true
```

3. Use the `--beta-features` option when using a supported AWS SAM CLI command. For example:

```
$ sam build --beta-features
```

4. Choose option `y` when the AWS SAM CLI prompts you to opt in. The following is an example:

```
$ sam build
Starting Build use cache
Build method "rust-cargolambda" is a beta feature.
Please confirm if you would like to proceed
You can also enable this beta feature with "sam build --beta-features". [y/N]: y
```

Configuring AWS SAM to use with Rust Lambda functions

Step 1: Configure your AWS SAM template

Configure your AWS SAM template with the following:

- **Binary** – Optional. Specify when your template contains multiple Rust Lambda functions.
- **BuildMethod** – `rust-cargolambda`.
- **CodeUri** – path to your `Cargo.toml` file.
- **Handler** – `bootstrap`.
- **Runtime** – `provided.al2`.

To learn more about custom runtimes, see Custom AWS Lambda runtimes in the *AWS Lambda Developer Guide*.

Here is an example of a configured AWS SAM template:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
```

```
Resources:
  MyFunction:
    Type: AWS::Serverless::Function
    Metadata:
      BuildMethod: rust-cargolambda
      BuildProperties: function_a
    Properties:
      CodeUri: ./rust_app
      Handler: bootstrap
      Runtime: provided.al2
...
```

Step 2: Use the AWS SAM CLI with your Rust Lambda function

Use any AWS SAM CLI command with your AWS SAM template. For more information, see AWS SAM CLI.

Examples

Hello World example

In this example, we build the sample Hello World application using Rust as our runtime.

First, we initialize a new serverless application using `sam init`. During the interactive flow, we select the **Hello World application** and choose the **Rust** runtime.

```
$ sam init
...
Which template source would you like to use?
        1 - AWS Quick Start Templates
        2 - Custom Template Location
Choice: 1

Choose an AWS Quick Start application template
        1 - Hello World Example
        2 - Multi-step workflow
        3 - Serverless API
        ...
Template: 1

Use the most popular runtime and package type? (Python and zip) [y/N]: ENTER

Which runtime would you like to use?
        1 - dotnet8
```

```
        2 - dotnet6
        3 - go (provided.al2)
        ...
        18 - python3.11
        19 - python3.10
        20 - ruby3.3
        21 - ruby3.2
        22 - rust (provided.al2)
        23 - rust (provided.al2023)
Runtime: 22

Based on your selections, the only Package type available is Zip.
We will proceed to selecting the Package type as Zip.

Based on your selections, the only dependency manager available is cargo.
We will proceed copying the template using cargo.

Would you like to enable X-Ray tracing on the function(s) in your application?  [y/
N]: ENTER

Would you like to enable monitoring using CloudWatch Application Insights?
For more info, please view https://docs.aws.amazon.com/AmazonCloudWatch/latest/
monitoring/cloudwatch-application-insights.html [y/N]: ENTER

Project name [sam-app]: hello-rust

    -----------------------
    Generating application:
    -----------------------
    Name: hello-rust
    Runtime: rust (provided.al2)
    Architectures: x86_64
    Dependency Manager: cargo
    Application Template: hello-world
    Output Directory: .
    Configuration file: hello-rust/samconfig.toml

    Next steps can be found in the README file at hello-rust/README.md


Commands you can use next
=========================
[*] Create pipeline: cd hello-rust && sam pipeline init --bootstrap
[*] Validate SAM template: cd hello-rust && sam validate
```

```
[*] Test Function in the Cloud: cd hello-rust && sam sync --stack-name {stack-name} --
watch
```

The following is the structure of our Hello World application:

```
hello-rust
### README.md
### events
#   ### event.json
### rust_app
#   ### Cargo.toml
#   ### src
#       ### main.rs
### samconfig.toml
### template.yaml
```

In our AWS SAM template, our Rust function is defined as the following:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function
    Metadata:
      BuildMethod: rust-cargolambda
    Properties:
      CodeUri: ./rust_app
      Handler: bootstrap
      Runtime: provided.al2
      Architectures:
        - x86_64
      Events:
        HelloWorld:
          Type: Api
            Path: /hello
            Method: get
```

Next, we run `sam build` to build our application and prepare for deployment. The AWS SAM CLI creates a `.aws-sam` directory and organizes our build artifacts there. Our function is built using Cargo Lambda and stored as an executable binary at `.aws-sam/build/HelloWorldFunction/bootstrap`.

> **Note**
>
> If you plan on running the **sam local invoke** command in MacOS, you need to build functions different before invoking. To do this, use the following command:
>
> - **SAM_BUILD_MODE=debug sam build**
>
> This command is only needed if local testing will be done. This is not recommended when building for deployment.

```
hello-rust$ sam build
Starting Build use cache
Build method "rust-cargolambda" is a beta feature.
Please confirm if you would like to proceed
You can also enable this beta feature with "sam build --beta-features". [y/N]: y

Experimental features are enabled for this session.
Visit the docs page to learn more about the AWS Beta terms https://aws.amazon.com/
service-terms/.

Cache is invalid, running build and copying resources for following functions
 (HelloWorldFunction)
Building codeuri: /Users/.../hello-rust/rust_app runtime: provided.al2 metadata:
 {'BuildMethod': 'rust-cargolambda'} architecture: x86_64 functions: HelloWorldFunction
Running RustCargoLambdaBuilder:CargoLambdaBuild
Running RustCargoLambdaBuilder:RustCopyAndRename

Build Succeeded

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

Commands you can use next
=========================
[*] Validate SAM template: sam validate
[*] Invoke Function: sam local invoke
[*] Test Function in the Cloud: sam sync --stack-name {{stack-name}} --watch
[*] Deploy: sam deploy --guided
```

Next, we deploy our application using `sam deploy --guided`.

```
hello-rust$ sam deploy --guided

Configuring SAM deploy
======================

        Looking for config file [samconfig.toml] :  Found
        Reading default arguments  :  Success

        Setting default arguments for 'sam deploy'
        =========================================
        Stack Name [hello-rust]: ENTER
        AWS Region [us-west-2]: ENTER
        #Shows you resources changes to be deployed and require a 'Y' to initiate
 deploy
        Confirm changes before deploy [Y/n]: ENTER
        #SAM needs permission to be able to create roles to connect to the resources in
 your template
        Allow SAM CLI IAM role creation [Y/n]: ENTER
        #Preserves the state of previously provisioned resources when an operation
 fails
        Disable rollback [y/N]: ENTER
        HelloWorldFunction may not have authorization defined, Is this okay? [y/N]: y
        Save arguments to configuration file [Y/n]: ENTER
        SAM configuration file [samconfig.toml]: ENTER
        SAM configuration environment [default]: ENTER

        Looking for resources needed for deployment:

        ...

        Uploading to hello-rust/56ba6585d80577dd82a7eaaee5945c0b  817973 / 817973
 (100.00%)

        Deploying with following values
        ===============================
        Stack name                   : hello-rust
        Region                       : us-west-2
        Confirm changeset            : True
        Disable rollback             : False
        Deployment s3 bucket         : aws-sam-cli-managed-default-samclisam-s3-demo-
bucket-1a4x26zbcdkqr
        Capabilities                 : ["CAPABILITY_IAM"]
        Parameter overrides          : {}
```

```
        Signing Profiles             : {}

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

        Uploading to hello-rust/a4fc54cb6ab75dd0129e4cdb564b5e89.template  1239 / 1239
 (100.00%)


Waiting for changeset to be created..

CloudFormation stack changeset
-----------------------------------------------------------------------------------------------
Operation                   LogicalResourceId          ResourceType
 Replacement
-----------------------------------------------------------------------------------------------
+ Add                       HelloWorldFunctionHelloW   AWS::Lambda::Permission    N/A

                            orldPermissionProd

...
-----------------------------------------------------------------------------------------------

Changeset created successfully. arn:aws:cloudformation:us-
west-2:012345678910:changeSet/samcli-deploy1681427201/
f0ef1563-5ab6-4b07-9361-864ca3de6ad6


Previewing CloudFormation changeset before deployment
=====================================================
Deploy this changeset? [y/N]: y

2023-04-13 13:07:17 - Waiting for stack create/update to complete

CloudFormation events from stack operations (refresh every 5.0 seconds)
-----------------------------------------------------------------------------------------------
ResourceStatus             ResourceType               LogicalResourceId
 ResourceStatusReason
-----------------------------------------------------------------------------------------------
CREATE_IN_PROGRESS         AWS::IAM::Role             HelloWorldFunctionRole     -

CREATE_IN_PROGRESS         AWS::IAM::Role             HelloWorldFunctionRole
 Resource creation
...
```

```
-----------------------------------------------------------------------------------------------------------

CloudFormation outputs from deployed stack
-----------------------------------------------------------------------------------------------------------
Outputs

-----------------------------------------------------------------------------------------------------------
Key                 HelloWorldFunctionIamRole

Description         Implicit IAM Role created for Hello World function

Value               arn:aws:iam::012345678910:role/hello-rust-
HelloWorldFunctionRole-10II2P13AUDUY

Key                 HelloWorldApi

Description         API Gateway endpoint URL for Prod stage for Hello World function

Value               https://ggdxec9le9.execute-api.us-west-2.amazonaws.com/Prod/hello/


Key                 HelloWorldFunction

Description         Hello World Lambda Function ARN

Value               arn:aws:lambda:us-west-2:012345678910:function:hello-rust-
HelloWorldFunction-
yk4HzGzYeZBj

-----------------------------------------------------------------------------------------------------------



Successfully created/updated stack - hello-rust in us-west-2
```

To test, we can invoke our Lambda function using the API endpoint.

```
$ curl https://ggdxec9le9.execute-api.us-west-2.amazonaws.com/Prod/hello/
Hello World!%
```

To test our function locally, first we ensure our function's `Architectures` property matches our local machine.

```
...
```

```
Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function # More info about Function Resource:
 https://github.com/awslabs/serverless-application-model/blob/master/
versions/2016-10-31.md#awsserverlessfunction
    Metadata:
      BuildMethod: rust-cargolambda # More info about Cargo Lambda: https://github.com/
cargo-lambda/cargo-lambda
    Properties:
      CodeUri: ./rust_app   # Points to dir of Cargo.toml
      Handler: bootstrap    # Do not change, as this is the default executable name
 produced by Cargo Lambda
      Runtime: provided.al2
      Architectures:
        - arm64
...
```

Since we modified our architecture from `x86_64` to `arm64` in this example, we run `sam build` to update our build artifacts. We then run `sam local invoke` to locally invoke our function.

```
hello-rust$ sam local invoke
Invoking bootstrap (provided.al2)
Local image was not found.
Removing rapid images for repo public.ecr.aws/sam/emulation-provided.al2
Building
 image.....................................................................................
Using local image: public.ecr.aws/lambda/provided:al2-rapid-arm64.

Mounting /Users/.../hello-rust/.aws-sam/build/HelloWorldFunction as /var/
task:ro,delegated, inside runtime container
START RequestId: fbc55e6e-0068-45f9-9f01-8e2276597fc6 Version: $LATEST
{"statusCode":200,"body":"Hello World!"}END RequestId:
 fbc55e6e-0068-45f9-9f01-8e2276597fc6
REPORT RequestId: fbc55e6e-0068-45f9-9f01-8e2276597fc6  Init Duration: 0.68 ms
 Duration: 130.63 ms     Billed Duration: 131 ms     Memory Size: 128 MB     Max Memory
 Used: 128 MB
```

Single Lambda function project

Here is an example of a serverless application containing one Rust Lambda function.

Project directory structure:

```
.
### Cargo.lock
### Cargo.toml
### src
#   ### main.rs
### template.yaml
```

AWS SAM template:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyFunction:
    Type: AWS::Serverless::Function
    Metadata:
      BuildMethod: rust-cargolambda
    Properties:
      CodeUri: ./
      Handler: bootstrap
      Runtime: provided.al2
...
```

Multiple Lambda function project

Here is an example of a serverless application containing multiple Rust Lambda functions.

Project directory structure:

```
.
### Cargo.lock
### Cargo.toml
### src
#   ### function_a.rs
#   ### function_b.rs
### template.yaml
```

AWS SAM template:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
```

```
Resources:
  FunctionA:
    Type: AWS::Serverless::Function
    Metadata:
      BuildMethod: rust-cargolambda
      BuildProperties:
        Binary: function_a
    Properties:
      CodeUri: ./
      Handler: bootstrap
      Runtime: provided.al2
  FunctionB:
    Type: AWS::Serverless::Function
    Metadata:
      BuildMethod: rust-cargolambda
      BuildProperties:
        Binary: function_b
    Properties:
      CodeUri: ./
      Handler: bootstrap
      Runtime: provided.al2
```

`Cargo.toml` file:

```
[package]
name = "test-handler"
version = "0.1.0"
edition = "2021"

[dependencies]
lambda_runtime = "0.6.0"
serde = "1.0.136"
tokio = { version = "1", features = ["macros"] }
tracing = { version = "0.1", features = ["log"] }
tracing-subscriber = { version = "0.3", default-features = false, features = ["fmt"] }

[[bin]]
name = "function_a"
path = "src/function_a.rs"

[[bin]]
name = "function_b"
path = "src/function_b.rs"
```

Building Python Lambda functions with uv in AWS SAM

This feature is in preview release for AWS SAM and is subject to change.

Use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) with uv, a fast Python package installer and resolver, to build your Python AWS Lambda functions.

Topics

- Prerequisites
- Configuring AWS SAM to use with Python Lambda functions and uv
- Examples

Prerequisites

Python

To install Python, see Download Python in the *Python website*.

uv

The AWS SAM CLI requires installation of uv, an extremely fast Python package installer and resolver. For installation instructions, see Installation in the *uv documentation*.

Opt in to AWS SAM CLI beta feature

Since this feature is in preview, you must opt in using one of the following methods:

1. Use the environment variable: `SAM_CLI_BETA_PYTHON_UV=1`.
2. Add the following to your `samconfig.toml` file:

```
[default.build.parameters]
beta_features = true
[default.sync.parameters]
beta_features = true
```

3. Use the `--beta-features` option when using a supported AWS SAM CLI command. For example:

```
$ sam build --beta-features
```

4. Choose option y when the AWS SAM CLI prompts you to opt in. The following is an example:

```
$ sam build
Starting Build use cache
Build method "python-uv" is a beta feature.
Please confirm if you would like to proceed
You can also enable this beta feature with "sam build --beta-features". [y/N]: y
```

Configuring AWS SAM to use with Python Lambda functions and uv

Step 1: Configure your AWS SAM template

Configure your AWS SAM template with the following:

- **BuildMethod** – `python-uv`.
- **CodeUri** – path to your function code directory containing `pyproject.toml` or `requirements.txt`.
- **Handler** – your function handler (e.g., `app.lambda_handler`).
- **Runtime** – Python runtime version (e.g., `python3.12`).

Here is an example of a configured AWS SAM template:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  MyFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: ./my_function
      Handler: app.lambda_handler
      Runtime: python3.12
    Metadata:
      BuildMethod: python-uv
...
```

Examples

Hello World example

In this example, we build a sample Hello World application using Python with uv as the package manager.

uv can use either `pyproject.toml` or `requirements.txt` to read dependencies. If both are given, `sam build` will read from `requirements.txt` for dependencies.

The following is the structure of our Hello World application:

```
hello-python-uv
### README.md
### events
#   ### event.json
### hello_world
#   ### __init__.py
#   ### app.py
#   ### pyproject.toml
### samconfig.toml
### template.yaml
```

`pyproject.toml` file:

```
[project]
name = "my-function"
version = "0.1.0"
requires-python = ">=3.12"
dependencies = [
    "requests>=2.31.0",
    "boto3>=1.28.0",
]
```

In our AWS SAM template, our Python function is defined as the following:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  HelloWorldFunction:
```

```
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: hello_world/
      Handler: app.lambda_handler
      Runtime: python3.12
      Architectures:
        - x86_64
    Metadata:
      BuildMethod: python-uv
```

Next, we run `sam build` to build our application and prepare for deployment. The AWS SAM CLI creates a `.aws-sam` directory and organizes our build artifacts there. Our function dependencies are installed using uv and stored at `.aws-sam/build/HelloWorldFunction/`.

```
hello-python-uv$ sam build
Starting Build use cache
Build method "python-uv" is a beta feature.
Please confirm if you would like to proceed
You can also enable this beta feature with "sam build --beta-features". [y/N]: y

Experimental features are enabled for this session.
Visit the docs page to learn more about the AWS Beta terms https://aws.amazon.com/
service-terms/.

Cache is invalid, running build and copying resources for following functions
 (HelloWorldFunction)
Building codeuri: /Users/.../hello-python-uv/hello_world runtime: python3.12 metadata:
 {'BuildMethod': 'python-uv'} architecture: x86_64 functions: HelloWorldFunction
Running PythonUvBuilder:UvBuild
Running PythonUvBuilder:CopySource

Build Succeeded

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

Commands you can use next
=========================
[*] Validate SAM template: sam validate
[*] Invoke Function: sam local invoke
[*] Test Function in the Cloud: sam sync --stack-name {{stack-name}} --watch
[*] Deploy: sam deploy --guided
```

> **Note**
>
> The `python-uv` build method is configured per function in the `Metadata` section. Each function in your template can use a different build method, allowing you to mix uv-based functions with `pip`-based functions in the same AWS SAM template. If no build method is specified, `pip` is used by default.

Building Lambda functions with custom runtimes in AWS SAM

You can use the `sam build` 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

> **Note**
>
> We recommend building Lambda functions with Cargo Lambda. To learn more, see Building Rust Lambda functions with Cargo Lambda in AWS SAM.

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 Python3.12 (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 Python3.12 runtime with a makefile builder.

```
Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function
    Properties:
      CodeUri: hello_world/
      Handler: app.lambda_handler
      Runtime: python3.12
    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
```

Building Lambda layers in AWS SAM

You can use AWS SAM to build custom Lambda layers. Lambda layers allow you to extract code from a Lambda function that can then be re-used across several Lambda functions. Building only Lambda layers (instead of building your entire application) can benefit you in a few ways. It can help you reduce the size of your deployment packages, separate core function logic from dependencies, and allow you to share dependencies across multiple functions. For information about layers, see AWS Lambda layers in the *AWS Lambda Developer Guide*.

How to build a Lambda layer in AWS SAM

> **Note**
>
> Before you can build a Lambda layer, you must first write a Lambda layer in your AWS SAM template. For information and examples on doing this, see Increase efficiency using Lambda layers with AWS SAM.

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: python3.12
  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 property of the `AWS::Serverless::LayerVersion` resource type.

When you include the `Metadata` resource attribute section, you can use the `sam build` 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 3.12 runtime environment

The following example AWS SAM template builds a layer against the Python 3.12 runtime environment.

```
Resources:
  MyLayer:
    Type: AWS::Serverless::LayerVersion
    Properties:
      ContentUri: my_layer
      CompatibleRuntimes:
        - python3.12
    Metadata:
      BuildMethod: python3.12   # 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:
        - python3.12
    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"
```

> **Note**
>
> When the `makefile` is called, the appropriate target is triggered and artifacts should be copied to the exposed environmental variable `$ARTIFACTS_DIR`. For more information, refer to aws-lambda-builders in GitHub.

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
```

Test your serverless application with AWS SAM

After writing and building your application, you will be ready to test your application to verify that it functions correctly. With the AWS SAM command line interface (CLI), you can locally test your serverless application before uploading it to the AWS Cloud. Testing your application helps you confirm the application's functionality, reliability, and performance all while identifying issues (bugs) that will need to be addressed.

This section provides guidance on common practices you can follow to test your application. The topics in this section focus mostly on the local testing you can do before deploying in the AWS Cloud. Testing before deploying helps you identify issues proactively, reducing unnecessary costs associated with deployment issues. Each topic in this section describes a test you can perform, tells yoxi include href? u the advantages of using it, and includes examples showing you how to perform the test. After testing your application, you'll be ready to debug any issues you've found.

Topics

- Introduction to testing with the sam local command
- Locally invoke Lambda functions with AWS SAM
- Locally run API Gateway with AWS SAM
- Introduction to cloud testing with sam remote test-event
- Introduction to testing in the cloud with sam remote invoke
- Automate local integration tests with AWS SAM
- Generate sample event payloads with AWS SAM
- Testing and debugging durable functions

Introduction to testing with the sam local command

Use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam local` command to test your serverless applications locally.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?.

Prerequisites

To use `sam local`, install the AWS SAM CLI by completing the following:

- AWS SAM prerequisites.
- Install the AWS SAM CLI.

Before using `sam local`, we recommend a basic understanding of the following:

- Configuring the AWS SAM CLI.
- Create your application in AWS SAM.
- Introduction to building with AWS SAM.
- Introduction to deploying with AWS SAM.

Using the sam local command

Use the `sam local` command with any of its subcommands to perform different types of local testing for your application.

```
$ sam local <subcommand>
```

To learn more about each subcommand, see the following:

- **Intro to sam local generate-event** – Generate AWS service events for local testing.
- **Intro to sam local invoke** – Initiate a one-time invocation of an AWS Lambda function locally.
- **Intro to sam local start-api** – Run your Lambda functions using a local HTTP server.
- **Intro to sam local start-lambda** – Run your Lambda functions using a local HTTP server for use with the AWS CLI or SDKs.

Introduction to testing with sam local generate-event

Use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam local generate-event` subcommand to generate event payload samples for supported AWS services. You can then modify and pass these events to local resources for testing.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For a list of `sam local generate-event` command options, see sam local generate-event.

An *event* is a JSON object that gets generated when an AWS service performs an action or task. These events contain specific information, such as the data that was processed or the timestamp of the event. Most AWS services generate events and each service's events are formatted uniquely for its service.

Events generated by one service are passed to other services as an *event source*. For example, an item placed in an Amazon Simple Storage Service (Amazon S3) bucket can generate an event. This event can then be used as the event source for an AWS Lambda function to process the data further.

Events that you generate with `sam local generate-event` are formatted in the same structure as the actual events created by the AWS service. You can modify the contents of these events and use them to test resources in your application.

Prerequisites

To use `sam local generate-event`, install the AWS SAM CLI by completing the following:

- AWS SAM prerequisites.
- Install the AWS SAM CLI.

Before using `sam local generate-event`, we recommend a basic understanding of the following:

- Configuring the AWS SAM CLI.
- Create your application in AWS SAM.
- Introduction to building with AWS SAM.
- Introduction to deploying with AWS SAM.

Generate sample events

Use the AWS SAM CLI `sam local generate-event` subcommand to generate events for supported AWS services.

To see a list of supported AWS services

1. Run the following:

```
$ sam local generate-event
```

2. The list of supported AWS services will display. The following is an example:

```
$ sam local generate-event
...
Commands:
  alb
  alexa-skills-kit
  alexa-smart-home
  apigateway
  appsync
  batch
  cloudformation
  ...
```

To generate a local event

1. Run `sam local generate-event` and provide the supported service name. This will display a list of event types that you can generate. The following is an example:

```
$ sam local generate-event s3

Usage: sam local generate-event s3 [OPTIONS] COMMAND [ARGS]...

Options:
  -h, --help  Show this message and exit.

Commands:
  batch-invocation  Generates an Amazon S3 Batch Operations Invocation Event
  delete            Generates an Amazon S3 Delete Event
  put               Generates an Amazon S3 Put Event
```

2. To generate the sample event, run `sam local generate-event`, providing the service and event type.

```
$ sam local generate-event <service> <event>
```

The following is an example:

```
$ sam local generate-event s3 put
{
  "Records": [
    {
      "eventVersion": "2.0",
      "eventSource": "aws:s3",
      "awsRegion": "us-east-1",
      "eventTime": "1970-01-01T00:00:00.000Z",
      "eventName": "ObjectCreated:Put",
      "userIdentity": {
        "principalId": "EXAMPLE"
      },
      "requestParameters": {
        "sourceIPAddress": "127.0.0.1"
      },
      "responseElements": {
        "x-amz-request-id": "EXAMPLE123456789",
        "x-amz-id-2": "EXAMPLE123/5678abcdefghijklambdaisawesome/
mnopqrstuvwxyzABCDEFGH"
      },
      "s3": {
        "s3SchemaVersion": "1.0",
        "configurationId": "testConfigRule",
        "bucket": {
          "name": "sam-s3-demo-bucket",
          "ownerIdentity": {
            "principalId": "EXAMPLE"
          },
          "arn": "arn:aws:s3:::sam-s3-demo-bucket"
        },
        "object": {
          "key": "test/key",
          "size": 1024,
          "eTag": "0123456789abcdef0123456789abcdef",
          "sequencer": "0A1B2C3D4E5F678901"
        }
      }
    }
  ]
}
```

These sample events contain placeholder values. You can modify these values to reference actual resources in your application or values to help with local testing.

To modify a sample event

1. You can modify sample events at the command prompt. To see your options, run the following:

```
$ sam local generate-event <service> <event> --help
```

   The following is an example:

```
$ sam local generate-event s3 put --help

Usage: sam local generate-event s3 put [OPTIONS]

Options:
  --region TEXT       Specify the region name you'd like, otherwise the
                      default = us-east-1
  --partition TEXT    Specify the partition name you'd like, otherwise the
                      default = aws
  --bucket TEXT       Specify the bucket name you'd like, otherwise the
                      default = example-bucket
  --key TEXT          Specify the key name you'd like, otherwise the default =
                      test/key
  --debug             Turn on debug logging to print debug message generated
                      by AWS SAM CLI and display timestamps.
  --config-file TEXT  Configuration file containing default parameter values.
                      [default: samconfig.toml]
  --config-env TEXT   Environment name specifying default parameter values in
                      the configuration file.  [default: default]
  -h, --help          Show this message and exit.
```

2. Use any of these options at the command prompt to modify your sample event payload. The following is an example:

```
$ sam local generate-event s3 put--bucket sam-s3-demo-bucket

{
  "Records": [
    {
      "eventVersion": "2.0",
```

```
      "eventSource": "aws:s3",
      "awsRegion": "us-east-1",
      "eventTime": "1970-01-01T00:00:00.000Z",
      "eventName": "ObjectCreated:Put",
      "userIdentity": {
        "principalId": "EXAMPLE"
      },
      "requestParameters": {
        "sourceIPAddress": "127.0.0.1"
      },
      "responseElements": {
        "x-amz-request-id": "EXAMPLE123456789",
        "x-amz-id-2": "EXAMPLE123/5678abcdefghijklambdaisawesome/
mnopqrstuvwxyzABCDEFGH"
      },
      "s3": {
        "s3SchemaVersion": "1.0",
        "configurationId": "testConfigRule",
        "bucket": {
          "name": "sam-s3-demo-bucket",
          "ownerIdentity": {
            "principalId": "EXAMPLE"
          },
          "arn": "arn:aws:s3:::sam-s3-demo-bucket"
        },
        "object": {
          "key": "test/key",
          "size": 1024,
          "eTag": "0123456789abcdef0123456789abcdef",
          "sequencer": "0A1B2C3D4E5F678901"
        }
      }
    }
  ]
}
```

Use generated events for local testing

Save your generated events locally and use other `sam local` subcommands to test.

To save your generated events locally

- Run the following:

```
$ sam local generate-event <service> <event> <event-option> > <filename.json>
```

  The following is an example of an event being saved as an `s3.json` file in the `events` folder of our project.

```
sam-app$ sam local generate-event s3 put --bucket amzn-s3-demo-bucket > events/
s3.json
```

To use a generated event for local testing

- Pass the event with other `sam local` subcommands by using the `--event` option.

  The following is an example of using the `s3.json` event to invoke our Lambda function locally:

```
sam-app$ sam local invoke --event events/s3.json S3JsonLoggerFunction

Invoking src/handlers/s3-json-logger.s3JsonLoggerHandler (nodejs18.x)
Local image is up-to-date
Using local image: public.ecr.aws/lambda/nodejs:18-rapid-x86_64.

Mounting /Users/.../sam-app/.aws-sam/build/S3JsonLoggerFunction as /var/
task:ro,delegated, inside runtime container
START RequestId: f4f45b6d-2ec6-4235-bc7b-495ec2ae0128 Version: $LATEST
END RequestId: f4f45b6d-2ec6-4235-bc7b-495ec2ae0128
REPORT RequestId: f4f45b6d-2ec6-4235-bc7b-495ec2ae0128  Init Duration: 1.23 ms
 Duration: 9371.93 ms      Billed Duration: 9372 ms        Memory Size: 128 MB
 Max Memory Used: 128 MB
```

Learn more

For a list of all `sam local generate-event` options, see sam local generate-event.

For a demo of using `sam local`, see AWS SAM for local development. Testing AWS Cloud resources from local development environments in the *Serverless Land Sessions with SAM series on YouTube*.

Introduction to testing with sam local invoke

Use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam local invoke` subcommand to initiate a one-time invocation of an AWS Lambda function locally.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For a list of `sam local invoke` command options, see sam local invoke.
- For an example of using `sam local invoke` during a typical development workflow, see Step 7: (Optional) Test your application locally.

> **Note**
>
> `sam local invoke` supports durable functions with automatic checkpointing and replay capabilities. When invoking durable functions locally, execution state is automatically managed.

Prerequisites

To use `sam local invoke`, install the AWS SAM CLI by completing the following:

- AWS SAM prerequisites.
- Install the AWS SAM CLI.

Before using `sam local invoke`, we recommend a basic understanding of the following:

- Configuring the AWS SAM CLI.
- Create your application in AWS SAM.
- Introduction to building with AWS SAM.
- Introduction to deploying with AWS SAM.

Invoke a Lambda function locally

When you run `sam local invoke`, the AWS SAM CLI assumes that your current working directory is your project's root directory. The AWS SAM CLI will first look for a `template.[yaml|yml]` file within a `.aws-sam` subfolder. If not found, the AWS SAM CLI will look for a `template.[yaml|yml]` file within your current working directory.

To invoke a Lambda function locally

1. From the root directory of your project, run the following:

```
$ sam local invoke <options>
```

2. If your application contains more than one function, provide the function's logical ID. The following is an example:

```
$ sam local invoke HelloWorldFunction
```

3. The AWS SAM CLI builds your function in a local container using Docker. It then invokes your function and outputs your function's response.

   The following is an example:

```
$ sam local invoke
Invoking app.lambda_handler (python3.9)
Local image is out of date and will be updated to the latest runtime. To skip this,
 pass in the parameter --skip-pull-image
Building
 image.....................................................................................
Using local image: public.ecr.aws/lambda/python:3.9-rapid-x86_64.

Mounting /Users/.../sam-app/.aws-sam/build/HelloWorldFunction as /var/
task:ro,delegated, inside runtime container
START RequestId: 64bf7e54-5509-4762-a97c-3d740498d3df Version: $LATEST
END RequestId: 64bf7e54-5509-4762-a97c-3d740498d3df
REPORT RequestId: 64bf7e54-5509-4762-a97c-3d740498d3df  Init Duration: 1.09 ms
  Duration: 608.42 ms       Billed Duration: 609 ms Memory Size: 128 MB     Max
 Memory Used: 128 MB
{"statusCode": 200, "body": "{\"message\": \"hello world\"}"}%
```

Managing logs

When using `sam local invoke`, the Lambda function runtime output (for example, logs) is output to `stderr`, and the Lambda function result is output to `stdout`.

The following is an example of a basic Lambda function:

```
def handler(event, context):
    print("some log") # this goes to stderr
    return "hello world" # this goes to stdout
```

You can save these standard outputs. The following is an example:

```
$ sam local invoke 1> stdout.log
...

$ cat stdout.log
"hello world"

$ sam local invoke 2> stderr.log
...

$ cat stderr.log
Invoking app.lambda_handler (python3.9)
Local image is up-to-date
Using local image: public.ecr.aws/lambda/python:3.9-rapid-x86_64.
Mounting /Users/.../sam-app/.aws-sam/build/HelloWorldFunction as /var/
task:ro,delegated, inside runtime container
START RequestId: 0b46e646-3bdf-4b58-8beb-242d00912c46 Version: $LATEST
some log
END RequestId: 0b46e646-3bdf-4b58-8beb-242d00912c46
REPORT RequestId: 0b46e646-3bdf-4b58-8beb-242d00912c46  Init Duration: 0.91 ms
 Duration: 589.19 ms Billed Duration: 590 ms Memory Size: 128 MB Max Memory Used: 128
 MB
```

You can use these standard outputs to further automate your local development processes.

Options

Pass custom events to invoke the Lambda function

To pass an event to the Lambda function, use the `--event` option. The following is an example:

```
$ sam local invoke --event events/s3.json S3JsonLoggerFunction
```

You can create events with the `sam local generate-event` subcommand. To learn more, see Introduction to testing with sam local generate-event.

Pass environment variables when invoking your Lambda function

If your Lambda function uses environment variables, you can pass them during local testing with the `--env-vars` option. This is a great way to test a Lambda function locally with services in your application that are already deployed in the cloud. The following is an example:

```
$ sam local invoke --env-vars locals.json
```

Specify a template or function

To specify a template for the AWS SAM CLI to reference, use the `--template` option. The AWS SAM CLI will load just that AWS SAM template and the resources it points to.

To invoke a function of a nested application or stack, provide the application or stack logical ID along with the function logical ID. The following is an example:

```
$ sam local invoke StackLogicalId/FunctionLogicalId
```

Test a Lambda function from your Terraform project

Use the `--hook-name` option to locally test Lambda functions from your Terraform projects. To learn more, see Using the AWS SAM CLI with Terraform for local debugging and testing.

The following is an example:

```
$ sam local invoke --hook-name terraform --beta-features
```

Best practices

If your application has a `.aws-sam` directory from running `sam build`, be sure to run `sam build` every time you update your function code. Then, run `sam local invoke` to locally test your updated function code.

Local testing is a great solution for quick development and testing before deploying to the cloud. However, local testing doesn't validate everything, such as permissions between your resources in the cloud. As much as possible, test your applications in the cloud. We recommend using `sam sync` to speed up your cloud testing workflows.

Examples

Generate an Amazon API Gateway sample event and use it to invoke a Lambda function locally

First, we generate an API Gateway HTTP API event payload and save it to our `events` folder.

```
$ sam local generate-event apigateway http-api-proxy > events/apigateway_event.json
```

Next, we modify our Lambda function to return a parameter value from the event.

```
def lambda_handler(event, context):
    print("HelloWorldFunction invoked")
    return {
        "statusCode": 200,
        "body": json.dumps({
            "message": event['queryStringParameters']['parameter2'],
        }),
    }
```

Next, we locally invoke our Lambda function and provide our custom event.

```
$ sam local invoke --event events/apigateway_event.json

Invoking app.lambda_handler (python3.9)
Local image is up-to-date
Using local image: public.ecr.aws/lambda/python:3.9-rapid-x86_64.

Mounting /Users/...sam-app/.aws-sam/build/HelloWorldFunction as /var/task:ro,delegated,
 inside runtime container
START RequestId: 59535d0d-3d9e-493d-8c98-6264e8e961b8 Version: $LATEST
some log
END RequestId: 59535d0d-3d9e-493d-8c98-6264e8e961b8
REPORT RequestId: 59535d0d-3d9e-493d-8c98-6264e8e961b8  Init Duration: 1.63 ms
 Duration: 564.07 ms       Billed Duration: 565 ms Memory Size: 128 MB     Max Memory
 Used: 128 MB
{"statusCode": 200, "body": "{\"message\": \"value\"}"}%
```

Pass environment variables when invoking a Lambda function locally

This application has a Lambda function that uses an environment variable for an Amazon DynamoDB table name. The following is an example of the function defined in the AWS SAM template:

```
AWSTemplateFormatVersion: 2010-09-09
Transform: AWS::Serverless-2016-10-31
...
Resources:
  getAllItemsFunction:
    Type: AWS::Serverless::Function
    Properties:
      Handler: src/get-all-items.getAllItemsHandler
      Description: get all items
      Policies:
        - DynamoDBReadPolicy:
            TableName: !Ref SampleTable
      Environment:
        Variables:
          SAMPLE_TABLE: !Ref SampleTable
...
```

We want to locally test our Lambda function while having it interact with our DynamoDB table in the cloud. To do this, we create our environment variables file and save it in our project's root directory as `locals.json`. The value provided here for `SAMPLE_TABLE` references our DynamoDB table in the cloud.

```
{
    "getAllItemsFunction": {
        "SAMPLE_TABLE": "dev-demo-SampleTable-1U991234LD5UM98"
    }
}
```

Next, we run `sam local invoke` and pass in our environment variables with the `--env-vars` option.

```
$ sam local invoke getAllItemsFunction --env-vars locals.json

Mounting /Users/...sam-app/.aws-sam/build/HelloWorldFunction as /var/task:ro,delegated,
 inside runtime container
START RequestId: 59535d0d-3d9e-493d-8c98-6264e8e961b8 Version: $LATEST
```

```
some log
END RequestId: 59535d0d-3d9e-493d-8c98-6264e8e961b8
REPORT RequestId: 59535d0d-3d9e-493d-8c98-6264e8e961b8  Init Duration: 1.63 ms
 Duration: 564.07 ms       Billed Duration: 565 ms Memory Size: 128 MB     Max Memory
 Used: 128 MB
{"statusCode":200,"body":"{}"}
```

Learn more

For a list of all `sam local invoke` options, see sam local invoke.

For a demo of using `sam local`, see AWS SAM for local development. Testing AWS Cloud resources from local development environments in the *Serverless Land Sessions with SAM series on YouTube*.

Introduction to testing with sam local start-api

Use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam local start-api` subcommand to run your AWS Lambda functions locally and test through a local HTTP server host. This type of test is helpful for Lambda functions that are invoked by an Amazon API Gateway endpoint.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For a list of `sam local start-api` command options, see sam local start-api.
- For an example of using `sam local start-api` during a typical development workflow, see Step 7: (Optional) Test your application locally.

> **Note**
>
> `sam local start-api` supports durable functions with automatic checkpointing and replay capabilities. Durable functions work seamlessly with the local API Gateway endpoint.

Prerequisites

To use `sam local start-api`, install the AWS SAM CLI by completing the following:

- AWS SAM prerequisites.
- Install the AWS SAM CLI.

Before using `sam local start-api`, we recommend a basic understanding of the following:

- Configuring the AWS SAM CLI.
- Create your application in AWS SAM.
- Introduction to building with AWS SAM.
- Introduction to deploying with AWS SAM.

Using sam local start-api

When you run `sam local start-api`, the AWS SAM CLI assumes that your current working directory is your project's root directory. The AWS SAM CLI will first look for a `template.[yaml|yml]` file within a `.aws-sam` subfolder. If not found, the AWS SAM CLI will look for a `template.[yaml|yml]` file within your current working directory.

To start a local HTTP server

1. From the root directory of your project, run the following:

```
$ sam local start-api <options>
```

2. The AWS SAM CLI builds your Lambda functions in a local Docker container. It then outputs the local address of your HTTP server endpoint. The following is an example:

```
$ sam local start-api

Initializing the lambda functions containers.
Local image is up-to-date
Using local image: public.ecr.aws/lambda/python:3.9-rapid-x86_64.

Mounting /Users/.../sam-app/.aws-sam/build/HelloWorldFunction as /var/
task:ro,delegated, inside runtime container
Containers Initialization is done.
Mounting HelloWorldFunction at http://127.0.0.1:3000/hello [GET]
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. If you used sam build before running local
 commands, you will need to re-run sam build for the changes to be picked up. You
 only need to restart SAM CLI if you update your AWS SAM template
2023-04-12 14:41:05 WARNING: This is a development server. Do not use it in a
 production deployment. Use a production WSGI server instead.
```

```
 * Running on http://127.0.0.1:3000
```

3. You can invoke your Lambda function through the browser or command prompt. The following is an example:

```
sam-app$ curl http://127.0.0.1:3000/hello
{"message": "Hello world!"}%
```

4. When you make changes to your Lambda function code, consider the following to refresh your local HTTP server:

   - If your application doesn't have a `.aws-sam` directory and your function uses an interpreted language, the AWS SAM CLI will automatically update your function by creating a new container and hosting it.
   - If your application does have a `.aws-sam` directory, you need to run `sam build` to update your function. Then run `sam local start-api` again to host the function.
   - If your function uses a compiled language or if your project requires complex packaging support, run your own build solution to update your function. Then run `sam local start-api` again to host the function.

Lambda functions that use Lambda authorizers

> **Note**
>
> This feature is new in AWS SAM CLI version 1.80.0. To upgrade, see Upgrading the AWS SAM CLI.

For Lambda functions that use Lambda authorizers, the AWS SAM CLI will automatically invoke your Lambda authorizer before invoking your Lambda function endpoint.

The following is an example of starting a local HTTP server for a function that uses a Lambda authorizer:

```
$ sam local start-api
2023-04-17 15:02:13 Attaching import module proxy for analyzing dynamic imports

AWS SAM CLI does not guarantee 100% fidelity between authorizers locally
and authorizers deployed on AWS. Any application critical behavior should
```

```
be validated thoroughly before deploying to production.

Testing application behaviour against authorizers deployed on AWS can be done using the
 sam sync command.

Mounting HelloWorldFunction at http://127.0.0.1:3000/authorized-request [GET]
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. If you used sam build before running local commands, you will
 need to re-run sam build for the changes to be picked up. You only need to restart SAM
 CLI if you update your AWS SAM template
2023-04-17 15:02:13 WARNING: This is a development server. Do not use it in a
 production deployment. Use a production WSGI server instead.
 * Running on http://127.0.0.1:3000
2023-04-17 15:02:13 Press CTRL+C to quit
```

When you invoke your Lambda function endpoint through the local HTTP server, the AWS SAM CLI first invokes your Lambda authorizer. If authorization is successful, the AWS SAM CLI will invoke your Lambda function endpoint. The following is an example:

```
$ curl http://127.0.0.1:3000/authorized-request --header "header:my_token"
{"message": "from authorizer"}%

Invoking app.authorizer_handler (python3.8)
Local image is up-to-date
Using local image: public.ecr.aws/lambda/python:3.8-rapid-x86_64.

Mounting /Users/.../sam-app/... as /var/task:ro,delegated, inside runtime container
START RequestId: 38d3b472-a2c8-4ea6-9a77-9b386989bef0 Version: $LATEST
END RequestId: 38d3b472-a2c8-4ea6-9a77-9b386989bef0
REPORT RequestId: 38d3b472-a2c8-4ea6-9a77-9b386989bef0    Init Duration: 1.08 ms
 Duration: 628.26 msBilled Duration: 629 ms    Memory Size: 128 MB    Max Memory Used:
 128 MB
Invoking app.request_handler (python3.8)
Using local image: public.ecr.aws/lambda/python:3.8-rapid-x86_64.

Mounting /Users/.../sam-app/... as /var/task:ro,delegated, inside runtime container
START RequestId: fdc12255-79a3-4365-97e9-9459d06446ff Version: $LATEST
END RequestId: fdc12255-79a3-4365-97e9-9459d06446ff
REPORT RequestId: fdc12255-79a3-4365-97e9-9459d06446ff    Init Duration: 0.95 ms
 Duration: 659.13 msBilled Duration: 660 ms    Memory Size: 128 MB    Max Memory Used:
 128 MB
No Content-Type given. Defaulting to 'application/json'.
```

```
2023-04-17 15:03:03 127.0.0.1 - - [17/Apr/2023 15:03:03] "GET /authorized-request
 HTTP/1.1" 200 -
```

Options

Continuously reuse containers to speed up local function invokes

By default, the AWS SAM CLI creates a new container each time your function is invoked through the local HTTP server. Use the `--warm-containers` option to automatically reuse your container for function invokes. This speeds up the time it takes for the AWS SAM CLI to prepare your Lambda function for local invocation. You can customize this option further by providing the `eager` or `lazy` argument.

- `eager` – Containers for all functions are loaded at startup and persist between invocations.
- `lazy` – Containers are only loaded when each function is first invoked. They then persist for additional invocations.

The following is an example:

```
$ sam local start-api --warm-containers eager
```

When using `--warm-containers` and modifying your Lambda function code:

- If your application has a `.aws-sam` directory, run `sam build` to update your function code in your application's build artifacts.
- When a code change is detected, the AWS SAM CLI automatically shuts down the Lambda function container.
- When you invoke the function again, the AWS SAM CLI automatically creates a new container.

Specify a container image to use for your Lambda functions

By default, the AWS SAM CLI uses Lambda base images from Amazon Elastic Container Registry (Amazon ECR) to invoke your functions locally. Use the `--invoke-image` option to reference a custom container image. The following is an example:

```
$ sam local start-api --invoke-image public.ecr.aws/sam/emu-python3.8
```

You can specify the function to use with the custom container image. The following is an example:

```
$ sam local start-api --invoke-image Function1=amazon/aws/sam-cli-emulation-image-
python3.8
```

Specify a template to locally test

To specify a template for the AWS SAM CLI to reference, use the `--template` option. The AWS SAM CLI will load just that AWS SAM template and the resources it points to. The following is an example:

```
$ sam local start-api --template myTemplate.yaml
```

Specify the host development environment of your Lambda function

By default, the `sam local start-api` subcommand creates an HTTP server using `localhost` with IP address `127.0.0.1`. You can customize these values if your local development environment is isolated from your local machine.

Use the `--container-host` option to specify a host. The following is an example:

```
$ sam local start-api --container-host host.docker.internal
```

Use the `--container-host-interface` option to specify the IP address of the host network that container ports should bind to. The following is an example:

```
$ sam local start-api --container-host-interface 0.0.0.0
```

Best practices

If your application has a `.aws-sam` directory from running `sam build`, be sure to run `sam build` every time you update your function code. Then, run `sam local start-api` to locally test your updated function code.

Local testing is a great solution for quick development and testing before deploying to the cloud. However, local testing doesn't validate everything, such as permissions between your resources in the cloud. As much as possible, test your applications in the cloud. We recommend using `sam sync` to speed up your cloud testing workflows.

Learn more

For a list of all `sam local start-api` options, see sam local start-api.

Introduction to testing with sam local start-lambda

Use the AWS SAM CLI subcommand `sam local start-lambda` to invoke your Lambda function through the AWS CLI and SDKs. This command starts a local endpoint that emulates Lambda.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For a list of `sam local start-lambda` command options, see sam local start-lambda.

> **Note**
>
> `sam local start-lambda` supports durable functions with automatic checkpointing and replay capabilities. Durable functions work seamlessly with the local Lambda endpoint.

Prerequisites

To use `sam local start-lambda`, install the AWS SAM CLI by completing the following:

- AWS SAM prerequisites.
- Install the AWS SAM CLI.

Before using `sam local start-lambda`, we recommend a basic understanding of the following:

- Configuring the AWS SAM CLI.
- Create your application in AWS SAM.
- Introduction to building with AWS SAM.
- Introduction to deploying with AWS SAM.

Using sam local start-lambda

When you run `sam local start-lambda`, the AWS SAM CLI assumes that your current working directory is your project's root directory. The AWS SAM CLI will first look for a `template.[yaml|`

yml] file within a .aws-sam subfolder. If not found, the AWS SAM CLI will look for a template.[yaml|yml] file within your current working directory.

To use sam local start-lambda

1. From the root directory of your project, run the following:

```
$ sam local start-lambda <options>
```

2. The AWS SAM CLI builds your Lambda functions in a local Docker container. It then outputs the local address to your HTTP server endpoint. The following is an example:

```
$ sam local start-lambda
Initializing the lambda functions containers.
Local image is up-to-date
Using local image: public.ecr.aws/lambda/python:3.9-rapid-x86_64.

Mounting /Users/.../sam-app/hello_world as /var/task:ro,delegated, inside runtime
 container
Containers Initialization is done.
Starting the Local Lambda Service. You can now invoke your Lambda Functions defined
 in your template through the endpoint.
2023-04-13 07:25:43 WARNING: This is a development server. Do not use it in a
 production deployment. Use a production WSGI server instead.
 * Running on http://127.0.0.1:3001
2023-04-13 07:25:43 Press CTRL+C to quit
```

3. Use the AWS CLI or SDKs to invoke your Lambda function locally.

   The following is an example using the AWS CLI:

```
$ aws lambda invoke --function-name "HelloWorldFunction" --endpoint-
url "http://127.0.0.1:3001" --no-verify-ssl out.txt

StatusCode: 200
(END)
```

   The following is an example using the AWS SDK for Python:

```
import boto3
from botocore.config import Config
from botocore import UNSIGNED
```

```
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=1,
                                           retries={'max_attempts': 0}
                                           )
                            )
lambda_client.invoke(FunctionName="HelloWorldFunction")
```

Options

Specify a template

To specify a template for the AWS SAM CLI to reference, use the `--template` option. The AWS SAM CLI will load just that AWS SAM template and the resources it points to. The following is an example:

```
$ sam local start-lambda --template myTemplate.yaml
```

For more information on AWS SAM templates, see AWS SAM template anatomy.

Best practices

If your application has a `.aws-sam` directory from running `sam build`, be sure to run `sam build` every time you update your function code. Then, run `sam local start-lambda` to locally test your updated function code.

Local testing is a great solution for quick development and testing before deploying to the cloud. However, local testing doesn't validate everything, such as permissions between your resources in the cloud. As much as possible, test your applications in the cloud. We recommend using `sam sync` to speed up your cloud testing workflows.

Learn more

For a list of all `sam local start-lambda` options, see sam local start-lambda.

Locally invoke Lambda functions with AWS SAM

Locally invoking a Lambda function before testing or deploying in the cloud can have a variety of benefits. It allows you to test the logic of your function faster. Testing locally first reduces the likelihood of identifying issues when testing in the cloud or during deployment, which can help you avoid unnecessary costs. Additionally, local testing makes debugging easier to do.

You can invoke your Lambda function locally by using the sam local invoke command and providing the function's logical ID and an event file. **sam local invoke** also accepts `stdin` as an event. For more information about events, see Event in the *AWS Lambda Developer Guide*. For information about event message formats from different AWS services, see Using AWS Lambda with other services in the *AWS Lambda Developer Guide*.

> **Note**
>
> The **sam local invoke** command corresponds to the AWS Command Line Interface (AWS CLI) command `aws lambda invoke`. You can use either command to invoke a Lambda function.

You must run the **sam local invoke** command in the project directory that contains the function that 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

To declare environment variables locally that override values defined in your templates, do the following:

1. Create a JSON file that contains the environment variables to override.
2. Use the `--env-vars` argument to override values defined in your templates.

Declaring environment variables

To declare environment variables that apply globally to all resources, specify a `Parameters` object like the following:

```
{
    "Parameters": {
        "TABLE_NAME": "localtable",
        "BUCKET_NAME": "amzn-s3-demo-bucket",
        "STAGE": "dev"
    }
}
```

To declare different environment variables for each resource, specify objects for each resource like the following:

```
{
    "MyFunction1": {
        "TABLE_NAME": "localtable",
        "BUCKET_NAME": "amzn-s3-demo-bucket",
    },
    "MyFunction2": {
        "TABLE_NAME": "localtable",
        "STAGE": "dev"
    }
}
```

When specifying objects for each resource, you can use the following identifiers, listed in order of highest to lowest precedence:

1. `logical_id`
2. `function_id`
3. `function_name`
4. Full path identifier

You can use both of the preceding methods of declaring environment variables together in a single file. When doing so, environment variables that you provided for specific resources take precedence over global environment variables.

Save your environment variables in a JSON file, such as `env.json`.

Overriding environment variable values

To override environment variables with those defined in your JSON file, use the `--env-vars` argument with the **invoke** or **start-api** commands. For example:

```
sam local invoke --env-vars env.json
```

Layers

If your application includes layers, for information about how to debug issues with layers on your local host, see Increase efficiency using Lambda layers with AWS SAM.

Learn more

For a hands-on example of invoking functions locally, see Module 2 - Run locally in *The Complete AWS SAM Workshop*.

Locally run API Gateway with AWS SAM

Locally running Amazon API Gateway can have a variety of benefits. For example, running API Gateway locally allows you to test API endpoints locally before deployment to the AWS cloud. If you test locally first, you can often reduce testing and development in the cloud, which can help reduce costs. Additionally, running locally makes debugging easier.

To start a local instance of API Gateway that you can use to test HTTP request/response functionality, use the `sam local start-api` AWS SAM CLI command. This functionality features hot reloading so that you can quickly develop and iterate over your functions.

> **Note**
>
> *Hot reloading* is when only the files that changed are refreshed, and the state of the application remains the same. In contrast, *live reloading* is when the entire application is refreshed, and the state of the application is lost.

For instructions on using the `sam local start-api` command, see Introduction to testing with sam local start-api.

By default, AWS SAM uses AWS Lambda proxy integrations and supports both `HttpApi` and `Api` resource types. For more information about proxy integrations for `HttpApi` resource types, see Working with AWS Lambda proxy integrations for HTTP APIs in the *API Gateway Developer Guide*. For more information about proxy integrations with `Api` resource types, see Understand API Gateway Lambda proxy integration in the *API Gateway Developer Guide*.

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 the function 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: python3.9
    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"
    });
}
```

If you modify your function's code, run the `sam build` command for `sam local start-api` to detect your changes.

Environment variable file

To declare environment variables locally that override values defined in your templates, do the following:

1. Create a JSON file that contains the environment variables to override.
2. Use the `--env-vars` argument to override values defined in your templates.

Declaring environment variables

To declare environment variables that apply globally to all resources, specify a `Parameters` object like the following:

```
{
    "Parameters": {
        "TABLE_NAME": "localtable",
        "BUCKET_NAME": "amzn-s3-demo-bucket",
        "STAGE": "dev"
    }
}
```

To declare different environment variables for each resource, specify objects for each resource like the following:

```
{
    "MyFunction1": {
        "TABLE_NAME": "localtable",
        "BUCKET_NAME": "amzn-s3-demo-bucket",
    },
    "MyFunction2": {
        "TABLE_NAME": "localtable",
        "STAGE": "dev"
    }
}
```

When specifying objects for each resource, you can use the following identifiers, listed in order of highest to lowest precedence:

1. `logical_id`
2. `function_id`
3. `function_name`
4. Full path identifier

You can use both of the preceding methods of declaring environment variables together in a single file. When doing so, environment variables that you provided for specific resources take precedence over global environment variables.

Save your environment variables in a JSON file, such as `env.json`.

Overriding environment variable values

To override environment variables with those defined in your JSON file, use the `--env-vars` argument with the **invoke** or **start-api** commands. For example:

```
$ sam local start-api --env-vars env.json
```

Layers

If your application includes layers, for information about how to debug issues with layers on your local host, see Increase efficiency using Lambda layers with AWS SAM.

Introduction to cloud testing with sam remote test-event

Use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam remote test-event` command to access and manage shareable test events for your AWS Lambda functions.

To learn more about shareable test events, see Shareable test events in the *AWS Lambda Developer Guide*.

Topics

- Set up the AWS SAM CLI to use sam remote test-event
- Using the sam remote test-event command
- Using shareable test events
- Managing shareable test events

Prerequisites

To use `sam remote test-event`, install the AWS SAM CLI by completing the following:

- AWS SAM prerequisites.
- Install the AWS SAM CLI.

If you already have the AWS SAM CLI installed, we recommend upgrading to the latest version of the AWS SAM CLI version. To learn more, see Upgrading the AWS SAM CLI.

Before using `sam remote test-event`, we recommend a basic understanding of the following:

- Configuring the AWS SAM CLI.
- Create your application in AWS SAM.
- Introduction to building with AWS SAM.
- Introduction to deploying with AWS SAM.
- Introduction to using sam sync to sync to AWS Cloud.

Set up the AWS SAM CLI to use sam remote test-event

Complete the following set up steps to use the AWS SAM CLI `sam remote test-event` command:

1. **Configure the AWS SAM CLI to use your AWS account** – Shareable test events for Lambda can be accessed and managed by users within the same AWS account. To configure the AWS SAM CLI to use your AWS account, see Configuring the AWS SAM CLI.
2. **Configure permissions for shareable test events** – To access and manage shareable test events, you must have the proper permissions. To learn more, see Shareable test events in the *AWS Lambda Developer Guide*.

Using the sam remote test-event command

The AWS SAM CLI `sam remote test-event` command provides the following subcommands that you can use to access and manage your shareable test events:

- `delete` – Delete a shareable test event from the Amazon EventBridge schema registry.

- `get` – Get a shareable test event from the EventBridge schema registry.
- `list` – List the existing shareable test events for a function from the EventBridge schema registry.
- `put` – Save an event from a local file to the EventBridge schema registry.

To list these subcommands using the AWS SAM CLI, run the following:

```
$ sam remote test-event --help
```

Deleting shareable test events

You can delete a shareable test event by using the `delete` subcommand along with the following:

- Provide the name of the shareable test event to delete.
- Provide an acceptable ID of the Lambda function associated with the event.
- If you are providing the Lambda function logical ID, you must also provide the AWS CloudFormation stack name associated with the Lambda function.

The following is an example:

```
$ sam remote test-event delete HelloWorldFunction --stack-name sam-app --name demo-
event
```

For a list of options to use with the `delete` subcommand, see sam remote test-event delete. You can also run the following from the AWS SAM CLI:

```
$ sam remote test-event delete --help
```

Getting shareable test events

You can get a shareable test event from the EventBridge schema registry by using the `get` subcommand along with the following:

- Provide the name of the shareable test event to get.
- Provide an acceptable ID of the Lambda function associated with the event.
- If you are providing the Lambda function logical ID, you must also provide the AWS CloudFormation stack name associated with the Lambda function.

The following is an example that gets a shareable test event named `demo-event` that is associated with the `HelloWorldFunction` Lambda function of the `sam-app` stack. This command will print the event to your console.

```
$ sam remote test-event get HelloWorldFunction --stack-name sam-app --name demo-event
```

To get a shareable test event and save it to your local machine, use the `--output-file` option and provide a file path and name. The following is an example that saves `demo-event` as `demo-event.json` in the current working directory:

```
$ sam remote test-event get HelloWorldFunction --stack-name sam-app --name demo-event
 --output-file demo-event.json
```

For a list of options to use with the `get` subcommand, see sam remote test-event get. You can also run the following from the AWS SAM CLI:

```
$ sam remote test-event get --help
```

Listing shareable test events

You can list all shareable test events for a particular Lambda function from the schema registry. Use the `list` subcommand along with the following:

- Provide an acceptable ID of the Lambda function associated with the events.
- If you are providing the Lambda function logical ID, you must also provide the CloudFormation stack name associated with the Lambda function.

The following is an example that obtains a list of all shareable test events associated with the `HelloWorldFunction` Lambda function of the `sam-app` stack:

```
$ sam remote test-event list HelloWorldFunction --stack-name sam-app
```

For a list of options to use with the `list` subcommand, see sam remote test-event list. You can also run the following from the AWS SAM CLI:

```
$ sam remote test-event list --help
```

Saving shareable test events

You can save shareable test events to the EventBridge schema registry. Use the `put` subcommand along with the following:

- Provide an acceptable ID of the Lambda function associated with the shareable test event.
- Provide a name for the shareable test event.
- Provide the file path and name to the local event to upload.

The following is an example that saves the local `demo-event.json` event as `demo-event` and associates it with the `HelloWorldFunction` Lambda function of the `sam-app` stack:

```
$ sam remote test-event put HelloWorldFunction --stack-name sam-app --name demo-event
 --file demo-event.json
```

If a shareable test event with the same name exists in the EventBridge schema registry, the AWS SAM CLI will not overwrite it. To overwrite, add the `--force` option to your command.

For a list of options to use with the `put` subcommand, see sam remote test-event put. You can also run the following from the AWS SAM CLI:

```
$ sam remote test-event put --help
```

Using shareable test events

Use shareable test events to test your Lambda functions in the AWS Cloud with the `sam remote invoke` command. To learn more, see Pass shareable test events to a Lambda function in the cloud.

Managing shareable test events

This topic contains examples on how you can manage and use shareable test events.

Get a shareable test event, modify it, and use it

You can get a shareable test event from the EventBridge schema registry, modify it locally, and use the local test event with your Lambda function in the AWS Cloud. The following is an example:

1. **Retrieve the shareable test event** – Use the `sam remote test-event get` subcommand to retrieve a shareable test event for a specific Lambda function and save it locally:

```
$ sam remote test-event get HelloWorldFunction --stack-name sam-app --name demo-event
 --output-file demo-event.json
```

2. **Modify the shareable test event** – Use a text editor of your choice to modify the shareable test event.
3. **Use the shareable test event** – Use the `sam remote invoke` command and provide the file path and name of the event with `--event-file`:

```
$ sam remote invoke HelloWorldFunction --stack-name sam-app --event-file demo-
event.json
```

Get a shareable test event, modify it, upload it, and use it

You can get a shareable test event from the EventBridge schema registry, modify it locally, and upload it. Then, you can pass the shareable test event directly to your Lambda function in the AWS Cloud. The following is an example:

1. **Retrieve the shareable test event** – Use the `sam remote test-event get` subcommand to retrieve a shareable test event for a specific Lambda function and save it locally:

```
$ sam remote test-event get HelloWorldFunction --stack-name sam-app --name demo-event
 --output-file demo-event.json
```

2. **Modify the shareable test event** – Use a text editor of your choice to modify the shareable test event.
3. **Upload the shareable test event** – Use the `sam remote test-event put` subcommand to upload and save the shareable test event to the EventBridge schema registry. In this example, we use the `--force` option to overwrite an older version of our shareable test:

```
$ sam remote test-event put HelloWorldFunction --stack-name sam-app --name demo-event
 --file demo-event.json --force
```

4. **Pass the shareable test event to your Lambda function** – Use the `sam remote invoke` command to pass the shareable test event directly to your Lambda function in the AWS Cloud:

```
$ sam remote invoke HelloWorldFunction --stack-name sam-app --test-event-name demo-
event
```

Introduction to testing in the cloud with sam remote invoke

Use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam remote invoke` command to interact with supported AWS resources in the AWS Cloud. You can use `sam remote invoke` to invoke the following resources:

- **Amazon Kinesis Data Streams** – Send data records to Kinesis Data Streams applications.
- **AWS Lambda** – Invoke and pass events to your Lambda functions.
- **Amazon Simple Queue Service (Amazon SQS)** – Send messages to Amazon SQS queues.
- **AWS Step Functions** – Invoke Step Functions state machines to start execution.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

For an example of using `sam remote invoke` during a typical development workflow, see Step 5: Interact with your function in the AWS Cloud.

Topics

- Using the sam remote invoke command
- Using sam remote invoke command options
- Configure your project configuration file
- Examples
- Related links

Prerequisites

To use `sam remote invoke`, install the AWS SAM CLI by completing the following:

- AWS SAM prerequisites.
- Install the AWS SAM CLI.

We also recommend upgrading to the latest version of the AWS SAM CLI. To learn more, see Upgrading the AWS SAM CLI.

Before using `sam remote invoke`, we recommend a basic understanding of the following:

- Configuring the AWS SAM CLI.
- Create your application in AWS SAM.
- Introduction to building with AWS SAM.
- Introduction to deploying with AWS SAM.
- Introduction to using sam sync to sync to AWS Cloud.

Using the sam remote invoke command

Before using this command, your resource must be deployed to the AWS Cloud.

Use the following command structure and run from your project's root directory:

```
$ sam remote invoke <arguments> <options>
```

> **Note**
>
> This page will show options being provided at the command prompt. You can also configure options in your project's configuration file instead of passing them at the command prompt. To learn more, Configure project settings.

For a description of `sam remote invoke` arguments and options, see sam remote invoke.

Using with Kinesis Data Streams

You can send data records to a Kinesis Data Streams application. The AWS SAM CLI will send your data record and return a shard ID and sequence number. The following is an example:

```
$ sam remote invoke KinesisStream --stack-name kinesis-example --event hello-world

 Putting record to Kinesis data stream KinesisStream

 Auto converting value 'hello-world' into JSON '"hello-world"'. If you don't want auto-
conversion, please provide
```

```
a JSON string as event

{
  "ShardId": "shardId-000000000000",
  "SequenceNumber": "49646251411914806775980850790050483811301135051202232322"
}%
```

To send a data record

1. Provide a resource ID value as an argument for your Kinesis Data Streams application. For information on valid resource IDs, see Resource ID.
2. Provide the data record as an event to send to your Kinesis Data Streams application. You can provide the event at the command line using the `--event` option, or from a file using `--event-file`. If you don't provide an event, the AWS SAM CLI sends an empty event.

Using with Lambda functions

You can invoke a Lambda function in the cloud and pass an empty event or provide an event at the command line or from a file. The AWS SAM CLI will invoke your Lambda function and return its response. The following is an example:

```
$ sam remote invoke HelloWorldFunction --stack-name sam-app

Invoking Lambda Function HelloWorldFunction
START RequestId: d5ef494b-5f45-4086-86fd-d7322fa1a1f9 Version: $LATEST
END RequestId: d5ef494b-5f45-4086-86fd-d7322fa1a1f9
REPORT RequestId: d5ef494b-5f45-4086-86fd-d7322fa1a1f9  Duration: 6.62 ms       Billed
 Duration: 7 ms     Memory Size: 128 MB     Max Memory Used: 67 MB  Init Duration:
 164.06 ms
{"statusCode":200,"body":"{\"message\":\"hello world\"}"}%
```

To invoke a Lambda function

1. Provide a resource ID value as an argument for your Lambda function. For information on valid resource IDs, see Resource ID.
2. Provide an event to send to your Lambda function. You can provide the event at the command line using the `--event` option, or from a file using `--event-file`. If you don't provide an event, the AWS SAM CLI sends an empty event.

Lambda functions configured with response streaming

The `sam remote invoke` command supports Lambda functions that are configured to stream responses. You can configure a Lambda function to stream responses using the `FunctionUrlConfig` property in your AWS SAM templates. When you use `sam remote invoke`, the AWS SAM CLI will automatically detect your Lambda configuration and invoke with response streaming.

For an example, see Invoke a Lambda function configured to stream responses.

Pass shareable test events to a Lambda function in the cloud

Shareable test events are test events that you can share with others in the same AWS account. To learn more, see Shareable test events in the *AWS Lambda Developer Guide*.

Accessing and managing shareable test events

You can use the AWS SAM CLI `sam remote test-event` command to access and manage shareable test events. For example, you can use `sam remote test-event` to do the following:

- Retrieve shareable test events from the Amazon EventBridge schema registry.
- Modify shareable test events locally and upload them to the EventBridge schema registry.
- Delete shareable test events from the EventBridge schema registry.

To learn more, see Introduction to cloud testing with sam remote test-event.

Pass a shareable test event to a Lambda function in the cloud

To pass a shareable test event from the EventBridge schema registry to your Lambda function in the cloud, use the `--test-event-name` option and provide the name of the shareable test event. The following is an example:

```
$ sam remote invoke HelloWorldFunction --stack-name sam-app --test-event-name demo-
event
```

If you save the shareable test event locally, you can use the `--event-file` option and provide the file path and name of the local test event. The following is an example:

```
$ sam remote invoke HelloWorldFunction --stack-name sam-app --event-file demo-
event.json
```

Using with Amazon SQS

You can send messages to Amazon SQS queues. The AWS SAM CLI returns the following:

- Message ID
- MD5 of message body
- Response metadata

The following is an example:

```
$ sam remote invoke MySqsQueue --stack-name sqs-example -event hello

Sending message to SQS queue MySqsQueue

{
  "MD5OfMessageBody": "5d41402abc4b2a76b9719d911017c592",
  "MessageId": "05c7af65-9ae8-4014-ae28-809d6d8ec652"
}%
```

To send a message

1. Provide a resource ID value as an argument for the Amazon SQS queue. For information on valid resource IDs, see Resource ID.
2. Provide an event to send to your Amazon SQS queue. You can provide the event at the command line using the `--event` option, or from a file using `--event-file`. If you don't provide an event, the AWS SAM CLI sends an empty event.

Using with Step Functions

You can invoke a Step Functions state machine to start execution. The AWS SAM CLI will wait for the state machine workflow to complete and return an output of the last step in the execution. The following is an example:

```
$ sam remote invoke HelloWorldStateMachine --stack-name state-machine-example --
event '{"is_developer": true}'

Invoking Step Function HelloWorldStateMachine
```

```
"Hello Developer World"%
```

To invoke a state machine

1. Provide a resource ID value as an argument for the Step Functions state machine. For information on valid resource IDs, see Resource ID.
2. Provide an event to send to your state machine. You can provide the event at the command line using the `--event` option, or from a file using `--event-file`. If you don't provide an event, the AWS SAM CLI sends an empty event.

Using sam remote invoke command options

This section covers some of the main options that you can use with the `sam remote invoke` command. For a full list of options, see sam remote invoke.

Pass an event to your resource

Use the following options to pass events to your resources in the cloud:

- `--event` – Pass an event at the command line.
- `--event-file` – Pass an event from a file.

Lambda examples

Use `--event` to pass an event at the command line as a string value:

```
$ sam remote invoke HelloWorldFunction --stack-name sam-app --event '{"message":
 "hello!"}'

Invoking Lambda Function HelloWorldFunction


START RequestId: b992292d-1fac-4aa2-922a-c9dc5c6fceab Version: $LATEST
END RequestId: b992292d-1fac-4aa2-922a-c9dc5c6fceab
REPORT RequestId: b992292d-1fac-4aa2-922a-c9dc5c6fceab  Duration: 16.41 ms      Billed
 Duration: 17 ms  Memory Size: 128 MB     Max Memory Used: 67 MB  Init Duration: 185.96
 ms
{"statusCode":200,"body":"{\"message\":\"hello!\"}"}%
```

Use `--event-file` to pass an event from a file and provide the path to the file:

```
$ cat event.json

{"message": "hello from file"}%

$ sam remote invoke HelloWorldFunction --stack-name sam-app --event-file event.json


Invoking Lambda Function HelloWorldFunction


START RequestId: 3bc71f7d-153a-4b1e-8c9a-901d91b1bec9 Version: $LATEST
END RequestId: 3bc71f7d-153a-4b1e-8c9a-901d91b1bec9
REPORT RequestId: 3bc71f7d-153a-4b1e-8c9a-901d91b1bec9  Duration: 21.15 ms      Billed
 Duration: 22 ms  Memory Size: 128 MB     Max Memory Used: 67 MB
{"statusCode":200,"body":"{\"message\":\"hello from file\"}"}%
```

Pass an event using `stdin`:

```
$ cat event.json

{"message": "hello from file"}%

$ cat event.json | sam remote invoke HelloWorldFunction --stack-name sam-app --event-
file -

Reading event from stdin (you can also pass it from file with --event-file)

Invoking Lambda Function HelloWorldFunction

START RequestId: 85ecc902-8ad0-4a2b-a8c8-9bb4f65f5a7a Version: $LATEST
END RequestId: 85ecc902-8ad0-4a2b-a8c8-9bb4f65f5a7a
REPORT RequestId: 85ecc902-8ad0-4a2b-a8c8-9bb4f65f5a7a  Duration: 1.36 ms       Billed
 Duration: 2 ms   Memory Size: 128 MB       Max Memory Used: 67 MB
{"statusCode":200,"body":"{\"message\":\"hello from file\"}"}%
```

Configure the AWS SAM CLI response output

When you invoke a supported resource with `sam remote invoke`, the AWS SAM CLI returns a response that contains the following:

- **Request metadata** – Metadata associated with the request. This includes a request ID and request start time.

- **Resource response** – The response from your resource after being invoked in the cloud.

You can use the `--output` option to configure the AWS SAM CLI output response. The following option values are available:

- `json` – Metadata and resource response are returned in a JSON structure. The response contains the full SDK output.
- `text` – Metadata is returned in text structure. The resource response is returned in the output format of the resource.

The following is an example of a `json` output:

```
$ sam remote invoke --stack-name sam-app --output json

Invoking Lambda Function HelloWorldFunction


{
  "ResponseMetadata": {
    "RequestId": "3bdf9a30-776d-4a90-94a6-4cccc0fc7b41",
    "HTTPStatusCode": 200,
    "HTTPHeaders": {
      "date": "Mon, 19 Jun 2023 17:15:46 GMT",
      "content-type": "application/json",
      "content-length": "57",
      "connection": "keep-alive",
      "x-amzn-requestid": "3bdf9a30-776d-4a90-94a6-4cccc0fc7b41",
      "x-amzn-remapped-content-length": "0",
      "x-amz-executed-version": "$LATEST",
      "x-amz-log-result":
 "U1RBUlQgUmVxdWVzdElkOiAzYmRmOWEzMC03NzZkLTRhOTAtOTRhNi00Y2NjYzBmYzdiNDEgVmVyc2lvbjogJExBVEVTV
      "x-amzn-trace-id":
 "root=1-64908d42-17dab270273fcc6b527dd6b8;sampled=0;lineage=2301f8dc:0"
    },
    "RetryAttempts": 0
  },
  "StatusCode": 200,
  "LogResult":
 "U1RBUlQgUmVxdWVzdElkOiAzYmRmOWEzMC03NzZkLTRhOTAtOTRhNi00Y2NjYzBmYzdiNDEgVmVyc2lvbjogJExBVEVTV
  "ExecutedVersion": "$LATEST",
  "Payload": "{\"statusCode\":200,\"body\":\"{\\\"message\\\":\\\"hello world\\\"}\"}"
```

```
}%
```

When you specify a `json` output, the entire response is returned to `stdout`. The following is an example:

```
$ sam remote invoke --stack-name sam-app --output json 1> stdout.log

Invoking Lambda Function HelloWorldFunction




$ cat stdout.log

{
  "ResponseMetadata": {
    "RequestId": "d30d280f-8188-4372-bc94-ce0f1603b6bb",
    "HTTPStatusCode": 200,
    "HTTPHeaders": {
      "date": "Mon, 19 Jun 2023 17:35:56 GMT",
      "content-type": "application/json",
      "content-length": "57",
      "connection": "keep-alive",
      "x-amzn-requestid": "d30d280f-8188-4372-bc94-ce0f1603b6bb",
      "x-amzn-remapped-content-length": "0",
      "x-amz-executed-version": "$LATEST",
      "x-amz-log-result":
 "U1RBUlQgUmVxdWVzdElkOiBkMzBkMjgwZi04MTg4LTQzNzItYmM5NC1jZTBmMTYwM2I2YmIgVmVyc2lvbjogJExBVEVTV
      "x-amzn-trace-id":
 "root=1-649091fc-771473c7778689627a6122b7;sampled=0;lineage=2301f8dc:0"
    },
    "RetryAttempts": 0
  },
  "StatusCode": 200,
  "LogResult":
 "U1RBUlQgUmVxdWVzdElkOiBkMzBkMjgwZi04MTg4LTQzNzItYmM5NC1jZTBmMTYwM2I2YmIgVmVyc2lvbjogJExBVEVTV
  "ExecutedVersion": "$LATEST",
  "Payload": "{\"statusCode\":200,\"body\":\"{\\\"message\\\":\\\"hello world\\\"}\"}"
}%
```

The following is an example of a `text` output:

```
$ sam remote invoke --stack-name sam-app --output text
```

```
Invoking Lambda Function HelloWorldFunction


START RequestId: 4dbacc43-1ec6-47c2-982b-9dc4620144d6 Version: $LATEST
END RequestId: 4dbacc43-1ec6-47c2-982b-9dc4620144d6
REPORT RequestId: 4dbacc43-1ec6-47c2-982b-9dc4620144d6  Duration: 9.13 ms       Billed
 Duration: 10 ms  Memory Size: 128 MB     Max Memory Used: 67 MB  Init Duration: 165.50
 ms
{"statusCode":200,"body":"{\"message\":\"hello world\"}"}%
```

When you specify a `text` output, the Lambda function runtime output (for example, logs) is returned to `stderr`. The Lambda function payload is returned to `stdout`. The following is an example:

```
$ sam remote invoke --stack-name sam-app --output text 2> stderr.log

{"statusCode":200,"body":"{\"message\":\"hello world\"}"}%



$ cat stderr.log

Invoking Lambda Function HelloWorldFunction
START RequestId: 82273c3b-aa3a-4d16-8f1c-1d2ad3ace891 Version: $LATEST
END RequestId: 82273c3b-aa3a-4d16-8f1c-1d2ad3ace891
REPORT RequestId: 82273c3b-aa3a-4d16-8f1c-1d2ad3ace891  Duration: 40.62 ms      Billed
 Duration: 41 ms  Memory Size: 128 MB     Max Memory Used: 68 MB

$ sam remote invoke --stack-name sam-app --output text 1> stdout.log

Invoking Lambda Function HelloWorldFunction


START RequestId: 74acaa9f-5b80-4a5c-b3b8-ffaccb84cbbd Version: $LATEST
END RequestId: 74acaa9f-5b80-4a5c-b3b8-ffaccb84cbbd
REPORT RequestId: 74acaa9f-5b80-4a5c-b3b8-ffaccb84cbbd  Duration: 2.31 ms       Billed
 Duration: 3 ms   Memory Size: 128 MB     Max Memory Used: 67 MB

$ cat stdout.log

{"statusCode":200,"body":"{\"message\":\"hello world\"}"}%
```

Customize Boto3 parameters

For `sam remote invoke`, the AWS SAM CLI utilizes the AWS SDK for Python (Boto3) to interact with your resources in the cloud. You can use the `--parameter` option to customize Boto3 parameters. For a list of supported parameters that you can customize, see `--parameter`.

Examples

Invoke a Lambda function to validate parameter values and verify permissions:

```
$ sam remote invoke HelloWorldFunction --stack-name sam-app --
parameter InvocationType="DryRun"
```

Use the `--parameter` option multiple times in a single command to provide multiple parameters:

```
$ sam remote invoke HelloWorldFunction --stack-name sam-app --
parameter InvocationType="Event" --parameter LogType="None"
```

Other options

For a full list of `sam remote invoke` options, see sam remote invoke.

Configure your project configuration file

To configure `sam remote invoke` in your configuration file, use `remote_invoke` in your table. The following is an example of a `samconfig.toml` file that configures default values for the `sam remote invoke` command.

```
...
version =0.1

[default]
...
[default.remote_invoke.parameters]
stack_name = "cloud-app"
event = '{"message": "Hello!"}'
```

Examples

For a basic example of using `sam remote invoke`, see Testing AWS Lambda functions with AWS SAM remote in the *AWS Compute Blog*.

Kinesis Data Streams examples

Basic examples

Send a data record to a Kinesis Data Streams application from a file. The Kinesis Data Streams application is identified by providing an ARN for the resource ID:

```
$ sam remote invoke arn:aws:kinesis:us-west-2:01234567890:stream/kinesis-example-KinesisStream-BgnLcAey4xUQ --event-file event.json
```

Send an event provided at the command line to a Kinesis Data Streams application:

```
$ sam remote invoke KinesisStream --stack-name kinesis-example --event hello-world

Putting record to Kinesis data stream KinesisStream

Auto converting value 'hello-world' into JSON '"hello-world"'. If you don't want auto-conversion, please provide
a JSON string as event

{
  "ShardId": "shardId-000000000000",
  "SequenceNumber": "49646251411914806775980903986194508740483329854174920706"
}%
```

Obtain the physical ID of the Kinesis Data Streams application. Then, provide an event at the command line:

```
$ sam list resources --stack-name kinesis-example --output json

[
  {
    "LogicalResourceId": "KinesisStream",
    "PhysicalResourceId": "kinesis-example-KinesisStream-ZgnLcQey4xUQ"
  }
]
```

```
$ sam remote invoke kinesis-example-KinesisStream-ZgnLcQey4xUQ --event hello

Putting record to Kinesis data stream KinesisStream

Auto converting value 'hello' into JSON '"hello"'. If you don't want auto-conversion,
 please provide a JSON
string as event

{
  "ShardId": "shardId-000000000000",
  "SequenceNumber": "49646251411914806775980904340716841045751814812900261890"
}%
```

Provide a JSON string at the command line as an event:

```
$ sam remote invoke KinesisStream --stack-name kinesis-example --event '{"method":
 "GET", "body": ""}'

Putting record to Kinesis data stream KinesisStream

{
  "ShardId": "shardId-000000000000",
  "SequenceNumber": "49646251411914806775980904492868617924990209230536441858"
}%
```

Send an empty event to the Kinesis Data Streams application:

```
$ sam remote invoke KinesisStream --stack-name kinesis-example

Putting record to Kinesis data stream KinesisStream

{
  "ShardId": "shardId-000000000000",
  "SequenceNumber": "49646251411914806775980904866469008589597168190416224258"
}%
```

Return the AWS SAM CLI response in JSON format:

```
$ sam remote invoke KinesisStream --stack-name kinesis-example --event '{"hello":
 "world"}' --output json
```

```
Putting record to Kinesis data stream KinesisStream

{
  "ShardId": "shardId-000000000000",
  "SequenceNumber": "49646251411914806775980905078409420803696667195489648642",
  "ResponseMetadata": {
    "RequestId": "ebbbd307-3e9f-4431-b67c-f0715e9e353e",
    "HTTPStatusCode": 200,
    "HTTPHeaders": {
      "x-amzn-requestid": "ebbbd307-3e9f-4431-b67c-f0715e9e353e",
      "x-amz-id-2": "Q3yBcgTwtPaQTV26IKclbECmZikUYOzKY+CzcxA84ZHgCkc5T2N/
ITWg6RPOQcWw8Gn0tNPcEJBEHyVVqboJAPgCritqsvCu",
      "date": "Thu, 09 Nov 2023 18:13:10 GMT",
      "content-type": "application/x-amz-json-1.1",
      "content-length": "110"
    },
    "RetryAttempts": 0
  }
}%
```

Return the JSON output to stdout:

```
$ sam remote invoke KinesisStream --stack-name kinesis-example --event '{"hello":
 "world"}' --output json 1> stdout.log

Putting record to Kinesis data stream KinesisStream


$ cat stdout.log
{
  "ShardId": "shardId-000000000000",
  "SequenceNumber": "49646251411914806775980906397777867595039988349006774274",
  "ResponseMetadata": {
    "RequestId": "f4290006-d84b-b1cd-a9ee-28306eeb2939",
    "HTTPStatusCode": 200,
    "HTTPHeaders": {
      "x-amzn-requestid": "f4290006-d84b-b1cd-a9ee-28306eeb2939",
      "x-amz-id-2": "npCqz
+IBKpoL4sQ1ClbUmxuJlbeA24Fx1UgpIrS6mm2NoIeV2qdZSN5AhNurdssykXajBrXaC9anMhj2eG/h7Hnbf
+bPuotU",
      "date": "Thu, 09 Nov 2023 18:33:26 GMT",
      "content-type": "application/x-amz-json-1.1",
      "content-length": "110"
```

```
    },
    "RetryAttempts": 0
  }
}%
```

Lambda examples

Basic examples

Invoke a Lambda function by providing the ARN as a resource ID:

```
$ sam remote invoke arn:aws:lambda:us-west-2:012345678910:function:sam-app-
HelloWorldFunction-ohRFEn2RuAvp
```

Invoke a Lambda function by providing the logical ID as a resource ID:

You must also provide the CloudFormation stack name using the `--stack-name` option. The following is an example:

```
$ sam remote invoke HelloWorldFunction --stack-name sam-app
```

If your application contains a single Lambda function, you don't have to specify it's logical ID. You can provide the `--stack-name` option only. The following is an example:

```
$ sam remote invoke --stack-name sam-app
```

Invoke a Lambda function by providing the physical ID as a resource ID:

The physical ID gets created when you deploy using CloudFormation.

```
$ sam remote invoke sam-app-HelloWorldFunction-TZvxQRFNv0k4
```

Invoke a Lambda function of a child stack:

For this example, our application contains the following directory structure:

```
lambda-example
### childstack
#   ### function
#   #   ### __init__.py
#   #   ### app.py
#   #   ### requirements.txt
```

```
#   ### template.yaml
### events
#   ### event.json
### samconfig.toml
### template.yaml
```

To invoke the Lambda function of our `childstack`, we run the following:

```
$ sam remote invoke ChildStack/HelloWorldFunction --stack-name lambda-example

Invoking Lambda Function HelloWorldFunction

START RequestId: 207a864b-e67c-4307-8478-365b004d4bcd Version: $LATEST
END RequestId: 207a864b-e67c-4307-8478-365b004d4bcd
REPORT RequestId: 207a864b-e67c-4307-8478-365b004d4bcd  Duration: 1.27 ms       Billed
 Duration: 2 ms   Memory Size: 128 MB     Max Memory Used: 36 MB  Init Duration: 111.07
 ms
{"statusCode": 200, "body": "{\"message\": \"Hello\", \"received_event\": {}}"}%
```

Invoke a Lambda function configured to stream responses

In this example, we use the AWS SAM CLI to initialize a new serverless application that contains a Lambda function configured to stream its response. We deploy our application to the AWS Cloud and use the `sam remote invoke` to interact with our function in the cloud.

We start by running the `sam init` command to create a new serverless application. We select the **Lambda Response Streaming** quick start template and name our application **lambda-streaming-nodejs-app**.

```
$ sam init

 You can preselect a particular runtime or package type when using the `sam init`
 experience.
 Call `sam init --help` to learn more.

 Which template source would you like to use?
        1 - AWS Quick Start Templates
        2 - Custom Template Location
 Choice: 1

 Choose an AWS Quick Start application template
        1 - Hello World Example
```

```
        ...
        9 - Lambda Response Streaming
        ...
        15 - Machine Learning
 Template: 9

 Which runtime would you like to use?
        1 - go (provided.al2)
        2 - nodejs18.x
        3 - nodejs16.x
 Runtime: 2

 Based on your selections, the only Package type available is Zip.
 We will proceed to selecting the Package type as Zip.

 Based on your selections, the only dependency manager available is npm.
 We will proceed copying the template using npm.

 Would you like to enable X-Ray tracing on the function(s) in your application?  [y/
N]: ENTER

 Would you like to enable monitoring using CloudWatch Application Insights?
 For more info, please view https://docs.aws.amazon.com/AmazonCloudWatch/latest/
monitoring/cloudwatch-application-insights.html [y/N]: ENTER

 Project name [sam-app]: lambda-streaming-nodejs-app

     -----------------------
     Generating application:
     -----------------------
     Name: lambda-streaming-nodejs-app
     Runtime: nodejs18.x
     Architectures: x86_64
     Dependency Manager: npm
     Application Template: response-streaming
     Output Directory: .
     Configuration file: lambda-streaming-nodejs-app/samconfig.toml

     Next steps can be found in the README file at lambda-streaming-nodejs-app/
README.md


 Commands you can use next
 =========================
```

```
 [*] Create pipeline: cd lambda-streaming-nodejs-app && sam pipeline init --bootstrap
 [*] Validate SAM template: cd lambda-streaming-nodejs-app && sam validate
 [*] Test Function in the Cloud: cd lambda-streaming-nodejs-app && sam sync --stack-
name {stack-name} --watch
```

The AWS SAM CLI creates our project with the following structure:

```
lambda-streaming-nodejs-app
 ### README.md
 ### __tests__
 #   ### unit
 #       ### index.test.js
 ### package.json
 ### samconfig.toml
 ### src
 #   ### index.js
 ### template.yaml
```

The following is an example of our Lambda function code:

```
exports.handler = awslambda.streamifyResponse(
   async (event, responseStream, context) => {
     const httpResponseMetadata = {
       statusCode: 200,
       headers: {
         "Content-Type": "text/html",
         "X-Custom-Header": "Example-Custom-Header"
       }
     };

     responseStream = awslambda.HttpResponseStream.from(responseStream,
 httpResponseMetadata);
     // It's recommended to use a `pipeline` over the `write` method for more complex
 use cases.
     // Learn more: https://docs.aws.amazon.com/lambda/latest/dg/configuration-
response-streaming.html
     responseStream.write("<html>");
     responseStream.write("<p>First write!</p>");

     responseStream.write("<h1>Streaming h1</h1>");
     await new Promise(r => setTimeout(r, 1000));
     responseStream.write("<h2>Streaming h2</h2>");
     await new Promise(r => setTimeout(r, 1000));
```

```
    responseStream.write("<h3>Streaming h3</h3>");
    await new Promise(r => setTimeout(r, 1000));

    // Long strings will be streamed
    const loremIpsum1 = "Lorem ipsum dolor sit amet, consectetur adipiscing elit.
Quisque vitae mi tincidunt tellus ultricies dignissim id et diam. Morbi pharetra eu
nisi et finibus. Vivamus diam nulla, vulputate et nisl cursus, pellentesque vehicula
libero. Cras imperdiet lorem ante, non posuere dolor sollicitudin a. Vestibulum ipsum
lacus, blandit nec augue id, lobortis dictum urna. Vestibulum ante ipsum primis in
faucibus orci luctus et ultrices posuere cubilia curae; Morbi auctor orci eget tellus
aliquam, non maximus massa porta. In diam ante, pulvinar aliquam nisl non, elementum
hendrerit sapien. Vestibulum massa nunc, mattis non congue vitae, placerat in quam.
Nam vulputate lectus metus, et dignissim erat varius a.";
    responseStream.write(`<p>${loremIpsum1}</p>`);
    await new Promise(r => setTimeout(r, 1000));

    responseStream.write("<p>DONE!</p>");
    responseStream.write("</html>");
    responseStream.end();
  }
);
```

The following is an example of our `template.yaml` file. Response streaming for our Lambda function is configured using the `FunctionUrlConfig` property.

```
AWSTemplateFormatVersion: '2010-09-09'
 Transform: AWS::Serverless-2016-10-31

 Description: >
   Sample SAM Template for lambda-streaming-nodejs-app

 Resources:
   StreamingFunction:
     Type: AWS::Serverless::Function
     Properties:
       CodeUri: src/
       Handler: index.handler
       Runtime: nodejs18.x
       Architectures:
         - x86_64
       Timeout: 10
       FunctionUrlConfig:
         AuthType: AWS_IAM
```

```
        InvokeMode: RESPONSE_STREAM

Outputs:
  StreamingFunction:
    Description: "Streaming Lambda Function ARN"
    Value: !GetAtt StreamingFunction.Arn
  StreamingFunctionURL:
    Description: "Streaming Lambda Function URL"
    Value: !GetAtt StreamingFunctionUrl.FunctionUrl
```

Typically, you can use `sam build` and `sam deploy --guided` to build and deploy a production application. In this example, we'll assume a development environment and use the `sam sync` command to build and deploy our application.

> **Note**
>
> The `sam sync` command is recommended for development environments. To learn more, see Introduction to using sam sync to sync to AWS Cloud.

Before running `sam sync`, we verify that our project is configured correctly in our `samconfig.toml` file. Most importantly, we verify the values for `stack_name` and `watch`. With these values specified in our configuration file, we don't have to provide them at the command line.

```
version = 0.1

 [default]
 [default.global.parameters]
 stack_name = "lambda-streaming-nodejs-app"

 [default.build.parameters]
 cached = true
 parallel = true

 [default.validate.parameters]
 lint = true

 [default.deploy.parameters]
 capabilities = "CAPABILITY_IAM"
 confirm_changeset = true
```

```
resolve_s3 = true
s3_prefix = "lambda-streaming-nodejs-app"
region = "us-west-2"
image_repositories = []

[default.package.parameters]
resolve_s3 = true

[default.sync.parameters]
watch = true

[default.local_start_api.parameters]
warm_containers = "EAGER"

[default.local_start_lambda.parameters]
warm_containers = "EAGER"
```

Next, we run `sam sync` to build and deploy our application. Since the `--watch` option is configured in our configuration file, the AWS SAM CLI will build our application, deploy our application, and watch for changes.

```
$ sam sync

The SAM CLI will use the AWS Lambda, Amazon API Gateway, and AWS StepFunctions APIs to
upload your code
without

performing a CloudFormation deployment. This will cause drift in your CloudFormation
stack.
**The sync command should only be used against a development stack**.



Queued infra sync. Waiting for in progress code syncs to complete...

Starting infra sync.

Building codeuri:

/Users/.../lambda-streaming-nodejs-app/src runtime: nodejs18.x metadata: {}
architecture: x86_64 functions: StreamingFunction
package.json file not found. Continuing the build without dependencies.
```

```
 Running NodejsNpmBuilder:CopySource


 Build Succeeded

 Successfully packaged artifacts and wrote output template to file /var/
folders/45/5ct135bx3fn2551_ptl5g6_80000gr/T/tmpavrzdhgp.
 Execute the following command to deploy the packaged template
 sam deploy --template-file /var/folders/45/5ct135bx3fn2551_ptl5g6_80000gr/T/
tmpavrzdhgp --stack-name <YOUR STACK NAME>


         Deploying with following values
         ===============================
         Stack name                   : lambda-streaming-nodejs-app
         Region                       : us-west-2
         Disable rollback             : False
         Deployment s3 bucket         : aws-sam-cli-managed-default-samclisam-s3-demo-
bucket-1a4x26zbcdkqr
         Capabilities                 : ["CAPABILITY_NAMED_IAM",
 "CAPABILITY_AUTO_EXPAND"]
         Parameter overrides          : {}
         Signing Profiles             : null

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


 2023-06-20 12:11:16 - Waiting for stack create/update to complete

 CloudFormation events from stack operations (refresh every 0.5 seconds)
 ---------------------------------------------------------------------------------------------------
 ResourceStatus            ResourceType              LogicalResourceId
 ResourceStatusReason
 ---------------------------------------------------------------------------------------------------
 CREATE_IN_PROGRESS        AWS::CloudFormation::St   lambda-streaming-
 Transformation
                           ack                       nodejs-app
 succeeded
 CREATE_IN_PROGRESS        AWS::IAM::Role            StreamingFunctionRole     -

 CREATE_IN_PROGRESS        AWS::CloudFormation::St   AwsSamAutoDependencyLay   -
```

```
                           ack                        erNestedStack

CREATE_IN_PROGRESS         AWS::IAM::Role             StreamingFunctionRole     Resource
creation

Initiated
CREATE_IN_PROGRESS         AWS::CloudFormation::St    AwsSamAutoDependencyLay   Resource
creation
                           ack                        erNestedStack
Initiated
CREATE_COMPLETE            AWS::IAM::Role             StreamingFunctionRole     -

CREATE_COMPLETE            AWS::CloudFormation::St    AwsSamAutoDependencyLay   -

                           ack                        erNestedStack

CREATE_IN_PROGRESS         AWS::Lambda::Function      StreamingFunction         -

CREATE_IN_PROGRESS         AWS::Lambda::Function      StreamingFunction         Resource
creation

Initiated
CREATE_COMPLETE            AWS::Lambda::Function      StreamingFunction         -

CREATE_IN_PROGRESS         AWS::Lambda::Url           StreamingFunctionUrl      -

CREATE_IN_PROGRESS         AWS::Lambda::Url           StreamingFunctionUrl      Resource
creation

Initiated
CREATE_COMPLETE            AWS::Lambda::Url           StreamingFunctionUrl      -

CREATE_COMPLETE            AWS::CloudFormation::St    lambda-streaming-         -

                           ack                        nodejs-app

-----------------------------------------------------------------------------------------------

CloudFormation outputs from deployed stack
-----------------------------------------------------------------------------------------------
Outputs

-----------------------------------------------------------------------------------------------
```

```
 Key                 StreamingFunction

 Description         Streaming Lambda Function ARN

 Value               arn:aws:lambda:us-west-2:012345678910:function:lambda-streaming-
nodejs-app-
 StreamingFunction-gUmhO833A0vZ


 Key                 StreamingFunctionURL

 Description         Streaming Lambda Function URL

 Value               https://wxgkcc2dyntgtrwhf2dgdcvylu0rnnof.lambda-url.us-
west-2.on.aws/
 -----------------------
```

```
 Nam vulputate lectus metus, et dignissim erat varius a.</p><p>DONE!</p></html>START
 RequestId: 1e4cdf04-60de-4769-b3a2-c1481982deb4 Version: $LATEST
 END RequestId: 1e4cdf04-60de-4769-b3a2-c1481982deb4
 REPORT RequestId: 1e4cdf04-60de-4769-b3a2-c1481982deb4  Duration: 4088.66 ms
 Billed Duration: 4089 ms        Memory Size: 128 MB     Max Memory Used: 68 MB  Init
 Duration: 168.45 ms
```

When we modify our function code, the AWS SAM CLI instantly detects and immediately deploys our changes. Here is an example of the AWS SAM CLI output after changes are made to our function code:

```
Syncing Lambda Function StreamingFunction...

 Building codeuri:

 /Users/.../lambda-streaming-nodejs-app/src runtime: nodejs18.x metadata: {}
 architecture:
 x86_64 functions: StreamingFunction

 package.json file not found. Continuing the build without dependencies.

 Running NodejsNpmBuilder:CopySource

 Finished syncing Lambda Function StreamingFunction.

 Syncing Layer StreamingFunctione9cfe924DepLayer...

 SyncFlow [Layer StreamingFunctione9cfe924DepLayer]: Skipping resource update as the

 content didn't change

 Finished syncing Layer StreamingFunctione9cfe924DepLayer.
```

We can now use `sam remote invoke` again to interact with our function in the cloud and test our changes.

SQS examples

Basic examples

Invoke an Amazon SQS queue by providing the ARN as a resource ID:

```
$ sam remote invoke arn:aws:sqs:us-west-2:01234567890:sqs-example-4DonhBsjsW1b --
event '{"hello": "world"}' --output json

Sending message to SQS queue MySqsQueue

{
  "MD5OfMessageBody": "49dfdd54b01cbcd2d2ab5e9e5ee6b9b9",
  "MessageId": "4f464cdd-15ef-4b57-bd72-3ad225d80adc",
  "ResponseMetadata": {
    "RequestId": "95d39377-8323-5ef0-9223-ceb198bd09bd",
    "HTTPStatusCode": 200,
    "HTTPHeaders": {
      "x-amzn-requestid": "95d39377-8323-5ef0-9223-ceb198bd09bd",
      "date": "Wed, 08 Nov 2023 23:27:26 GMT",
      "content-type": "application/x-amz-json-1.0",
      "content-length": "106",
      "connection": "keep-alive"
    },
    "RetryAttempts": 0
  }
}%
```

Step Functions examples

Basic examples

Invoke a state machine by providing its physical ID as a resource ID:

First, we use `sam list resources` to obtain our physical ID:

```
$ sam list resources --stack-name state-machine-example --output json

[
  {
    "LogicalResourceId": "HelloWorldStateMachine",
    "PhysicalResourceId": "arn:aws:states:us-
west-2:513423067560:stateMachine:HelloWorldStateMachine-z69tFEUx0F66"
  },
  {
    "LogicalResourceId": "HelloWorldStateMachineRole",
    "PhysicalResourceId": "simple-state-machine-HelloWorldStateMachineRole-
PduA0BDGuFXw"
  }
```

```
]
```

Next, we invoke our state machine using the physical ID as a resource ID. We pass in an event at the command line with the `--event` option:

```
$ sam remote invoke arn:aws:states:us-
west-2:01234567890:stateMachine:HelloWorldStateMachine-z69tFEUx0F66 --
event '{"is_developer": true}'

Invoking Step Function arn:aws:states:us-
west-2:01234567890:stateMachine:HelloWorldStateMachine-z69tFEUx0F66
"Hello Developer World"%
```

Invoke a state machine by passing an empty event:

```
$ sam remote invoke HelloWorldStateMachine --stack-name state-machine-example

Invoking Step Function HelloWorldStateMachine

"Hello World"%
```

Related links

For documentation related to `sam remote invoke` and using the AWS SAM CLI, see the following:

- sam remote invoke
- AWS SAM CLI troubleshooting

Automate local integration tests with AWS SAM

While you can use Introduction to testing with sam local invoke to manually test code, AWS SAM also lets you test your code using automated integration testing. Integration testing helps you detect issues early in the development cycle, improve the quality of your code, and save time while reducing costs.

To author automated integration tests in AWS SAM, you first run tests against local Lambda functions before deploying to the AWS Cloud. The Introduction to testing with sam local start-

lambda command starts a local endpoint that emulates the Lambda invoke endpoint. You can invoke it from your automated tests. Because this endpoint emulates the 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=15,
            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.

Generate sample event payloads with AWS SAM

To test your Lambda functions, you can generate and customize sample event payloads that imitate the data your Lambda functions will receive when triggered by other AWS services. This includes services like API Gateway, CloudFormation, Amazon S3, and more.

Generating sample event payloads helps you test the behavior of your Lambda function with a variety of different inputs without needing to work in a live environment. This approach also saves time when compared to manually creating AWS service event samples to test functions.

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
```

Testing and debugging durable functions

Testing and debugging durable functions locally works similarly to regular Lambda functions, with automatic support for checkpointing and replay. This guide covers common testing scenarios and troubleshooting techniques.

Local testing workflow

When testing durable functions locally, the workflow differs from regular Lambda functions:

Durable function testing workflow

1. Build your application:

   ```
   $ sam build
   ```

2. Invoke your durable function:

   ```
   $ sam local invoke MyDurableFunction --durable-execution-name test
   ```

3. Check execution history if needed:

   ```
   $ sam local execution history execution-id
   ```

Common testing scenarios

Testing checkpointing behavior

To test that your function properly checkpoints state:

```
# Example Python durable function
def handler(event, context):
    # This will create a checkpoint
    context.wait(10)  # Wait 10 seconds

    # Function resumes here after wait
    return {"message": "Function resumed after wait"}
```

When you invoke this function locally, the wait period is handled automatically.

Testing callback scenarios

For functions that wait for external callbacks:

1. Start your durable function that waits for a callback
2. In another terminal, resolve the callback:

```
$ sam local callback succeed callback-id
```

3. Observe the function resume execution

Troubleshooting

Durable function not executing properly

Problem: The function doesn't behave as a durable function.

Solutions:

- Verify that `DurableConfig` is set in your SAM template
- Ensure your function code uses durable function SDK methods (e.g., `context.wait()`)
- Check that you're using a supported runtime (TypeScript, JavaScript, Python)

Cannot retrieve execution history

Problem: The `local execution history` command returns no results.

Solutions:

- Verify the execution ID is correct
- Check that the function has been invoked at least once

Callback commands not working

Problem: Callback commands don't resolve pending operations.

Solutions:

- Verify the callback ID is correct
- Ensure the function is actually waiting for a callback
- Verify you're using the correct callback command syntax

Debugging tips

- **Use execution history** - Review execution history to understand the flow of your durable function
- **Test incrementally** - Start with simple wait operations before adding complex logic
- **Use verbose logging** - Enable detailed logging to trace execution flow

Learn more

For more information about testing and debugging, see:

- Introduction to testing with sam local invoke - Local invoke documentation
- sam local execution history - Execution history

Debug your serverless application with AWS SAM

After testing your application, you will be ready to debug any issues you've found. With the AWS SAM command line interface (CLI), you can locally test and debug your serverless application before uploading it to the AWS Cloud. Debugging your application identifies and fixes issues or errors in your application.

You can use AWS SAM to perform step-through debugging, which is a method of running code one line or instruction at a time. 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 different variables, and fix issues the same way you would for any other application. 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.

> **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.

Topics

- Locally debug functions with AWS SAM
- Pass multiple runtime arguments when debugging with AWS SAM
- Validate your AWS SAM applications with CloudFormation Linter

Locally debug functions with AWS SAM

You can use AWS SAM with a variety of AWS toolkits and debuggers to test and debug your serverless applications locally. Step-through debugging of your Lambda functions allows you to identify and fix issues in your application one line or instruction at a time in your local environment.

Some of the ways you can perform local step-through debugging includes 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.

You can use AWS Toolkits to debug, and you can also run AWS SAM in debug mode. See the topics in this section for details.

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 of 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

IDE	Runtime	AWS Toolkit	Instructions for step-through debugging
			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*
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 or sam local start-api 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.

Pass multiple runtime arguments when debugging with AWS SAM

You may choose to pass additional runtime arguments with AWS SAM to inspect issues and troubleshoot variables more effectively. Doing this provides added control and flexibility to your debugging process, which can help you with customized runtime configurations and environments.

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.

Validate your AWS SAM applications with CloudFormation Linter

AWS CloudFormation Linter (cfn-lint) is an open-source tool that you can use to perform detailed validation on your CloudFormation templates. Cfn-lint contains rules that are guided by the CloudFormation resource specification. Use cfn-lint to compare your resources against those rules to receive detailed messages on errors, warnings, or informational suggestions. Alternatively, create your own custom rules to validate against. To learn more about cfn-lint, see cfn-lint in the *CloudFormation GitHub repository*.

You can use cfn-lint to validate your AWS Serverless Application Model (AWS SAM) templates through the AWS SAM Command Line Interface (AWS SAM CLI) by running **sam validate** with the **--lint** option.

```
sam validate --lint
```

To customize cfn-lint behavior, such as creating custom rules or specifying validation options, you can define a configuration file. To learn more, see Config File in the *cfn-lint CloudFormation GitHub repository*. When you run **sam validate --lint**, cfn-lint behavior defined in your configuration file will be applied.

Examples

Perform cfn-lint validation on an AWS SAM template

```
sam validate --lint --template myTemplate.yaml
```

Learn more

To learn more about the **sam validate** command, see sam validate.

Deploy your application and resources with AWS SAM

Deploying your application provisions and configures your AWS resources in the AWS Cloud, making your application run in the cloud. AWS SAM uses CloudFormation as its underlying deployment mechanism. AWS SAM uses the build artifacts you create when running the **sam build** command as the standard inputs for deploying your serverless application.

With AWS SAM, you can deploy your serverless application manually, or you can automate deployments. To automate deployments, you use AWS SAM pipelines with a continuous integration and continuous deployment (CI/CD) system of your choice. Your deployment pipeline is an automated sequence of steps that are performed to release a new version of your serverless application.

The topics in this section provide guidance on both automated and manual deployments. To deploy your application manually, you use AWS SAM CLI commands. To automate deployments, refer to the topics in this section. They specifically provide in-depth content on automating deployments using pipelines and a CI/CD system. This includes generating a starter pipeline, setting up automation, troubleshooting deployments, using OpenID Connect (OIDC) user authentication, and uploading local files at deployment.

Topics

- Introduction to deploying with AWS SAM
- Options for deploying your application with AWS SAM
- Using CI/CD systems and pipelines to deploy with AWS SAM
- Introduction to using sam sync to sync to AWS Cloud

Introduction to deploying with AWS SAM

Use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam deploy` command to deploy your serverless application to the AWS Cloud.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?.
- For a list of `sam deploy` command options, see sam deploy.
- For an example of using `sam deploy` during a typical development workflow, see Step 3: Deploy your application to the AWS Cloud.

Topics

- Prerequisites
- Deploying applications using sam deploy
- Best practices
- Options for sam deploy
- Troubleshooting
- Examples
- Learn more

Prerequisites

To use `sam deploy`, install the AWS SAM CLI by completing the following:

- AWS SAM prerequisites.
- Install the AWS SAM CLI.

Before using `sam deploy`, we recommend a basic understanding of the following:

- Configuring the AWS SAM CLI.
- Create your application in AWS SAM.
- Introduction to building with AWS SAM.

Deploying applications using sam deploy

When you deploy a serverless application for the first time, use the `--guided` option. The AWS SAM CLI will guide you through an interactive flow to configure your application's deployment settings.

To deploy an application using the interactive flow

1. Go to the root directory of your project. This is the same location as your AWS SAM template.

```
$ cd sam-app
```

2. Run the following command:

```
$ sam deploy --guided
```

3. During the interactive flow, the AWS SAM CLI prompts you with options to configure your application's deployment settings.

   Brackets (`[ ]`) indicate default values. Leave your answer blank to select the default value. Default values are obtained from the following configuration files:

   - `~/.aws/config` – Your general AWS account settings.
   - `~/.aws/credentials` – Your AWS account credentials.
   - *`<project>`*`/samconfig.toml` – Your project's configuration file.

   Provide values by answering the AWS SAM CLI prompts. For example, you can enter **y** for **yes**, **n** for **no**, or string values.

   The AWS SAM CLI writes your responses to your project's `samconfig.toml` file. For subsequent deployments, you can use `sam deploy` to deploy using these configured values. To reconfigure these values, use `sam deploy --guided` again or directly modify your configuration files.

   The following is an example output:

```
sam-app $ sam deploy --guided

Configuring SAM deploy
======================

        Looking for config file [samconfig.toml] :  Found
        Reading default arguments  :  Success

        Setting default arguments for 'sam deploy'
        =========================================
        Stack Name [sam-app]: ENTER
        AWS Region [us-west-2]: ENTER
        #Shows you resources changes to be deployed and require a 'Y' to initiate
 deploy
        Confirm changes before deploy [Y/n]: ENTER
        #SAM needs permission to be able to create roles to connect to the
 resources in your template
```

```
        Allow SAM CLI IAM role creation [Y/n]: ENTER
        #Preserves the state of previously provisioned resources when an operation
 fails
        Disable rollback [y/N]: ENTER
        HelloWorldFunction may not have authorization defined, Is this okay? [y/
N]: y
        Save arguments to configuration file [Y/n]: ENTER
        SAM configuration file [samconfig.toml]: ENTER
        SAM configuration environment [default]: ENTER
```

4. Next, the AWS SAM CLI deploys your application to the AWS Cloud. During deployment, progress is displayed in your command prompt. The following are the major stages in deployment:

   - For applications with AWS Lambda functions packaged as a .zip file archive, the AWS SAM CLI zips and uploads the package to an Amazon Simple Storage Service (Amazon S3) bucket. If necessary, the AWS SAM CLI will create a new bucket.
   - For applications with Lambda functions package as a container image, the AWS SAM CLI uploads the image to Amazon Elastic Container Registry (Amazon ECR). If necessary, the AWS SAM CLI will create a new repository.
   - The AWS SAM CLI creates an AWS CloudFormation change set and deploys your application to CloudFormation as a stack.
   - The AWS SAM CLI modifies your deployed AWS SAM template with the new `CodeUri` value for your Lambda functions.

   The following is an example of the AWS SAM CLI deployment output:

```
        Looking for resources needed for deployment:

        Managed S3 bucket: aws-sam-cli-managed-default-samclisam-s3-demo-
bucket-1a4x26zbcdkqr
        A different default S3 bucket can be set in samconfig.toml and auto
 resolution of buckets turned off by setting resolve_s3=False

        Parameter "stack_name=sam-app" in [default.deploy.parameters] is defined as
 a global parameter [default.global.parameters].
        This parameter will be only saved under [default.global.parameters] in /
Users/.../sam-app/samconfig.toml.

        Saved arguments to config file
```

```
        Running 'sam deploy' for future deployments will use the parameters saved
 above.
        The above parameters can be changed by modifying samconfig.toml
        Learn more about samconfig.toml syntax at
        https://docs.aws.amazon.com/serverless-application-model/latest/
developerguide/serverless-sam-cli-config.html

        Uploading to sam-app-zip/da3c598813f1c2151579b73ad788cac8  262144 / 619839
 (42.29%)Uploading to sam-app-zip/da3c598813f1c2151579b73ad788cac8  524288 / 619839
  (84.58%)Uploading to sam-app-zip/da3c598813f1c2151579b73ad788cac8  619839 /
 619839  (100.00%)

        Deploying with following values
        ===============================
        Stack name                   : sam-app
        Region                       : us-west-2
        Confirm changeset            : True
        Disable rollback             : False
        Deployment s3 bucket         : aws-sam-cli-managed-default-samclisam-s3-
demo-bucket-1a4x26zbcdkqr
        Capabilities                 : ["CAPABILITY_IAM"]
        Parameter overrides          : {}
        Signing Profiles             : {}

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

        Uploading to sam-app-zip/be84c20f868068e4dc4a2c11966edf2d.template  1212 /
 1212  (100.00%)


Waiting for changeset to be created..

CloudFormation stack changeset
-----------------------------------------------------------------------------------------------
Operation                LogicalResourceId        ResourceType
 Replacement
-----------------------------------------------------------------------------------------------
+ Add                    HelloWorldFunctionHell   AWS::Lambda::Permissio   N/A

                         oWorldPermissionProd     n

+ Add                    HelloWorldFunctionRole   AWS::IAM::Role           N/A
```

```
+ Add                     HelloWorldFunction       AWS::Lambda::Function    N/A

+ Add                     ServerlessRestApiDeplo   AWS::ApiGateway::Deplo   N/A

                          yment47fc2d5f9d          yment

+ Add                     ServerlessRestApiProdS   AWS::ApiGateway::Stage   N/A

                          tage

+ Add                     ServerlessRestApi        AWS::ApiGateway::RestA   N/A

                                                   pi

-----------------------------------------------------------------------------------------------------------------------------------


Changeset created successfully. arn:aws:cloudformation:us-
west-2:012345678910:changeSet/samcli-deploy1680559234/d9f58a77-98bc-41cd-
b9f4-433a5a450d7a


Previewing CloudFormation changeset before deployment
=====================================================
Deploy this changeset? [y/N]: y

2023-04-03 12:00:50 - Waiting for stack create/update to complete

CloudFormation events from stack operations (refresh every 5.0 seconds)
-----------------------------------------------------------------------------------------------------------------------------------
ResourceStatus           ResourceType             LogicalResourceId
 ResourceStatusReason
-----------------------------------------------------------------------------------------------------------------------------------
CREATE_IN_PROGRESS       AWS::IAM::Role           HelloWorldFunctionRole   -

CREATE_IN_PROGRESS       AWS::IAM::Role           HelloWorldFunctionRole   Resource
 creation

 Initiated
CREATE_COMPLETE          AWS::IAM::Role           HelloWorldFunctionRole   -

CREATE_IN_PROGRESS       AWS::Lambda::Function    HelloWorldFunction       -
```

```
CREATE_IN_PROGRESS       AWS::Lambda::Function    HelloWorldFunction       Resource
 creation

 Initiated
CREATE_COMPLETE          AWS::Lambda::Function    HelloWorldFunction       -

CREATE_IN_PROGRESS       AWS::ApiGateway::RestA   ServerlessRestApi        -

                         pi

CREATE_IN_PROGRESS       AWS::ApiGateway::RestA   ServerlessRestApi        Resource
 creation
                         pi
 Initiated
CREATE_COMPLETE          AWS::ApiGateway::RestA   ServerlessRestApi        -

                         pi

CREATE_IN_PROGRESS       AWS::Lambda::Permissio   HelloWorldFunctionHell   -

                         n                        oWorldPermissionProd

CREATE_IN_PROGRESS       AWS::ApiGateway::Deplo   ServerlessRestApiDeplo   -

                         yment                    yment47fc2d5f9d

CREATE_IN_PROGRESS       AWS::Lambda::Permissio   HelloWorldFunctionHell   Resource
 creation
                         n                        oWorldPermissionProd
 Initiated
CREATE_IN_PROGRESS       AWS::ApiGateway::Deplo   ServerlessRestApiDeplo   Resource
 creation
                         yment                    yment47fc2d5f9d
 Initiated
CREATE_COMPLETE          AWS::ApiGateway::Deplo   ServerlessRestApiDeplo   -

                         yment                    yment47fc2d5f9d

CREATE_IN_PROGRESS       AWS::ApiGateway::Stage   ServerlessRestApiProdS   -

                                                  tage

CREATE_IN_PROGRESS       AWS::ApiGateway::Stage   ServerlessRestApiProdS   Resource
 creation
```

```
                                                    tage
 Initiated
CREATE_COMPLETE          AWS::ApiGateway::Stage   ServerlessRestApiProdS   -

                                                    tage

CREATE_COMPLETE          AWS::Lambda::Permissio   HelloWorldFunctionHell   -

                         n                        oWorldPermissionProd

CREATE_COMPLETE          AWS::CloudFormation::S   sam-app-zip             -

                         tack

-----------------------------------------------------------------------------------------------

CloudFormation outputs from deployed stack
-----------------------------------------------------------------------------------------------
Outputs

-----------------------------------------------------------------------------------------------
Key                 HelloWorldFunctionIamRole

Description         Implicit IAM Role created for Hello World function

Value               arn:aws:iam::012345678910:role/sam-app-zip-

HelloWorldFunctionRole-11ZOGSCG28H0M


Key                 HelloWorldApi

Description         API Gateway endpoint URL for Prod stage for Hello World
 function
Value               https://njzfhdmls0.execute-api.us-west-2.amazonaws.com/Prod/
hello/

Key                 HelloWorldFunction

Description         Hello World Lambda Function ARN

Value               arn:aws:lambda:us-west-2:012345678910:function:sam-app-
```

```
HelloWorldFunction-XPqNX4TBu7qn

-----------------------
```

```
Operation                LogicalResourceId        ResourceType
 Replacement
-----------------------------------------------------------------------------------------------
+ Add                    HelloWorldFunctionHell   AWS::Lambda::Permissio   N/A

                         oWorldPermissionProd     n

+ Add                    HelloWorldFunctionRole   AWS::IAM::Role           N/A

+ Add                    HelloWorldFunction       AWS::Lambda::Function    N/A

+ Add                    ServerlessRestApiDeplo   AWS::ApiGateway::Deplo   N/A

                         yment47fc2d5f9d          yment

+ Add                    ServerlessRestApiProdS   AWS::ApiGateway::Stage   N/A

                         tage

+ Add                    ServerlessRestApi        AWS::ApiGateway::RestA   N/A

                                                  pi

-----------------------------------------------------------------------------------------------

Changeset created successfully. arn:aws:cloudformation:us-
west-2:012345678910:changeSet/samcli-deploy1680559234/d9f58a77-98bc-41cd-
b9f4-433a5a450d7a
Previewing CloudFormation changeset before deployment
=====================================================
Deploy this changeset? [y/N]: y
```

Specify additional parameters during deployment

You can specify additional parameter values to configure when deploying. You do this by modifying your AWS SAM template and configuring your parameter value during deployment.

To specify additional parameters

1. Modify the `Parameters` section of your AWS SAM template. The following is an example:

```
AWSTemplateFormatVersion: '2010-09-09'
```

```
Transform: AWS::Serverless-2016-10-31
...
Globals:
...
Parameters:
  DomainName:
    Type: String
    Default: example
    Description: Domain name
```

2. Run `sam deploy --guided`. The following is an example output:

```
sam-app $ sam deploy --guided

Configuring SAM deploy
======================

        Looking for config file [samconfig.toml] :  Found
        Reading default arguments  :  Success

        Setting default arguments for 'sam deploy'
        =========================================
        Stack Name [sam-app-zip]: ENTER
        AWS Region [us-west-2]: ENTER
        Parameter DomainName [example]: ENTER
```

Configure code signing for your Lambda functions

You can configure code signing for your Lambda functions at deployment. You do this by modifying your AWS SAM template and configuring code signing during deployment.

To configure code signing

1. Specify `CodeSigningConfigArn` in your AWS SAM template. The following is an example:

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  HelloWorldFunction:
    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
```

2. Run `sam deploy --guided`. The AWS SAM CLI will prompt you to configure code signing. The following is an example output:

```
#Found code signing configurations in your function definitions
Do you want to sign your code? [Y/n]: ENTER
#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):
```

Best practices

- When using `sam deploy`, the AWS SAM CLI deploys your application's build artifacts located in the `.aws-sam` directory. When you make changes to your application's original files, run `sam build` to update the `.aws-sam` directory before deploying.
- When deploying an application for the first time, use `sam deploy --guided` to configure deployment settings. For subsequent deployments, you can use `sam deploy` to deploy with your configured settings.

Options for sam deploy

The following are commonly used options for `sam deploy`. For a list of all options, see sam deploy.

Use the guided interactive flow to deploy your application

Use the `--guided` option to configure your application's deployment settings through an interactive flow. The following is an example:

```
$ sam deploy --guided
```

Your application's deployment settings are saved in your project's `samconfig.toml` file. To learn more, see Configure project settings.

Troubleshooting

To troubleshoot the AWS SAM CLI, see AWS SAM CLI troubleshooting.

Examples

Deploy a Hello World application that contains a Lambda function packaged as a .zip file archive

For an example, see Step 3: Deploy your application to the AWS Cloud in the Hello World application tutorial.

Deploy a Hello World application that contains a Lambda function packaged as a container image

First, we use `sam init` to create our Hello World application. During the interactive flow, we choose the `Python3.9` runtime and `Image` package type.

```
$ sam init
...
Which template source would you like to use?
        1 - AWS Quick Start Templates
        2 - Custom Template Location
Choice: 1

Choose an AWS Quick Start application template
        1 - Hello World Example
        2 - Multi-step workflow
        ...
Template: 1

Use the most popular runtime and package type? (Python and zip) [y/N]:  ENTER

Which runtime would you like to use?
        1 - aot.dotnet7 (provided.al2)
```

```
        ...
        15 - nodejs12.x
        16 - python3.9
        17 - python3.8
        ...
Runtime: 16

What package type would you like to use?
        1 - Zip
        2 - Image
Package type: 2

Based on your selections, the only dependency manager available is pip.
We will proceed copying the template using pip.
...
Project name [sam-app]: ENTER

    -----------------------
    Generating application:
    -----------------------
    Name: sam-app
    Base Image: amazon/python3.9-base
    Architectures: x86_64
    Dependency Manager: pip
    Output Directory: .
    Configuration file: sam-app/samconfig.toml

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

Next, we `cd` to the root directory of our project and run `sam build`. The AWS SAM CLI builds our Lambda function locally using Docker.

```
sam-app $ sam build
Building codeuri: /Users/.../sam-app runtime: None metadata: {'Dockerfile':
 'Dockerfile', 'DockerContext': '/Users/.../sam-app/hello_world', 'DockerTag':
 'python3.9-v1'} architecture: x86_64 functions: HelloWorldFunction
Building image for HelloWorldFunction function
Setting DockerBuildArgs: {} for HelloWorldFunction function
Step 1/5 : FROM public.ecr.aws/lambda/python:3.9
 ---> 0a5e3da309aa
Step 2/5 : COPY requirements.txt ./
 ---> abc4e82e85f9
```

```
Step 3/5 : RUN python3.9 -m pip install -r requirements.txt -t .
 ---> [Warning] The requested image's platform (linux/amd64) does not match the
 detected host platform (linux/arm64/v8) and no specific platform was requested
 ---> Running in 43845e7aa22d
Collecting requests
  Downloading requests-2.28.2-py3-none-any.whl (62 kB)
     ######################################## 62.8/62.8 KB 829.5 kB/s eta 0:00:00
Collecting idna<4,>=2.5
  Downloading idna-3.4-py3-none-any.whl (61 kB)
     ######################################## 61.5/61.5 KB 2.4 MB/s eta 0:00:00
Collecting charset-normalizer<4,>=2
  Downloading charset_normalizer-3.1.0-cp39-cp39-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (199 kB)
     ######################################## 199.2/199.2 KB 2.1 MB/s eta 0:00:00
Collecting certifi>=2017.4.17
  Downloading certifi-2022.12.7-py3-none-any.whl (155 kB)
     ######################################## 155.3/155.3 KB 10.2 MB/s eta 0:00:00
Collecting urllib3<1.27,>=1.21.1
  Downloading urllib3-1.26.15-py2.py3-none-any.whl (140 kB)
     ######################################## 140.9/140.9 KB 9.1 MB/s eta 0:00:00
Installing collected packages: urllib3, idna, charset-normalizer, certifi, requests
Successfully installed certifi-2022.12.7 charset-normalizer-3.1.0 idna-3.4
 requests-2.28.2 urllib3-1.26.15
Removing intermediate container 43845e7aa22d
 ---> cab8ace899ce
Step 4/5 : COPY app.py ./
 ---> 4146f3cd69f2
Step 5/5 : CMD ["app.lambda_handler"]
 ---> [Warning] The requested image's platform (linux/amd64) does not match the
 detected host platform (linux/arm64/v8) and no specific platform was requested
 ---> Running in f4131ddffb31
Removing intermediate container f4131ddffb31
 ---> d2f5180b2154
Successfully built d2f5180b2154
Successfully tagged helloworldfunction:python3.9-v1



Build Succeeded

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

Commands you can use next
=========================
```

```
[*] Validate SAM template: sam validate
[*] Invoke Function: sam local invoke
[*] Test Function in the Cloud: sam sync --stack-name {{stack-name}} --watch
[*] Deploy: sam deploy --guided
```

Next, we run `sam deploy --guided` to deploy our application. The AWS SAM CLI guides us through configuring our deployment settings. Then, the AWS SAM CLI deploys our application to the AWS Cloud.

```
sam-app $ sam deploy --guided

Configuring SAM deploy
======================

        Looking for config file [samconfig.toml] :  Found
        Reading default arguments  :  Success

        Setting default arguments for 'sam deploy'
        =========================================
        Stack Name [sam-app]: ENTER
        AWS Region [us-west-2]: ENTER
        #Shows you resources changes to be deployed and require a 'Y' to initiate
 deploy
        Confirm changes before deploy [Y/n]: ENTER
        #SAM needs permission to be able to create roles to connect to the resources in
 your template
        Allow SAM CLI IAM role creation [Y/n]: ENTER
        #Preserves the state of previously provisioned resources when an operation
 fails
        Disable rollback [y/N]: ENTER
        HelloWorldFunction may not have authorization defined, Is this okay? [y/N]: y
        Save arguments to configuration file [Y/n]: ENTER
        SAM configuration file [samconfig.toml]: ENTER
        SAM configuration environment [default]: ENTER

        Looking for resources needed for deployment:

        Managed S3 bucket: aws-sam-cli-managed-default-samclisam-s3-demo-
bucket-1a4x26zbcdkqr
        A different default S3 bucket can be set in samconfig.toml and auto resolution
 of buckets turned off by setting resolve_s3=False
```

```
        Parameter "stack_name=sam-app" in [default.deploy.parameters] is defined as a
 global parameter [default.global.parameters].
        This parameter will be only saved under [default.global.parameters] in /
Users/.../sam-app/samconfig.toml.

        Saved arguments to config file
        Running 'sam deploy' for future deployments will use the parameters saved
 above.
        The above parameters can be changed by modifying samconfig.toml
        Learn more about samconfig.toml syntax at
        https://docs.aws.amazon.com/serverless-application-model/latest/developerguide/
serverless-sam-cli-config.html

e95fc5e75742: Pushed
d8df51e7bdd7: Pushed
b1d0d7e0b34a: Pushed
0071317b94d8: Pushed
d98f98baf147: Pushed
2d244e0816c6: Pushed
eb2eeb1ebe42: Pushed
a5ca065a3279: Pushed
fe9e144829c9: Pushed
helloworldfunction-d2f5180b2154-python3.9-v1: digest:
 sha256:cceb71401b47dc3007a7a1e1f2e0baf162999e0e6841d15954745ecc0c447533 size: 2206

        Deploying with following values
        ===============================
        Stack name                   : sam-app
        Region                       : us-west-2
        Confirm changeset            : True
        Disable rollback             : False
        Deployment image repository  :
                                       {
                                           "HelloWorldFunction":
 "012345678910.dkr.ecr.us-west-2.amazonaws.com/samapp7427b055/
helloworldfunction19d43fc4repo"
                                       }
        Deployment s3 bucket         : aws-sam-cli-managed-default-samclisam-s3-demo-
bucket-1a4x26zbcdkqr
        Capabilities                 : ["CAPABILITY_IAM"]
        Parameter overrides          : {}
        Signing Profiles             : {}

Initiating deployment
```

```
=====================

HelloWorldFunction may not have authorization defined.
        Uploading to sam-app/682ad27c7cf7a17c7f77a1688b0844f2.template  1328 / 1328
 (100.00%)


Waiting for changeset to be created..

CloudFormation stack changeset
-----------------------------------------------------------------------------------------------------
Operation                LogicalResourceId        ResourceType             Replacement

-----------------------------------------------------------------------------------------------------
+ Add                    HelloWorldFunctionHell   AWS::Lambda::Permissio   N/A

                         oWorldPermissionProd     n

+ Add                    HelloWorldFunctionRole   AWS::IAM::Role           N/A

+ Add                    HelloWorldFunction       AWS::Lambda::Function    N/A

+ Add                    ServerlessRestApiDeplo   AWS::ApiGateway::Deplo   N/A

                         yment47fc2d5f9d          yment

+ Add                    ServerlessRestApiProdS   AWS::ApiGateway::Stage   N/A

                         tage

+ Add                    ServerlessRestApi        AWS::ApiGateway::RestA   N/A

                                                  pi

-----------------------------------------------------------------------------------------------------


Changeset created successfully. arn:aws:cloudformation:us-
west-2:012345678910:changeSet/samcli-deploy1680634124/0ffd4faf-2e2b-487e-
b9e0-9116e8299ac4


Previewing CloudFormation changeset before deployment
=====================================================
```

```
Deploy this changeset? [y/N]: y

2023-04-04 08:49:15 - Waiting for stack create/update to complete

CloudFormation events from stack operations (refresh every 5.0 seconds)
---------------------------------------------------------------------------------------------------
ResourceStatus           ResourceType             LogicalResourceId
 ResourceStatusReason
---------------------------------------------------------------------------------------------------
CREATE_IN_PROGRESS       AWS::CloudFormation::S   sam-app                  User
 Initiated
                         tack

CREATE_IN_PROGRESS       AWS::IAM::Role           HelloWorldFunctionRole   -

CREATE_IN_PROGRESS       AWS::IAM::Role           HelloWorldFunctionRole   Resource
 creation
                                                                           Initiated

CREATE_COMPLETE          AWS::IAM::Role           HelloWorldFunctionRole   -

CREATE_IN_PROGRESS       AWS::Lambda::Function    HelloWorldFunction       -

CREATE_IN_PROGRESS       AWS::Lambda::Function    HelloWorldFunction       Resource
 creation
                                                                           Initiated

CREATE_COMPLETE          AWS::Lambda::Function    HelloWorldFunction       -

CREATE_IN_PROGRESS       AWS::ApiGateway::RestA   ServerlessRestApi        -

                         pi

CREATE_IN_PROGRESS       AWS::ApiGateway::RestA   ServerlessRestApi        Resource
 creation
                         pi                                                Initiated

CREATE_COMPLETE          AWS::ApiGateway::RestA   ServerlessRestApi        -

                         pi

CREATE_IN_PROGRESS       AWS::Lambda::Permissio   HelloWorldFunctionHell   -
```

```
                         n                        oWorldPermissionProd

CREATE_IN_PROGRESS       AWS::ApiGateway::Deplo   ServerlessRestApiDeplo   -

                         yment                    yment47fc2d5f9d

CREATE_IN_PROGRESS       AWS::Lambda::Permissio   HelloWorldFunctionHell   Resource
 creation
                         n                        oWorldPermissionProd     Initiated

CREATE_IN_PROGRESS       AWS::ApiGateway::Deplo   ServerlessRestApiDeplo   Resource
 creation
                         yment                    yment47fc2d5f9d          Initiated

CREATE_COMPLETE          AWS::ApiGateway::Deplo   ServerlessRestApiDeplo   -

                         yment                    yment47fc2d5f9d

CREATE_IN_PROGRESS       AWS::ApiGateway::Stage   ServerlessRestApiProdS   -

                                                  tage

CREATE_IN_PROGRESS       AWS::ApiGateway::Stage   ServerlessRestApiProdS   Resource
 creation
                                                  tage                     Initiated

CREATE_COMPLETE          AWS::ApiGateway::Stage   ServerlessRestApiProdS   -

                                                  tage

CREATE_COMPLETE          AWS::Lambda::Permissio   HelloWorldFunctionHell   -

                         n                        oWorldPermissionProd

CREATE_COMPLETE          AWS::CloudFormation::S   sam-app                  -

                         tack

-------------------------------------------------------------------------------------------------------

CloudFormation outputs from deployed stack
-------------------------------------------------------------------------------------------------------
Outputs
```

```
-----------------------------------------------------------------------------------------------------------
Key                 HelloWorldFunctionIamRole

Description         Implicit IAM Role created for Hello World function

Value               arn:aws:iam::012345678910:role/sam-app-HelloWorldFunctionRole-
JFML1JOKHJ71

Key                 HelloWorldApi

Description         API Gateway endpoint URL for Prod stage for Hello World function

Value               https://endlwiqqod.execute-api.us-west-2.amazonaws.com/Prod/hello/


Key                 HelloWorldFunction

Description         Hello World Lambda Function ARN

Value               arn:aws:lambda:us-west-2:012345678910:function:sam-app-
HelloWorldFunction-
kyg6Y2iNRUPg

-----------------------------------------------------------------------------------------------------------



Successfully created/updated stack - sam-app in us-west-2
```

Learn more

To learn more about using the AWS SAM CLI `sam deploy` command, see the following:

- **The Complete AWS SAM Workshop: Module 3 - Deploy manually** – Learn how to build, package, and deploy a serverless application using the AWS SAM CLI.

Options for deploying your application with AWS SAM

With AWS SAM, you can deploy your application manually and automate deployments. Use the AWS SAM CLI to manually deploy your application. To automate deployment, use pipelines and a continuous integration and continuous deployment (CI/CD) system. The topics in this section provide information on both approaches.

Topics

- How to use the AWS SAM CLI to manually deploy
- Deploy with CI/CD systems and pipelines
- Gradual deployments
- Troubleshooting deployments using the AWS SAM CLI
- Learn more

How to use the AWS SAM CLI to manually deploy

After you develop and test your serverless application locally, you can deploy your application using the **sam deploy** 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 container images). The command then deploys your application to the AWS Cloud.

Example:

```
# Deploy an application using prompts:
sam deploy --guided
```

Deploy with CI/CD systems and pipelines

AWS SAM helps you automate deployment using pipelines and a continuous integration and continuous deployment (CI/CD) system. AWS SAM can be used to create pipelines and simplify CI/CD tasks for serverless applications. Multiple CI/CD systems support AWS SAM build container images, and AWS SAM also provides a set of default pipeline templates for multiple CI/CD systems that encapsulate AWS's deployment best practices.

For more information, see Using CI/CD systems and pipelines to deploy with AWS SAM.

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 with AWS SAM.

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 Control API access with your AWS SAM template.
- 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.

Learn more

For hands-on examples of deploying serverless applications, see the following from *The Complete AWS SAM Workshop*:

- Module 3 - Deploy manually – Learn how to build, package, and deploy a serverless application using the AWS SAM CLI.
- Module 4 - CI/CD – Learn how to automate the build, package, and deployment phases by creating a *continuous integration and delivery (CI/CD)* pipeline.

Using CI/CD systems and pipelines to deploy with AWS SAM

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 for AWS SAM.

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.

Topics

- What is a pipeline?
- How AWS SAM uploads local files at deployment
- Generate a starter CI/CD pipeline with AWS SAM
- How to customize starter pipelines with AWS SAM
- Automate the deployment of your AWS SAM application
- How to use OIDC authentication with AWS SAM pipelines

What is a pipeline?

A pipeline is an automated sequence of steps that are performed to release a new version of an application. With AWS SAM, you can use many common CI/CD systems to deploy your applications, including AWS CodePipeline, Jenkins, GitLab CI/CD, and GitHub Actions.

Pipeline templates include AWS deployment best practices to help with multi-account and multi-Region deployments. AWS environments such as dev and production typically exist in different AWS accounts. This allows development teams to configure safe deployment pipelines, without making unintended changes to infrastructure.

You can also supply your own custom pipeline templates to help to standardize pipelines across development teams.

How AWS SAM uploads local files at deployment

When you deploy your application to the AWS Cloud, AWS CloudFormation requires that your local files are first uploaded to an accessible AWS service, such as Amazon Simple Storage Service (Amazon S3). This includes local files your AWS SAM template references. To meet this requirement, the AWS SAM CLI does the following when you use the `sam deploy` or `sam package` command:

1. Automatically uploads your local files to an accessible AWS service.
2. Automatically updates your application template to reference the new file path.

Topics

- Demo: Use the AWS SAM CLI to upload Lambda function code
- Supported use cases
- Learn more

Demo: Use the AWS SAM CLI to upload Lambda function code

In this demo, we initialize the sample Hello World application using a .zip package type for our Lambda function. We use the AWS SAM CLI to automatically upload our Lambda function code to Amazon S3 and reference its new path in our application template.

First, we run `sam init` to initialize our Hello World application.

```
$ sam init
...
Which template source would you like to use?
        1 - AWS Quick Start Templates
        2 - Custom Template Location
Choice: 1

Choose an AWS Quick Start application template
        1 - Hello World Example
        2 - Multi-step workflow
        ...
Template: 1

Use the most popular runtime and package type? (Python and zip) [y/N]: y

Would you like to enable X-Ray tracing on the function(s) in your application?  [y/
N]: ENTER

Would you like to enable monitoring using CloudWatch Application Insights?
For more info, please view https://docs.aws.amazon.com/AmazonCloudWatch/latest/
monitoring/cloudwatch-application-insights.html [y/N]: ENTER

Project name [sam-app]: demo

    -----------------------
    Generating application:
    -----------------------
    Name: demo
    Runtime: python3.9
    Architectures: x86_64
    Dependency Manager: pip
    Application Template: hello-world
    Output Directory: .
    Configuration file: demo/samconfig.toml

...
```

Our Lambda function code is organized in the `hello_world` subdirectory of our project.

```
demo
### README.md
### hello_world
#   ### __init__.py
```

```
#   ### app.py
#   ### requirements.txt
### template.yaml
### tests
```

Within our AWS SAM template, we reference the local path to our Lambda function code using the `CodeUri` property.

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function # More info about Function Resource:
 https://github.com/awslabs/serverless-application-model/blob/master/
versions/2016-10-31.md#awsserverlessfunction
    Properties:
      CodeUri: hello_world/
      Handler: app.lambda_handler
      Runtime: python3.9
      ...
```

Next, we run `sam build` to build our application and prepare for deployment.

```
$ sam build
Starting Build use cache
Manifest file is changed (new hash: 3298f13049d19cffaa37ca931dd4d421) or dependency
 folder (.aws-sam/deps/7896875f-9bcc-4350-8adb-2c1d543627a1) is missing for
 (HelloWorldFunction), downloading dependencies and copying/building source
Building codeuri: /Users/.../demo/hello_world runtime: python3.9 metadata: {}
 architecture: x86_64 functions: HelloWorldFunction
Running PythonPipBuilder:CleanUp
Running PythonPipBuilder:ResolveDependencies
Running PythonPipBuilder:CopySource
Running PythonPipBuilder:CopySource

Build Succeeded

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

Next, we run `sam deploy --guided` to deploy our application.

```
$ sam deploy --guided

Configuring SAM deploy
======================

        Looking for config file [samconfig.toml] :  Found
        Reading default arguments  :  Success

        Setting default arguments for 'sam deploy'
        =========================================
        Stack Name [demo]: ENTER
        AWS Region [us-west-2]: ENTER
        #Shows you resources changes to be deployed and require a 'Y' to initiate
 deploy
        Confirm changes before deploy [Y/n]: n
        #SAM needs permission to be able to create roles to connect to the resources in
 your template
        Allow SAM CLI IAM role creation [Y/n]: ENTER
        #Preserves the state of previously provisioned resources when an operation
 fails
        Disable rollback [y/N]: ENTER
        HelloWorldFunction may not have authorization defined, Is this okay? [y/N]: y
        Save arguments to configuration file [Y/n]: ENTER
        SAM configuration file [samconfig.toml]: ENTER
        SAM configuration environment [default]: ENTER

        Looking for resources needed for deployment:
        ...
        Saved arguments to config file
        Running 'sam deploy' for future deployments will use the parameters saved
 above.
        The above parameters can be changed by modifying samconfig.toml
        Learn more about samconfig.toml syntax at
        https://docs.aws.amazon.com/serverless-application-model/latest/developerguide/
serverless-sam-cli-config.html

File with same data already exists at demo/da3c598813f1c2151579b73ad788cac8, skipping
 upload

        Deploying with following values
        ===============================
        Stack name                   : demo
```

```
        Region                      : us-west-2
        Confirm changeset           : False
        Disable rollback            : False
        Deployment s3 bucket        : aws-sam-cli-managed-default-samclisam-s3-demo-
bucket-1a4x26zbcdkqr
        Capabilities                : ["CAPABILITY_IAM"]
        Parameter overrides         : {}
        Signing Profiles            : {}

Initiating deployment
=====================
...
Waiting for changeset to be created..
CloudFormation stack changeset
-----------------------------------------------------------------------------------------------
Operation                LogicalResourceId        ResourceType             Replacement

-----------------------------------------------------------------------------------------------
+ Add                    HelloWorldFunctionHell   AWS::Lambda::Permissio   N/A

                         oWorldPermissionProd     n

+ Add                    HelloWorldFunctionRole   AWS::IAM::Role           N/A

...
-----------------------------------------------------------------------------------------------

Changeset created successfully. arn:aws:cloudformation:us-
west-2:012345678910:changeSet/samcli-deploy1680906292/1164338d-72e7-4593-a372-
f2b3e67f542f

2023-04-07 12:24:58 - Waiting for stack create/update to complete

CloudFormation events from stack operations (refresh every 5.0 seconds)
-----------------------------------------------------------------------------------------------
ResourceStatus           ResourceType             LogicalResourceId
 ResourceStatusReason
-----------------------------------------------------------------------------------------------
CREATE_IN_PROGRESS       AWS::IAM::Role           HelloWorldFunctionRole   -

CREATE_IN_PROGRESS       AWS::IAM::Role           HelloWorldFunctionRole   Resource
 creation
                                                                           Initiated
```

```
...
-----------------------------------------------------------------------------------------------------
CloudFormation outputs from deployed stack
-----------------------------------------------------------------------------------------------------
Outputs

-----------------------------------------------------------------------------------------------------
Key                 HelloWorldFunctionIamRole

Description         Implicit IAM Role created for Hello World function

Value               arn:aws:iam::012345678910:role/demo-HelloWorldFunctionRole-
VQ4CU7UY7S2K

Key                 HelloWorldApi

Description         API Gateway endpoint URL for Prod stage for Hello World function

Value               https://satnon55e9.execute-api.us-west-2.amazonaws.com/Prod/hello/


Key                 HelloWorldFunction

Description         Hello World Lambda Function ARN

Value               arn:aws:lambda:us-west-2:012345678910:function:demo-

HelloWorldFunction-G14inKTmSQvK

-----------------------------------------------------------------------------------------------------
Successfully created/updated stack - demo in us-west-2
```

During deployment, the AWS SAM CLI automatically uploads our Lambda function code to Amazon S3 and updates our template. Our modified template in the CloudFormation console reflects the Amazon S3 bucket path.

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function
    Properties:
```

```
      CodeUri: s3://aws-sam-cli-managed-default-samclisam-s3-demo-bucket-1a4x26zbcdkqr/
demo/da3c598813f1c2151579b73ad788cac8
      Handler: app.lambda_handler
      ...
```

Supported use cases

The AWS SAM CLI can automatically facilitate this process for a number of file types, CloudFormation resource types, and CloudFormation macros.

File types

Application files and Docker images are supported.

CloudFormation resource types

The following is a list of the supported resource types and their properties:

Resource	Properties
`AWS::ApiGateway::RestApi`	`BodyS3Location`
`AWS::ApiGatewayV2::Api`	`BodyS3Location`

`AWS::AppSync::FunctionConfiguration`	`CodeS3Location`
	`RequestMappingTemplateS3Location`
	`ResponseMappingTemplateS3Location`

`AWS::AppSync::GraphQLSchema`	`DefinitionS3Location`

`AWS::AppSync::Resolver`	`CodeS3Location`
	`RequestMappingTemplateS3Location`
	`ResponseMappingTemplateS3Location`

Resource	Properties
AWS::CloudFormation::ModuleVersion	ModulePackage
AWS::CloudFormation::ResourceVersion	SchemaHandlerPackage
AWS::ECR::Repository	RepositoryName
AWS::ElasticBeanstalk::ApplicationVersion	SourceBundle
AWS::Glue::Job	Command.ScriptLocation
AWS::Lambda::Function	Code Code.ImageUri
AWS::Lambda::LayerVersion	Content
AWS::Serverless::Api	DefinitionUri
AWS::Serverless::Function	CodeUri ImageUri
AWS::Serverless::GraphQLApi	SchemaUri Function.CodeUri Resolver.CodeUri
AWS::Serverless::HttpApi	DefinitionUri
AWS::Serverless::LayerVersion	ContentUri
AWS::Serverless::StateMachine	DefinitionUri

Resource	Properties
`AWS::StepFunctions::StateMachine`	`DefinitionS3Location`

CloudFormation macros

Files referenced using the `AWS::Include` transform macro are supported.

Learn more

To learn more about the `AWS::Include` transform, see AWS::Include transform in the *AWS CloudFormation User Guide*.

To see an example of using the `AWS::Include` transform in an AWS SAM template, see the API Gateway HTTP API to SQS pattern at *Serverless Land*.

Generate a starter CI/CD pipeline with AWS SAM

When you are ready automate deployment, you can use one of AWS SAM's starter pipeline templates to generate a deployment pipeline for the CI/CD system you choose to use. Your deployment pipeline is what you configure and use to automate the deployment of your serverless application. A starter pipeline template is pre-configured to help you quickly set up your deployment pipeline for your serverless application.

With a starter pipeline template, you can generate pipelines in minutes using the sam pipeline init 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, GitHub Actions, and Bitbucket Pipelines.

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 in AWS SAM.
- If you are using Jenkins, GitLab CI/CD, GitHub Actions, or Bitbucket Pipelines, see Use AWS SAM to generate starter pipelines for Jenkins, GitLab CI/CD, GitHub Actions, Bitbucket Pipelines.

Generating starter pipeline for AWS CodePipeline in AWS SAM

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` and `sam pipeline init`. 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**
>
> Run the previous command 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>"
```

Learn more

For a hands-on example of setting up a CI/CD pipeline, see CI/CD with AWS CodePipeline in *The Complete AWS SAM Workshop*.

Use AWS SAM to generate starter pipelines for Jenkins, GitLab CI/CD, GitHub Actions, Bitbucket Pipelines

To generate a starter pipeline configuration for Jenkins, GitLab CI/CD, GitHub Actions, or Bitbucket Pipelines 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` and `sam pipeline init`. 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**
>
> Run the previous command 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
> 3. Bitbucket Pipelines with a Bitbucket 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.
- If you're using Bitbucket Pipelines, create two "secure variables", one for each of key id and secret key. Follow the instructions in the Variables and secrets - 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.

Learn more

For a hands-on example of setting up a CI/CD pipeline using GitHub Actions, see CI/CD with GitHub in *The Complete AWS SAM Workshop*.

How to customize starter pipelines with AWS SAM

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 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 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}}'
    ...
```

Automate the deployment of your AWS SAM application

In AWS SAM, how you automate the deployment of your AWS SAM application varies depending on the CI/CD system you are using. For this reason, the examples in this section show you how to configure various CI/CD systems to automate building serverless applications in an AWS SAM build container image. These build container images make it easier to build and package serverless applications using the AWS SAM CLI.

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:

Topics

- Using AWS CodePipeline to deploy with AWS SAM
- Using Bitbucket Pipelines to deploying with AWS SAM
- Using Jenkins to deploy with AWS SAM
- Using GitLab CI/CD to deploy with AWS SAM
- Using GitHub Actions to deploy with AWS SAM

Using AWS CodePipeline to deploy with AWS SAM

To configure your AWS CodePipeline pipeline to automate the build and deployment of your AWS SAM application, your 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-nodejs20.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: nodejs20.x`.

CloudFormation template snippet:

```
  CodeBuildProject:
    Type: AWS::CodeBuild::Project
    Properties:
      Environment:
        ComputeType: BUILD_GENERAL1_SMALL
        Image: public.ecr.aws/sam/build-nodejs20.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 for AWS SAM.

Using Bitbucket Pipelines to deploying with AWS SAM

To configure your Bitbucket Pipeline to automate the build and deployment of your AWS SAM application, your `bitbucket-pipelines.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-nodejs20.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: nodejs20.x`.

```
image: public.ecr.aws/sam/build-nodejs20.x

pipelines:
  branches:
    main: # branch name
      - step:
          name: Build and Package
          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 for AWS SAM.

Using Jenkins to deploy with AWS SAM

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-nodejs20.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: nodejs20.x`.

```
pipeline {
    agent { docker { image 'public.ecr.aws/sam/build-nodejs20.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 for AWS SAM.

Using GitLab CI/CD to deploy with AWS SAM

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-nodejs20.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: nodejs20.x`.

```
image: public.ecr.aws/sam/build-nodejs20.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 for AWS SAM.

Using GitHub Actions to deploy with AWS SAM

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@v3
      - uses: actions/setup-python@v3
      - uses: aws-actions/setup-sam@v2
      - 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 for AWS SAM.

How to use OIDC authentication with AWS SAM pipelines

AWS Serverless Application Model (AWS SAM) supports OpenID Connect (OIDC) user authentication for Bitbucket, GitHub Actions, and GitLab continuous integration and continuous delivery (CI/CD) platforms. With this support, you can use authorized CI/CD user accounts from any of these platforms to manage your serverless application pipelines. Otherwise, you would need to create and manage multiple AWS Identity and Access Management (IAM) users to control access to AWS SAM pipelines.

Set up OIDC with AWS SAM pipeline

During the `sam pipeline bootstrap` configuration process, do the following to set up OIDC with your AWS SAM pipeline.

1. When prompted to choose an identity provider, select **OIDC**.
2. Next, select a supported OIDC provider.
3. Enter the OIDC provider URL, beginning with **`https://`**.

> **Note**
>
> AWS SAM references this URL when it generates the `AWS::IAM::OIDCProvider` resource type.

4. Next, follow the prompts and enter the CI/CD platform information needed to access the selected platform. These details vary by platform and can include:
   - OIDC client ID.
   - Code repository name or universally unique identifier (UUID).
   - Group or Organization name associated with the repository.
   - GitHub organization that the code repository belongs to.
   - GitHub repository name.
   - Branch that deployments will occur from.
5. AWS SAM displays a summary of the entered OIDC configuration. Enter the number for a setting to edit it, or press **Enter** to continue.
6. When prompted to confirm the creation of resources needed to support the entered OIDC connection, press **Y** to continue.

AWS SAM generates an `AWS::IAM::OIDCProvider` AWS CloudFormation resource with the provided configuration that assumes the pipeline execution role. To learn more about this CloudFormation resource type, see AWS::IAM::OIDCProvider in the *AWS CloudFormation User Guide*.

> **Note**
>
> If the identity provider (IdP) resource already exists in your AWS account, AWS SAM references it instead of creating a new resource.

Example

The following is an example of setting up OIDC with AWS SAM pipeline.

```
Select a permissions provider:
    1 - IAM (default)
    2 - OpenID Connect (OIDC)
Choice (1, 2): 2
Select an OIDC provider:
    1 - GitHub Actions
    2 - GitLab
    3 - Bitbucket
Choice (1, 2, 3): 1
```

```
Enter the URL of the OIDC provider [https://token.actions.githubusercontent.com]:
Enter the OIDC client ID (sometimes called audience) [sts.amazonaws.com]:
Enter the GitHub organization that the code repository belongs to. If there is no
 organization enter your username instead: my-org
Enter GitHub repository name: testing
Enter the name of the branch that deployments will occur from [main]:

[3] Reference application build resources
Enter the pipeline execution role ARN if you have previously created one, or we will
 create one for you []:
Enter the CloudFormation execution role ARN if you have previously created one, or we
 will create one for you []:
Please enter the artifact bucket ARN for your Lambda function. If you do not have a
 bucket, we will create one for you []:
Does your application contain any IMAGE type Lambda functions? [y/N]:

[4] Summary
Below is the summary of the answers:
    1 - Account: 123456
    2 - Stage configuration name: dev
    3 - Region: us-east-1
    4 - OIDC identity provider URL: https://token.actions.githubusercontent.com
    5 - OIDC client ID: sts.amazonaws.com
    6 - GitHub organization: my-org
    7 - GitHub repository: testing
    8 - Deployment branch: main
    9 - Pipeline execution role: [to be created]
    10 - CloudFormation execution role: [to be created]
    11 - Artifacts bucket: [to be created]
    12 - ECR image repository: [skipped]
Press enter to confirm the values above, or select an item to edit the value:

This will create the following required resources for the 'dev' configuration:
    - IAM OIDC Identity Provider
    - Pipeline execution role
    - CloudFormation execution role
    - Artifact bucket
Should we proceed with the creation? [y/N]:
```

Learn more

For more information on using OIDC with AWS SAM pipeline, see sam pipeline bootstrap.

Introduction to using sam sync to sync to AWS Cloud

The AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam sync` command provides options to quickly sync local application changes to the AWS Cloud. Use `sam sync` when developing your applications to:

1. Automatically detect and sync local changes to the AWS Cloud.
2. Customize what local changes are synced to the AWS Cloud.
3. Prepare your application in the cloud for testing and validation.

With `sam sync`, you can create a rapid development workflow that shortens the time it takes to sync your local changes to the cloud for testing and validation.

> **Note**
>
> The `sam sync` command is recommended for development environments. For production environments, we recommend using `sam deploy` or configuring a *continuous integration and delivery (CI/CD)* pipeline. To learn more, see Deploy your application and resources with AWS SAM.

The `sam sync` command is a part of AWS SAM Accelerate. *AWS SAM Accelerate* provides tools that you can use to speed up the experience of developing and testing serverless applications in the AWS Cloud.

Topics

- Automatically detect and sync local changes to the AWS Cloud
- Customize what local changes are synced to the AWS Cloud
- Prepare your application in the cloud for testing and validation
- Options for the sam sync command
- Troubleshooting
- Examples
- Learn more

Automatically detect and sync local changes to the AWS Cloud

Run `sam sync` with the `--watch` option to begin syncing your application to the AWS Cloud. This does the following:

1. **Build your application** – This process is similar to using the `sam build` command.
2. **Deploy your application** – The AWS SAM CLI deploys your application to AWS CloudFormation using your default settings. The following default values are used:
   a. AWS credentials and general configuration settings found in your `.aws` user folder.
   b. Application deployment settings found in your application's `samconfig.toml` file.

   If default values can't be found, the AWS SAM CLI will inform you and exit the sync process.
3. **Watch for local changes** – The AWS SAM CLI remains running and watches for local changes to your application. This is what the `--watch` option provides.

   This option may be turned on by default. For default values, see your application's `samconfig.toml` file. The following is an example file:

   ```
   ...
   [default.sync]
   [default.sync.parameters]
   watch = true
   ...
   ```
4. **Sync local changes to the AWS Cloud** – When you make local changes, the AWS SAM CLI detects and syncs those changes to the AWS Cloud through the quickest method available. Depending on the type of change, the following may occur:
   a. If your updated resource supports AWS service APIs, the AWS SAM CLI will use it to deploy your changes. This results in a quick sync to update your resource in the AWS Cloud.
   b. If your updated resource doesn't support AWS service APIs, the AWS SAM CLI will perform an CloudFormation deployment. This updates your entire application in the AWS Cloud. While not as quick, it does prevent you from having to manually initiate a deployment.

Since the `sam sync` command automatically updates your application in the AWS Cloud, it is recommended for development environments only. When you run `sam sync`, you will be asked to confirm:

```
**The sync command should only be used against a development stack**.

Confirm that you are synchronizing a development stack.

Enter Y to proceed with the command, or enter N to cancel:
 [Y/n]: ENTER
```

Customize what local changes are synced to the AWS Cloud

Provide options to customize what local changes are synced to the AWS Cloud. This can speed up the time it takes to see your local changes in the cloud for testing and validation.

For example, provide the `--code` option to sync only code changes, such as AWS Lambda function code. During development, if you are focused specifically on Lambda code, this will get your changes into the cloud quickly for testing and validation. The following is an example:

```
$ sam sync --code --watch
```

To sync only code changes for a specific Lambda function or layer, use the `--resource-id` option. The following is an example:

```
$ sam sync --code --resource-id HelloWorldFunction --resource-id HelloWorldLayer
```

Prepare your application in the cloud for testing and validation

The `sam sync` command automatically finds the quickest method available to update your application in the AWS Cloud. This can speed up your development and cloud testing workflows. By utilizing AWS service APIs, you can quickly develop, sync, and test supported resources. For a hands-on example, see Module 6 - AWS SAM Accelerate in *The Complete AWS SAM Workshop*.

Options for the sam sync command

The following are some of the main options you can use to modify the `sam sync` command. For a list of all options, see sam sync.

Perform a one-time CloudFormation deployment

Use the `--no-watch` option to turn off automatic syncing. The following is an example:

```
$ sam sync --no-watch
```

The AWS SAM CLI will perform a one-time CloudFormation deployment. This command groups together the actions performed by the `sam build` and `sam deploy` commands.

Skip the initial CloudFormation deployment

You can customize whether an CloudFormation deployment is required each time `sam sync` is run.

- Provide `--no-skip-deploy-sync` to require an CloudFormation deployment each time `sam sync` is run. This ensures that your local infrastructure is synced to CloudFormation, preventing drift. Using this option does add additional time to your development and testing workflow.
- Provide `--skip-deploy-sync` to make CloudFormation deployment optional. The AWS SAM CLI will compare your local AWS SAM template with your deployed CloudFormation template and will skip the initial CloudFormation deployment if a change isn't detected. Skipping CloudFormation deployment can save you time when syncing local changes to the AWS Cloud.

  If no change is detected, the AWS SAM CLI will still perform an CloudFormation deployment in the following scenarios:

  - If its been 7 days or more since your last CloudFormation deployment.
  - If a large number of Lambda function code changes are detected, making CloudFormation deployment the quickest method to update your application.

The following is an example:

```
$ sam sync --skip-deploy-sync
```

Sync a resource from a nested stack

To sync a resource from a nested stack

1. Provide the root stack using `--stack-name`.
2. Identify the resource in the nested stack using the following format: *`nestedStackId/resourceId`*.
3. Provide the resource in the nested stack using `--resource-id`.

   The following is an example:

```
$ sam sync --code --stack-name sam-app --resource-id myNestedStack/
HelloWorldFunction
```

For more information about creating nested applications, see Reuse code and resources using nested applications in AWS SAM.

Specify a specific CloudFormation stack to update

To specify a specific CloudFormation stack to update, provide the `--stack-name` option. The following is an example:

```
$ sam sync --stack-name dev-sam-app
```

Speed up build times by building your project in the source folder

For supported runtimes and build methods, you can use the `--build-in-source` option to build your project directly in the source folder. By default, the AWS SAM CLI builds in a temporary directory, which involves copying over source code and project files. With `--build-in-source`, the AWS SAM CLI builds directly in your source folder, which speeds up the build process by removing the need to copy files to a temporary directory.

For a list of supported runtimes and build methods, see `--build-in-source`.

Specify files and folders that won't initiate a sync

Use the `--watch-exclude` option to specify any file or folder that won't initiate a sync when updated. For more information about this option, see `--watch-exclude`.

The following is an example that excludes the `package-lock.json` file associated with our `HelloWorldFunction` function:

```
$ sam sync --watch --watch-exclude HelloWorldFunction=package-lock.json
```

When this command is run, the AWS SAM CLI will initiate the sync process. This includes the following:

- Run `sam build` to build your functions and prepare your application for deployment.
- Run `sam deploy` to deploy your application.

- Watch for changes to your application.

When we modify the `package-lock.json` file, the AWS SAM CLI won't initiate a sync. When another file is updated, the AWS SAM CLI will initiate a sync, which will include the `package-lock.json` file.

The following is an example of specifying a Lambda function of a child stack:

```
$ sam sync --watch --watch-exclude ChildStackA/MyFunction=database.sqlite3
```

Troubleshooting

To troubleshoot the AWS SAM CLI, see AWS SAM CLI troubleshooting.

Examples

Using sam sync to update the Hello World application

In this example, we start by initializing the sample Hello World application. To learn more about this application, see Tutorial: Deploy a Hello World application with AWS SAM.

Running `sam sync` begins the build and deployment process.

```
$ sam sync

The SAM CLI will use the AWS Lambda, Amazon API Gateway, and AWS StepFunctions APIs to
 upload your code without
performing a CloudFormation deployment. This will cause drift in your CloudFormation
 stack.
**The sync command should only be used against a development stack**.

Confirm that you are synchronizing a development stack.

Enter Y to proceed with the command, or enter N to cancel:
 [Y/n]:
Queued infra sync. Waiting for in progress code syncs to complete...
Starting infra sync.
Manifest file is changed (new hash: 3298f13049d19cffaa37ca931dd4d421) or dependency
 folder (.aws-sam/deps/0663e6fe-a888-4efb-b908-e2344261e9c7) is missing for
 (HelloWorldFunction), downloading dependencies and copying/building source
Building codeuri: /Users/.../Demo/sync/sam-app/hello_world runtime: python3.9 metadata:
 {} architecture: x86_64 functions: HelloWorldFunction
```

```
Running PythonPipBuilder:CleanUp
Running PythonPipBuilder:ResolveDependencies
Running PythonPipBuilder:CopySource

Build Succeeded

Successfully packaged artifacts and wrote output template to file /var/
folders/45/5ct135bx3fn2551_ptl5g6_80000gr/T/tmpx_5t4u3f.
Execute the following command to deploy the packaged template
sam deploy --template-file /var/folders/45/5ct135bx3fn2551_ptl5g6_80000gr/T/tmpx_5t4u3f
 --stack-name <YOUR STACK NAME>


    Deploying with following values
    ===============================
    Stack name                   : sam-app
    Region                       : us-west-2
    Disable rollback             : False
    Deployment s3 bucket         : aws-sam-cli-managed-default-samclisam-s3-demo-
bucket-1a4x26zbcdkqr
    Capabilities                 : ["CAPABILITY_NAMED_IAM", "CAPABILITY_AUTO_EXPAND"]
    Parameter overrides          : {}
    Signing Profiles             : null

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


2023-03-17 11:17:19 - Waiting for stack create/update to complete

CloudFormation events from stack operations (refresh every 0.5 seconds)
---------------------------------------------------------------------------------------------
ResourceStatus                      ResourceType
 LogicalResourceId                   ResourceStatusReason
---------------------------------------------------------------------------------------------
CREATE_IN_PROGRESS                  AWS::CloudFormation::Stack          sam-app
                     Transformation succeeded
CREATE_IN_PROGRESS                  AWS::CloudFormation::Stack
 AwsSamAutoDependencyLayerNestedSt   -
                                                                         ack
CREATE_IN_PROGRESS                  AWS::IAM::Role
 HelloWorldFunctionRole              -
CREATE_IN_PROGRESS                  AWS::IAM::Role
 HelloWorldFunctionRole              Resource creation Initiated
```

```
CREATE_IN_PROGRESS                  AWS::CloudFormation::Stack
 AwsSamAutoDependencyLayerNestedSt   Resource creation Initiated
                                                                        ack
CREATE_COMPLETE                     AWS::IAM::Role
 HelloWorldFunctionRole              -
CREATE_COMPLETE                     AWS::CloudFormation::Stack
 AwsSamAutoDependencyLayerNestedSt   -
                                                                        ack
CREATE_IN_PROGRESS                  AWS::Lambda::Function
 HelloWorldFunction                  -
CREATE_IN_PROGRESS                  AWS::Lambda::Function
 HelloWorldFunction                  Resource creation Initiated
CREATE_COMPLETE                     AWS::Lambda::Function
 HelloWorldFunction                  -
CREATE_IN_PROGRESS                  AWS::ApiGateway::RestApi
 ServerlessRestApi                   -
CREATE_IN_PROGRESS                  AWS::ApiGateway::RestApi
 ServerlessRestApi                   Resource creation Initiated
CREATE_COMPLETE                     AWS::ApiGateway::RestApi
 ServerlessRestApi                   -
CREATE_IN_PROGRESS                  AWS::ApiGateway::Deployment
 ServerlessRestApiDeployment47fc2d   -
                                                                        5f9d
CREATE_IN_PROGRESS                  AWS::Lambda::Permission
 HelloWorldFunctionHelloWorldPermi   -
                                                                        ssionProd
CREATE_IN_PROGRESS                  AWS::Lambda::Permission
 HelloWorldFunctionHelloWorldPermi   Resource creation Initiated
                                                                        ssionProd
CREATE_IN_PROGRESS                  AWS::ApiGateway::Deployment
 ServerlessRestApiDeployment47fc2d   Resource creation Initiated
                                                                        5f9d
CREATE_COMPLETE                     AWS::ApiGateway::Deployment
 ServerlessRestApiDeployment47fc2d   -
                                                                        5f9d
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
 HelloWorldFunctionHelloWorldPermi   -
                                                                        ssionProd
```

```
CREATE_COMPLETE                     AWS::CloudFormation::Stack          sam-app
                      -
-----------------------------------------------------------------------------------------------------

CloudFormation outputs from deployed stack
-----------------------------------------------------------------------------------------------------
Outputs
-----------------------------------------------------------------------------------------------------
Key                 HelloWorldFunctionIamRole
Description         Implicit IAM Role created for Hello World function
Value               arn:aws:iam::012345678910:role/sam-app-HelloWorldFunctionRole-
BUFVMO2PJIYF

Key                 HelloWorldApi
Description         API Gateway endpoint URL for Prod stage for Hello World function
Value               https://pcrx5gdaof.execute-api.us-west-2.amazonaws.com/Prod/hello/

Key                 HelloWorldFunction
Description         Hello World Lambda Function ARN
Value               arn:aws:lambda:us-west-2:012345678910:function:sam-app-
HelloWorldFunction-2PlN6TPTQoco
-----------------------------------------------------------------------------------------------------
Stack creation succeeded. Sync infra completed.

Infra sync completed.
CodeTrigger not created as CodeUri or DefinitionUri is missing for ServerlessRestApi.
```

Once deployment is complete, we modify the `HelloWorldFunction` code. The AWS SAM CLI detects this change and syncs our application to the AWS Cloud. Since AWS Lambda supports AWS service APIs, a quick sync is performed.

```
Syncing Lambda Function HelloWorldFunction...
Manifest is not changed for (HelloWorldFunction), running incremental build
Building codeuri: /Users/.../Demo/sync/sam-app/hello_world runtime: python3.9 metadata:
 {} architecture: x86_64 functions: HelloWorldFunction
Running PythonPipBuilder:CopySource
Finished syncing Lambda Function HelloWorldFunction.
```

Next, we modify our API endpoint in the application's AWS SAM template. We change `/hello` to `/helloworld`.

```
AWSTemplateFormatVersion: '2010-09-09'
```

```
Transform: AWS::Serverless-2016-10-31
...
Resources:
  HelloWorldFunction:
    ...
    Properties:
      ...
      Events:
        HelloWorld:
          Type: Api
          Properties:
            Path: /helloworld
            Method: get
```

Since the Amazon API Gateway resource doesn't support the AWS service API, the AWS SAM CLI automatically performs an CloudFormation deployment. The following is an example output:

```
Queued infra sync. Waiting for in progress code syncs to complete...
Starting infra sync.
Manifest is not changed for (HelloWorldFunction), running incremental build
Building codeuri: /Users/.../Demo/sync/sam-app/hello_world runtime: python3.9 metadata:
 {} architecture: x86_64 functions: HelloWorldFunction
Running PythonPipBuilder:CopySource

Build Succeeded

Successfully packaged artifacts and wrote output template to file /var/
folders/45/5ct135bx3fn2551_ptl5g6_80000gr/T/tmpuabo0jb9.
Execute the following command to deploy the packaged template
sam deploy --template-file /var/folders/45/5ct135bx3fn2551_ptl5g6_80000gr/T/tmpuabo0jb9
 --stack-name <YOUR STACK NAME>


    Deploying with following values
    ===============================
    Stack name                   : sam-app
    Region                       : us-west-2
    Disable rollback             : False
    Deployment s3 bucket         : aws-sam-cli-managed-default-samclisam-s3-demo-
bucket-1a4x26zbcdkqr
    Capabilities                 : ["CAPABILITY_NAMED_IAM", "CAPABILITY_AUTO_EXPAND"]
    Parameter overrides          : {}
    Signing Profiles             : null
```

```
Initiating deployment
=====================



2023-03-17 14:41:18 - Waiting for stack create/update to complete

CloudFormation events from stack operations (refresh every 0.5 seconds)
-----------------------------------------------------------------------------------------------------
ResourceStatus                      ResourceType
 LogicalResourceId                   ResourceStatusReason
-----------------------------------------------------------------------------------------------------
UPDATE_IN_PROGRESS                  AWS::CloudFormation::Stack          sam-app
                     Transformation succeeded
UPDATE_IN_PROGRESS                  AWS::CloudFormation::Stack
 AwsSamAutoDependencyLayerNestedSt   -
                                                                        ack
UPDATE_COMPLETE                     AWS::CloudFormation::Stack
 AwsSamAutoDependencyLayerNestedSt   -
                                                                        ack
UPDATE_IN_PROGRESS                  AWS::ApiGateway::RestApi
 ServerlessRestApi                   -
UPDATE_COMPLETE                     AWS::ApiGateway::RestApi
 ServerlessRestApi                   -
CREATE_IN_PROGRESS                  AWS::ApiGateway::Deployment
 ServerlessRestApiDeployment8cf30e   -
                                                                        d3cd
UPDATE_IN_PROGRESS                  AWS::Lambda::Permission
 HelloWorldFunctionHelloWorldPermi   Requested update requires the
                                                                        ssionProd
                     creation of a new physical

                     resource; hence creating one.
UPDATE_IN_PROGRESS                  AWS::Lambda::Permission
 HelloWorldFunctionHelloWorldPermi   Resource creation Initiated
                                                                        ssionProd
CREATE_IN_PROGRESS                  AWS::ApiGateway::Deployment
 ServerlessRestApiDeployment8cf30e   Resource creation Initiated
                                                                        d3cd
CREATE_COMPLETE                     AWS::ApiGateway::Deployment
 ServerlessRestApiDeployment8cf30e   -
                                                                        d3cd
UPDATE_IN_PROGRESS                  AWS::ApiGateway::Stage
 ServerlessRestApiProdStage          -
```

```
UPDATE_COMPLETE                     AWS::ApiGateway::Stage
 ServerlessRestApiProdStage          -
UPDATE_COMPLETE                     AWS::Lambda::Permission
 HelloWorldFunctionHelloWorldPermi   -
                                                                        ssionProd
UPDATE_COMPLETE_CLEANUP_IN_PROGRE   AWS::CloudFormation::Stack          sam-app
                      -
SS
DELETE_IN_PROGRESS                  AWS::Lambda::Permission
 HelloWorldFunctionHelloWorldPermi   -
                                                                        ssionProd
DELETE_IN_PROGRESS                  AWS::ApiGateway::Deployment
 ServerlessRestApiDeployment47fc2d   -
                                                                        5f9d
DELETE_COMPLETE                     AWS::ApiGateway::Deployment
 ServerlessRestApiDeployment47fc2d   -
                                                                        5f9d
UPDATE_COMPLETE                     AWS::CloudFormation::Stack
 AwsSamAutoDependencyLayerNestedSt   -
                                                                        ack
DELETE_COMPLETE                     AWS::Lambda::Permission
 HelloWorldFunctionHelloWorldPermi   -
                                                                        ssionProd
UPDATE_COMPLETE                     AWS::CloudFormation::Stack          sam-app
                      -
-----------------------------------------------------------------------------------------------------

CloudFormation outputs from deployed stack
-----------------------------------------------------------------------------------------------------
Outputs
-----------------------------------------------------------------------------------------------------
Key                 HelloWorldFunctionIamRole
Description         Implicit IAM Role created for Hello World function
Value               arn:aws:iam::012345678910:role/sam-app-HelloWorldFunctionRole-
BUFVMO2PJIYF

Key                 HelloWorldApi
Description         API Gateway endpoint URL for Prod stage for Hello World function
Value               https://pcrx5gdaof.execute-api.us-west-2.amazonaws.com/Prod/hello/

Key                 HelloWorldFunction
Description         Hello World Lambda Function ARN
Value               arn:aws:lambda:us-west-2:012345678910:function:sam-app-
HelloWorldFunction-2PlN6TPTQoco
```

```
-----------------------
```

Monitor your serverless application with AWS SAM

After deploying your serverless application, you can monitor it to provide insights on its operations and detect anomalies, which can help with troubleshooting. This section provides details on monitoring your serverless application. This includes information on how to configure Amazon CloudWatch to notify you when it detects anomalies. It also provides information on working with logs, including error highlighting and tips for viewing, filtering, fetching, and tailing logs.

Topics

- Using CloudWatch Application Insights to monitor your AWS SAM serverless applications
- Working with logs in AWS SAM

Using CloudWatch Application Insights to monitor your AWS SAM serverless applications

Amazon CloudWatch Application Insights helps you monitor the AWS resources in your applications to help identify potential issues. It can analyze AWS resource data for signs of problems and build automated dashboards to visualize them. You can configure CloudWatch Application Insights to use with your AWS Serverless Application Model (AWS SAM) applications. To learn more about CloudWatch Application Insights, see Amazon CloudWatch Application Insights in the *Amazon CloudWatch User Guide*.

Topics

- Configuring CloudWatch Application Insights with AWS SAM
- Next steps

Configuring CloudWatch Application Insights with AWS SAM

Configure CloudWatch Application Insights for your AWS SAM applications through the AWS SAM Command Line Interface (AWS SAM CLI) or through your AWS SAM templates.

Configure through the AWS SAM CLI

When initializing your application with **sam init**, activate CloudWatch Application Insights through the interactive flow or by using the **--application-insights** option.

To activate CloudWatch Application Insights through the AWS SAM CLI interactive flow, enter **y** when prompted.

```
Would you like to enable monitoring using CloudWatch Application Insights?
For more info, please view https://docs.aws.amazon.com/AmazonCloudWatch/latest/
monitoring/cloudwatch-application-insights.html [y/N]:
```

To activate CloudWatch Application Insights with the **--application-insights** option, do the following.

```
sam init --application-insights
```

To learn more about using the **sam init** command, see sam init.

Configure through AWS SAM templates

Activate CloudWatch Application Insights by defining the `AWS::ResourceGroups::Group` and `AWS::ApplicationInsights::Application` resources in your AWS SAM templates.

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
...
Resources:
  ApplicationResourceGroup:
    Type: AWS::ResourceGroups::Group
    Properties:
      Name:
        Fn::Join:
        - ''
        - - ApplicationInsights-SAM-
        - Ref: AWS::StackName
      ResourceQuery:
        Type: CLOUDFORMATION_STACK_1_0
  ApplicationInsightsMonitoring:
    Type: AWS::ApplicationInsights::Application
    Properties:
      ResourceGroupName:
        Fn::Join:
          - ''
          - - ApplicationInsights-SAM-
          - Ref: AWS::StackName
        AutoConfigurationEnabled: 'true'
```

```
    DependsOn: ApplicationResourceGroup
```

- `AWS::ResourceGroups::Group` – Creates a group to organize your AWS resources in order to manage and automate tasks on a large number of resources at one time. Here, you create a resource group to use with CloudWatch Application Insights. For more information on this resource type, see `AWS::ResourceGroups::Group` in the *AWS CloudFormation User Guide*.
- `AWS::ApplicationInsights::Application` – Configures CloudWatch Application Insights for the resource group. For more information on this resource type, see `AWS::ApplicationInsights::Application` in the *AWS CloudFormation User Guide*.

Both resources are automatically passed through to CloudFormation at application deployment. You can use the CloudFormation syntax in your AWS SAM template to configure CloudWatch Application Insights further. For more information, see Use CloudFormation templates in the *Amazon CloudWatch User Guide*.

When using the **sam init --application-insights** command, both of these resources are automatically generated in your AWS SAM template. Here is an example of a generated template.

```
AWSTemplateFormatVersion: '2010-09-09'
Transform: AWS::Serverless-2016-10-31
Description: >
  sam-app-test

  Sample SAM Template for sam-app-test

# More info about Globals: https://github.com/awslabs/serverless-application-model/
blob/master/docs/globals.rst
Globals:
  Function:
    Timeout: 3
    MemorySize: 128

Resources:
  HelloWorldFunction:
    Type: AWS::Serverless::Function # More info about Function Resource:
 https://github.com/awslabs/serverless-application-model/blob/master/
versions/2016-10-31.md#awsserverlessfunction
    Properties:
      CodeUri: hello_world/
      Handler: app.lambda_handler
```

```
      Runtime: python3.9
      Architectures:
      - x86_64
      Events:
        HelloWorld:
          Type: Api # More info about API Event Source: https://github.com/awslabs/
serverless-application-model/blob/master/versions/2016-10-31.md#api
          Properties:
            Path: /hello
            Method: get

  ApplicationResourceGroup:
    Type: AWS::ResourceGroups::Group
    Properties:
      Name:
        Fn::Join:
        - ''
        - - ApplicationInsights-SAM-
        - Ref: AWS::StackName
      ResourceQuery:
       Type: CLOUDFORMATION_STACK_1_0
  ApplicationInsightsMonitoring:
    Type: AWS::ApplicationInsights::Application
    Properties:
      ResourceGroupName:
        Fn::Join:
        - ''
        - - ApplicationInsights-SAM-
        - Ref: AWS::StackName
      AutoConfigurationEnabled: 'true'
    DependsOn: ApplicationResourceGroup

Outputs:
  # ServerlessRestApi is an implicit API created out of Events key under
 Serverless::Function
  # Find out more about other implicit resources you can reference within SAM
  # https://github.com/awslabs/serverless-application-model/blob/master/docs/internals/
generated_resources.rst#api
  HelloWorldApi:
    Description: API Gateway endpoint URL for Prod stage for Hello World function
    Value: !Sub "https://${ServerlessRestApi}.execute-api.${AWS::Region}.amazonaws.com/
Prod/hello/"
  HelloWorldFunction:
    Description: Hello World Lambda Function ARN
```

```
    Value: !GetAtt HelloWorldFunction.Arn
  HelloWorldFunctionIamRole:
    Description: Implicit IAM Role created for Hello World function
    Value: !GetAtt HelloWorldFunctionRole.Arn
```

Next steps

After configuring CloudWatch Application Insights, use **sam build** to build your application and **sam deploy** to deploy your application. All CloudWatch Application Insights supported resources will be configured for monitoring.

- For a list of supported resources, see Supported logs and metrics in the *Amazon CloudWatch User Guide*.
- To learn how to access CloudWatch Application Insights, see Access CloudWatch Application Insights in the *Amazon CloudWatch User Guide*.

Working with logs in AWS SAM

To simplify troubleshooting, the AWS SAM CLI has a command called `sam logs`. 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 CloudFormation stack

When your function is a part of an 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.

AWS SAM reference

This section contains AWS SAM reference material. This includes AWS SAM CLI reference material, like reference information on AWS SAM CLI commands and additional AWS SAM CLI information, like configuration, version control, and troubleshooting information. Additionally, this section includes reference information on the AWS SAM specification and the AWS SAM template, like reference information on connectors, image repositories, and deployments.

AWS SAM specification and the AWS SAM template

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 SAM template. AWS SAM specification comes with a simplified short-hand syntax you use to define the functions, events, APIs, configurations, and permissions of your serverless application.

You interact with AWS SAM specification through the AWS SAM application project directory, which are the folders and files that are created when you run the **sam init** command. This directory includes the AWS SAM template, an important file that defines your AWS resources. The AWS SAM template is an extension of a AWS CloudFormation template. For the full reference for CloudFormation templates, see Template reference in the *AWS CloudFormation User Guide*.

AWS SAM CLI command reference

The AWS Serverless Application Model Command Line Interface (AWS SAM CLI) is a command line tool that you can use with AWS SAM templates and supported third-party integrations to build and run your serverless applications.

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 that your Lambda function generates. 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*. You need the deployment package 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 Install the AWS SAM CLI.

AWS SAM policy templates

With AWS SAM, you can choose from a list of policy templates to scope your AWS Lambda function's permissions to the resources that your application uses. For a list of available policy templates, refer to Policy template table. For general information on policy templates and AWS SAM, refer to AWS SAM policy templates.

Topics

- AWS SAM template
- AWS SAM CLI command reference
- AWS SAM CLI configuration file
- AWS SAM connector reference
- AWS SAM policy templates
- Image repositories for AWS SAM
- Telemetry in the AWS SAM CLI
- Set up and manage resource access in your AWS SAM template

AWS SAM CLI command reference

This section includes reference information on AWS SAM CLI commands. This includes details on usage, a comprehensive list of the different options available for each command, and additional information. When applicable, additional information includes details like arguments, environment

variables, and events. See each command for details. For instructions about installing the AWS SAM CLI, see Install the AWS SAM CLI.

Topics

- sam build
- sam delete
- sam deploy
- sam init
- sam list
- sam local callback
- sam local execution
- sam local generate-event
- sam local invoke
- sam local start-api
- sam local start-lambda
- sam logs
- sam package
- sam pipeline bootstrap
- sam pipeline init
- sam publish
- sam remote callback
- sam remote execution
- sam remote invoke
- sam remote test-event
- sam sync
- sam traces
- sam validate

sam build

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam build` command.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam build` command, see Introduction to building with AWS SAM.

The `sam build` command prepares an application for subsequent steps in the developer workflow, such as local testing or deploying to the AWS Cloud.

Usage

```
$ sam build <arguments> <options>
```

Arguments

Resource ID

Optional. Instructs AWS SAM to build a single resource declared in an 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

`--base-dir, -s` *`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`

`--beta-features | --no-beta-features`

Allow or deny beta features.

`--build-dir, -b` *`DIRECTORY`*

The path to a directory where the built artifacts are stored. This directory and all of its content are removed with this option.

`--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.

`--build-in-source | --no-build-in-source`

Provide `--build-in-source` to build your project directly in the source folder.

The `--build-in-source` option supports the following runtimes and build methods:

- **Runtimes** – Any Node.js runtime supported by the `sam init --runtime` option.
- **Build methods** – `Makefile`, `esbuild`.

The `--build-in-source` option is not compatible with the following options:

- `--hook-name`
- `--use-container`

Default: `--no-build-in-source`

`--cached | --no-cached`

Enable or disable 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. By default, builds are not cached. If the `--no-cached` option is invoked, it overrides the `cached = true` setting in samconfig.toml.

> **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`.

`--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.

`--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.

`--container-env-var, -e` *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.

`--container-env-var-file, -ef` *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.

This option only applies if the `--use-container` option is specified, otherwise an error will result.

`--debug`

Turns on debug logging to print debug messages that the AWS SAM CLI generates, and to display timestamps.

`--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.

`--exclude, -x`

The Name of the resource(s) to exclude from the `sam build`. For example, if your template contains `Function1`, `Function2`, and `Function3` and you run `sam build --exclude Function2`, only `Function1` and `Function3` will be built.

`--help`

Shows this message and exits.

`--hook-name` *TEXT*

The name of the hook that is used to extend AWS SAM CLI functionality.

Accepted values: `terraform`.

`--manifest , -m` *PATH*

The path to a custom dependency manifest file (for example, package.json) to use instead of the default.

`--mount-symlinks`

Ensures the AWS SAM CLI always mounts symlinks that are present in the files to build or invoke. This applies only to symlinks on the top level directory (that is, symlinks that are directly on the function's root). By default, symlinks are not mounted except for those needed to use `build-in-source` for `node_modules` in NodeJS.

`--no-use-container`

An option that allows you to use the IDE toolkit to set default behavior. You can also use `sam build --no-use-container` to run a build in your local machine instead of a docker container.

`--parallel`

Enables 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.

`--parameter-overrides`

(Optional) A string that contains 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`'. This option is not compatible with `--hook-name`.

`--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.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--skip-prepare-infra`

Skips the preparation stage if no infrastructure changes have been made. Use with the `--hook-name` option.

`--skip-pull-image`

Specifies whether the command should skip pulling down the latest Docker image for the Lambda runtime.

`--template-file, --template, -t PATH`

The path and file name of AWS SAM template file `[default: template.[yaml|yml]]`. This option is not compatible with `--hook-name`.

`--terraform-project-root-path`

The relative or absolute path to the top-level directory containing your Terraform configuration files or function source code. If these files are located outside of the directory containing your Terraform root module, use this option to specify its absolute or relative path. This option requires that `--hook-name` be set to `terraform`.

`--use-container, -u`

If your functions depend on packages that have natively compiled dependencies, use this option to build your function inside a Lambda-like Docker container.

Example

For a detailed example and in-depth walkthrough on using the `sam build` subcommand, refer to Introduction to building with AWS SAM.

sam delete

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam delete` command.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam delete` command deletes an AWS SAM application by deleting the CloudFormation stack, the artifacts that were packaged and deployed to Amazon S3 and Amazon ECR, and the AWS SAM template file.

This command 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 repositories are deleted by default.

Usage

```
$ sam delete <options>
```

Options

`--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.

`--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.

`--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.

`--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.

`--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.

`--s3-bucket`

The path of the Amazon S3 bucket you want to delete.

`--s3-prefix`

The prefix of the Amazon S3 bucket you want to delete.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--stack-name` *TEXT*

The name of the CloudFormation stack that you want to delete.

Examples

The following command deletes the stack `MY-STACK`.

```
$ sam delete --stack-name MY-STACK
```

The following command deletes the stack `MY-STACK` and the S3 bucket `sam-s3-demo-bucket`:

```
$ sam delete \
    --stack-name MyStack \
    --s3-bucket MySAMBucket
```

sam deploy

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam deploy` command.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam deploy` command, see Introduction to deploying with AWS SAM.

The `sam deploy` command deploys an application to the AWS Cloud using AWS CloudFormation.

Usage

```
$ <environment variables> sam deploy <options>
```

Environment variables

`SAM_CLI_POLL_DELAY`

Set the `SAM_CLI_POLL_DELAY` environment variable with a value of seconds in your shell to configure how often the AWS SAM CLI checks the CloudFormation stack state, which is useful when seeing throttling from CloudFormation. This env variable is used for polling `describe_stack` API calls, which are made while running `sam deploy`.

The following is an example of this variable:

```
$ SAM_CLI_POLL_DELAY=5 sam deploy
```

Options

`--capabilities LIST`

A list of capabilities that you must specify to allow CloudFormation to create certain stacks. Some stack templates might include resources that 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, then you can specify either capability. If you have IAM resources with custom names, then you must specify `CAPABILITY_NAMED_IAM`. If you don't specify this option, then the operation returns an `InsufficientCapabilities` error.

When you deploy an application that contains nested applications, you must use `CAPABILITY_AUTO_EXPAND` to acknowledge the application contains nested applications. For more information, see Deploying nested applications.

`--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.

`--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.

`--confirm-changeset | --no-confirm-changeset`

Prompt to confirm whether the AWS SAM CLI deploys the computed changeset.

`--debug`

Turn on debug logging to print the debug message that the AWS SAM CLI generates and to display timestamps.

`--disable-rollback | --no-disable-rollback`

Specify whether to roll back your CloudFormation stack if an error occurs during a deployment. By default, if there's an error during a deployment, your CloudFormation stack rolls back to the last stable state. If you specify `--disable-rollback` and an error occurs during a deployment, then resources that were created or updated before the error occurred aren't rolled back.

`--fail-on-empty-changeset | --no-fail-on-empty-changeset`

Specify whether to return a non-zero exit code if there are no changes to make to the stack. The default behavior is to return a non-zero exit code.

`--force-upload`

Specify this option to upload artifacts even if they match existing artifacts in the Amazon S3 bucket. Matching artifacts are overwritten.

`--guided, -g`

Specify this option to have the AWS SAM CLI use prompts to guide you through the deployment.

`--help`

Show this message and exit.

`--image-repositories` *`TEXT`*

A mapping of functions to their Amazon ECR repository URI. Reference functions by their logical ID. The following is an example:

```
$ sam deploy --image-repositories Function1=123456789012.dkr.ecr.us-
east-1.amazonaws.com/my-repo
```

You can specify this option multiple times in a single command.

`--image-repository` *`TEXT`*

The name of the Amazon ECR repository where this command uploads your function's image. This option is 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 you don't specify this option, then AWS SAM uses Amazon S3-managed encryption keys.

`--metadata`

A map of metadata to attach to all artifacts that are referenced in your template.

`--no-execute-changeset`

Indicates whether to apply the changeset. Specify this option if you want to view your stack changes before applying the changeset. This command creates an CloudFormation changeset and then exits without applying the changeset. To apply the changeset, run the same command without this option.

`--no-progressbar`

Do not display a progress bar when uploading artifacts to Amazon S3.

`--notification-arns` *LIST*

A list of Amazon Simple Notification Service (Amazon SNS) topic ARNs that CloudFormation associates with the stack.

`--on-failure [ROLLBACK | DELETE | DO_NOTHING]`

Specify the action to take when a stack fails to create.

The following options are available:

- `ROLLBACK` – Rolls back the stack to a previous known good state.
- `DELETE` – Rolls back the stack to a previous known good state, if one exists. Otherwise, deletes the stack.
- `DO_NOTHING` – Neither rolls back nor deletes the stack. The effect is the same as that of `--disable-rollback`.

The default behavior is `ROLLBACK`.

> **Note**
>
> You can specify either the `--disable-rollback` option or the `--on-failure` option, but not both.

`--parameter-overrides` *LIST*

A string that contains CloudFormation parameter overrides encoded as key-value pairs. Each override uses the format `ParameterKey=name,ParameterValue=value`. Multiple overrides are separated by spaces. Here are two examples:

```
$ sam deploy --parameter-overrides ParameterKey=value1,ParameterValue=value2
```

```
$ sam deploy --parameter-overrides ParameterKey=value1,ParameterValue=value2
 ParameterKey=hello,ParameterValue=world ParameterKey=apple,ParameterValue=banana
```

`--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.

`--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 the AWS SAM CLI ignores `--resolve-image-repos`.

> **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, then the corresponding Amazon ECR repositories are automatically deleted.

`--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 the AWS SAM CLI ignores `--resolve-s3`. If you specify both the `--s3-bucket` and `--resolve-s3` options, then an error occurs.

`--role-arn` *TEXT*

The Amazon Resource Name (ARN) of an IAM role that CloudFormation assumes when applying the changeset.

`--s3-bucket` *TEXT*

The name of the Amazon S3 bucket where this command uploads your CloudFormation template. If your template is larger than 51,200 bytes, then either the `--s3-bucket` option or the `--resolve-s3` option is required. If you specify both the `--s3-bucket` and `--resolve-s3` options, then an error occurs.

`--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.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--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`.

`--stack-name` *TEXT*

(Required) The name of the CloudFormation stack that you're deploying to. If you specify an existing stack, then the command updates the stack. If you specify a new stack, then the command creates it.

`--tags` *LIST*

A list of tags to associate with the stack that is created or updated. CloudFormation also propagates these tags to resources in the stack that support it.

`--template-file, --template, -t` *PATH*

The path and file name where your AWS SAM template is located.

> **Note**
>
> If you specify this option, then AWS SAM deploys only the template and the local resources that it points to.

`--use-json`

Output JSON for the CloudFormation template. The default output is YAML.

Example

For a detailed example and in-depth walkthrough on using the `sam deploy` subcommand, refer to Introduction to deploying with AWS SAM.

sam init

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam init` command.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam init` command, see Create your application in AWS SAM.

The `sam init` command provides options to initialize a new serverless application.

Usage

```
$ sam init <options>
```

Options

`--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.

`--application-insights | --no-application-insights`

Activate Amazon CloudWatch Application Insights monitoring for your application. To learn more, see Using CloudWatch Application Insights to monitor your AWS SAM serverless applications.

The default option is `--no-application-insights`.

`--architecture, -a` *[x86_64 | arm64]*

The instruction set architecture for your application's Lambda functions. Specify one of `x86_64` or `arm64`.

`--base-image` *[amazon/dotnet8-base | amazon/dotnet6-base | amazon/java25-base | amazon/java21-base | amazon/java17-base | amazon/java11-base | amazon/nodejs24.x-base | amazon/nodejs22.x-base | amazon/nodejs20.x-base | amazon/nodejs18.x-base | amazon/nodejs16.x-base | amazon/python3.14-base | amazon/python3.13-base | amazon/python3.12-base | amazon/python3.11-base | amazon/python3.10-base | amazon/python3.9-base | amazon/python3.8-base | amazon/ruby3.4-base | amazon/ruby3.3-base | amazon/ruby3.2-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, `--package-type` is specified as `Image`, and `--location` is not specified.

`--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.

`--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.

`--debug`

Turns on debug logging to print debug messages that the AWS SAM CLI generates, and to display timestamps.

`--dependency-manager, -d` *[gradle | mod | maven | bundler | npm | cli-package | pip]*

The dependency manager of your Lambda runtime.

`--extra-content`

Override any custom parameters in the template's `cookiecutter.json` configuration, for example, `{"customParam1": "customValue1", "customParam2":"customValue2"}`.

`--help, -h`

Shows this message and exits.

`--location, -l` *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.

`--name, -n` *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.

`--no-input`

Disables Cookiecutter prompting and accepts the vcfdefault values that are defined in the template configuration.

`--no-interactive`

Disable interactive prompting for init parameters, and fail if any required values are missing.

`--output-dir, -o` *PATH*

The location where the initialized application is output.

`--package-type` *[Zip | Image]*

The package type of the example application. `Zip` creates a .zip file archive, and `Image` creates a container image.

`--runtime, -r` *[dotnet8 | dotnet6 | java25 | java21 | java17 | java11 | nodejs24.x | nodejs22.x | nodejs20.x | nodejs18.x | nodejs16.x | python3.14 | python3.13 | python3.12 | python3.11 | python3.10 | python3.9 | python3.8 | ruby3.4 | ruby3.3 | ruby3.2]*

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, `--package-type` is specified as `Zip`, and `--location` is not specified.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--tracing | --no-tracing`

Activate AWS X-Ray tracing for your Lambda functions.

Example

For a detailed example and in-depth walkthrough on using the `sam init` subcommand, refer to Create your application in AWS SAM.

sam list

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam list` command.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam list` command outputs important information about the resources in your serverless application and the state of your serverless application. Use **sam list** before and after deployment to assist during local and cloud development.

Usage

```
$ sam list <options> <subcommand>
```

Options

`--help, -h`

Show this message and exit.

Subcommands

`endpoints`

Displays a list of cloud and local endpoints from your CloudFormation stack. For more information, see sam list endpoints.

`resources`

Displays the resources in your AWS Serverless Application Model (AWS SAM) template that are created in AWS CloudFormation at deployment. For more information, see sam list resources.

`stack-outputs`

Displays the outputs of your CloudFormation stack from an AWS SAM or CloudFormation template. For more information, see sam list stack-outputs.

sam list endpoints

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam list endpoints` subcommand.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam list endpoints` subcommand displays a list of cloud and local endpoints from your CloudFormation stack. You can interact with these resources through the **sam local** and **sam sync** commands.

AWS Lambda and Amazon API Gateway resource types are supported with this command.

> **Note**
>
> Custom domains are supported when configured for your Amazon API Gateway resources. This command will output the custom domain instead of the default endpoint.

Usage

```
$ sam list endpoints <options>
```

Options

`--config-env` *TEXT*

The environment name specifying the default parameter values in the configuration file to use.

Default value: `default`

For more information about configuration files, see AWS SAM CLI configuration file.

`--config-file` *TEXT*

The path and file name of the configuration file containing default parameter values to use.

Default value: `samconfig.toml` in current working directory.

For more information about configuration files, see AWS SAM CLI configuration file.

`--debug`

Turn on debug logging to print debug messages generated by the AWS SAM CLI with timestamps.

`--help, -h`

Show this message and exit.

`--output [json|table]`

Specify the format to output results.

Default value: `table`

`--profile` *TEXT*

Select a specific profile from your credential file to get AWS credentials.

`--region` *TEXT*

Set the AWS region of the service. For example, `us-east-1`.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--stack-name` *TEXT*

Name of the deployed CloudFormation stack. The stack name can be found in your application's `samconfig.toml` file or designated configuration file.

When this option is not specified, local resources defined in your template will display.

`--template-file, --template, -t` *PATH*

AWS SAM template file.

Default value: `template.[yaml|yml|json]`

Examples

Display an output, in json format, of deployed resource endpoints from your CloudFormation stack named `test-stack`.

```
$ sam list endpoints --stack-name test-stack --output json

[
  {
    "LogicalResourceId": "HelloWorldFunction",
    "PhysicalResourceId": "sam-app-test-list-HelloWorldFunction-H85Y7yIV7ZLq",
    "CloudEndpoint": "https://zt55oi7kbljxjmcoahsj3cknwu0rposq.lambda-url.us-
east-1.on.aws/",
    "Methods": "-"
  },
  {
    "LogicalResourceId": "ServerlessRestApi",
    "PhysicalResourceId": "uj80uoe2o2",
    "CloudEndpoint": [
      "https://uj80uoe2o2.execute-api.us-east-1.amazonaws.com/Prod",
      "https://uj80uoe2o2.execute-api.us-east-1.amazonaws.com/Stage"
    ],
    "Methods": [
      "/hello['get']"
    ]
  }
```

```
]
```

sam list resources

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam list resources` subcommand.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam list resources` subcommand displays the resources in your AWS Serverless Application Model (AWS SAM) template that are created in AWS CloudFormation by the AWS SAM transform at deployment.

Use **sam list resources** with an AWS SAM template before deployment to see resources that will be created. Provide an CloudFormation stack name to view a consolidated list that includes deployed resources.

> **Note**
>
> To generate a list of resources from your AWS SAM template, a local transform of your template is performed. Resources that will be deployed with conditions, such as within a specific region, are included in this list.

Usage

```
$ sam list resources <options>
```

Options

`--config-env` *TEXT*

The environment name specifying the default parameter values in the configuration file to use.

Default value: `default`

For more information about configuration files, see AWS SAM CLI configuration file.

`--config-file` *TEXT*

The path and file name of the configuration file containing default parameter values to use.

Default value: `samconfig.toml` in current working directory.

For more information about configuration files, see AWS SAM CLI configuration file.

`--debug`

Turn on debug logging to print debug messages generated by the AWS SAM CLI with timestamps.

`--help, -h`

Show this message and exit.

`--output [json|table]`

Specify the format to output results.

Default value: `table`

`--profile` *TEXT*

Select a specific profile from your credential file to get AWS credentials.

`--region` *TEXT*

Set the AWS region of the service. For example, `us-east-1`.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--stack-name` *TEXT*

Name of the deployed CloudFormation stack. The stack name can be found in your application's `samconfig.toml` file or designated configuration file.

When provided, resource logical IDs from your template will be mapped to their corresponding physical IDs in CloudFormation. To learn more about physical IDs, see Resource fields in the *AWS CloudFormation User Guide*.

When this option is not specified, local resources defined in your template will display.

`--template-file, --template, -t` *PATH*

AWS SAM template file.

Default value: `template.[yaml|yml|json]`

Examples

Display an output, in table format, of local resources from your AWS SAM template and deployed resources from your CloudFormation stack named `test-stack`. Run from the same directory as your local template.

```
$ sam list resources --stack-name test-stack --output table

-----------------------------------------------------------------------------------------------------
Logical ID                                                      Physical ID
-----------------------------------------------------------------------------------------------------
HelloWorldFunction                                              sam-app-test-list-
HelloWorldFunction-H85Y7yIV7ZLq
HelloWorldFunctionHelloWorldPermissionProd                      sam-app-test-list-

 HelloWorldFunctionHelloWorldPermissionProd-1QH7CPOCBL2IK
HelloWorldFunctionRole                                          sam-app-test-list-
HelloWorldFunctionRole-SRJDMJ6F7F41
ServerlessRestApi                                               uj80uoe2o2
ServerlessRestApiDeployment47fc2d5f9d                           pncw5f
ServerlessRestApiProdStage                                      Prod
ServerlessRestApiDeploymentf5716dc08b                           -
-----------------------------------------------------------------------------------------------------
```

sam list stack-outputs

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam list stack-outputs` subcommand.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam list stack-outputs` subcommand displays the outputs of your AWS CloudFormation stack from an AWS Serverless Application Model (AWS SAM) or CloudFormation template. For more information on `Outputs`, see Outputs in the *AWS CloudFormation User Guide*.

Usage

```
$ sam list stack-outputs <options>
```

Options

`--config-env` *TEXT*

The environment name specifying the default parameter values in the configuration file to use.

Default value: `default`

For more information about configuration files, see AWS SAM CLI configuration file.

`--config-file` *TEXT*

The path and file name of the configuration file containing default parameter values to use.

Default value: `samconfig.toml` in current working directory.

For more information about configuration files, see AWS SAM CLI configuration file.

`--debug`

Turn on debug logging to print debug messages generated by the AWS SAM CLI with timestamps.

`--help, -h`

Show this message and exit.

`--output [json|table]`

Specify the format to output results.

Default value: `table`

`--profile` *TEXT*

Select a specific profile from your credential file to get AWS credentials.

`--region` *TEXT*

Set the AWS region of the service. For example, `us-east-1`.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--stack-name` *TEXT*

Name of the deployed CloudFormation stack. The stack name can be found in your application's `samconfig.toml` file or designated configuration file.

This option is required.

Examples

Displays the outputs, in table format, of resources in your CloudFormation stack named `test-stack`.

```
$ sam list stack-outputs --stack-name test-stack --output table

-------------------------------------------------------------------------------------------------------
OutputKey                                 OutputValue
 Description
-------------------------------------------------------------------------------------------------------
HelloWorldFunctionIamRole                 arn:aws:iam::account-number:role/sam-
 Implicit IAM Role created for Hello
                                          app-test-list-HelloWorldFunctionRole-    World
 function
                                          SRJDMJ6F7F41
HelloWorldApi                             https://uj80uoe2o2.execute-api.us-       API
 Gateway endpoint URL for Prod
                                          east-1.amazonaws.com/Prod/hello/         stage
 for Hello World function
HelloWorldFunction                        arn:aws:lambda:us-                       Hello
 World Lambda Function ARN
                                          east-1:account-number:function:sam-app-
                                          test-list-
                                          HelloWorldFunction-H85Y7yIV7ZLq
-------------------------------------------------------------------------------------------------------
```

sam local callback

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam local callback` command.

For an introduction to the AWS SAM CLI, see [What is the AWS SAM CLI?]

The `sam local callback` command allows you to send callbacks to local durable function executions during development and testing.

Usage

```
$ sam local callback <subcommand> <options>
```

Options

`--help, -h`

Show this message and exit.

Subcommands

`succeed`

Send a success callback to a durable function execution. For more information, see sam local callback succeed.

`fail`

Send a failure callback to a durable function execution. For more information, see sam local callback fail.

`heartbeat`

Send a heartbeat callback to a durable function execution. For more information, see sam local callback heartbeat.

sam local callback succeed

Send a success callback to a durable function execution.

Usage

```
$ sam local callback succeed CALLBACK_ID [OPTIONS]
```

Required Arguments

`CALLBACK_ID`

The unique identifier of the callback to send a success response to.

Options

`-r, --result TEXT`

Success result payload as string.

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Send success callback with no result:

```
$ sam local callback succeed my-callback-id
```

Send success callback with result:

```
$ sam local callback succeed my-callback-id --result 'Task completed successfully'
```

Send success callback with short option:

```
$ sam local callback succeed my-callback-id -r 'Success result'
```

sam local callback fail

Send a failure callback to a durable function execution.

Usage

```
$ sam local callback fail CALLBACK_ID [OPTIONS]
```

Required Arguments

`CALLBACK_ID`

The unique identifier of the callback to send a failure response to.

Options

`--error-data TEXT`

Additional error data.

`--stack-trace TEXT`

Stack trace entries. This option can be specified multiple times.

`--error-type TEXT`

Type of error.

`--error-message TEXT`

Detailed error message.

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Send failure callback with no parameters:

```
$ sam local callback fail my-callback-id
```

Send failure callback with error message:

```
$ sam local callback fail my-callback-id --error-message 'Task failed'
```

Send failure callback with all parameters:

```
$ sam local callback fail my-callback-id --error-message 'Task failed' --error-type
 'ValidationError' --stack-trace 'at line 42' --error-data '{"code": 500}'
```

sam local callback heartbeat

Send a heartbeat callback to a durable function execution.

Usage

```
$ sam local callback heartbeat CALLBACK_ID [OPTIONS]
```

Required Arguments

`CALLBACK_ID`

The unique identifier of the callback to send a heartbeat to.

Options

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Send heartbeat callback:

```
$ sam local callback heartbeat my-callback-id
```

sam local execution

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam local execution` command.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam local execution` command allows you to manage and inspect local durable function executions during development and testing.

> **Note**
>
> These commands may not require access to AWS credentials.

Usage

```
$ sam local execution <subcommand> <options>
```

Options

`--help, -h`

Show this message and exit.

Subcommands

`get`

Get details of a durable function execution. For more information, see sam local execution get.

`history`

Get execution history of a durable function execution. For more information, see sam local execution history.

`stop`

Stop a durable function execution. For more information, see sam local execution stop.

sam local execution get

Retrieve the details of a specific durable function execution.

> **Note**
> This command may not require access to AWS credentials.

Usage

```
$ sam local execution get DURABLE_EXECUTION_ARN [OPTIONS]
```

Required Arguments

`DURABLE_EXECUTION_ARN`

The Amazon Resource Name (ARN) of the durable function execution to retrieve details for.

Options

`--format [summary|json]`

Output format. Default: `summary`

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Get execution details with default summary format:

```
$ sam local execution get arn:aws:lambda:us-east-1:123456789012:function:MyFunction:
$LATEST/durable-execution/my-execution-name/my-execution-id
```

Get execution details in JSON format:

```
$ sam local execution get arn:aws:lambda:us-east-1:123456789012:function:MyFunction:
$LATEST/durable-execution/my-execution-name/my-execution-id --format json
```

sam local execution history

Get execution history of a durable function execution.

Usage

```
$ sam local execution history EXECUTION_ID [OPTIONS]
```

Required Arguments

`EXECUTION_ID`

The unique identifier of the durable function execution to retrieve history for.

Options

`--format [table|json]`

Output format. Default: `table`

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Get execution history in table format:

```
$ sam local execution history my-execution-id
```

Get execution history in JSON format:

```
$ sam local execution history my-execution-id --format json
```

sam local execution stop

Stop a running durable function execution.

> **Note**
> This command may not require access to AWS credentials.

Usage

```
$ sam local execution stop DURABLE_EXECUTION_ARN [OPTIONS]
```

Required Arguments

`DURABLE_EXECUTION_ARN`

The Amazon Resource Name (ARN) of the durable function execution to stop.

Options

`--error-message TEXT`

Error message to associate with the stopped execution.

`--error-type TEXT`

Error type to associate with the stopped execution.

`--error-data TEXT`

Error data to associate with the stopped execution.

`--stack-trace TEXT`

Stack trace entries. This option can be specified multiple times.

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Stop execution without error details:

```
$ sam local execution stop arn:aws:lambda:us-east-1:123456789012:function:MyFunction:
$LATEST/durable-execution/my-execution-name/my-execution-id
```

Stop execution with error message and type:

```
$ sam local execution stop arn:aws:lambda:us-east-1:123456789012:function:MyFunction:
$LATEST/durable-execution/my-execution-name/my-execution-id --error-message "Execution
 cancelled" --error-type "UserCancellation"
```

Stop execution with full error details and stack trace:

```
$ sam local execution stop arn:aws:lambda:us-east-1:123456789012:function:MyFunction:
$LATEST/durable-execution/my-execution-name/my-execution-id --error-message "Task
 failed" --error-type "TaskFailure" --error-data '{"reason":"timeout"}' --stack-trace
 "at function1()" --stack-trace "at function2()"
```

sam local generate-event

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam local generate-event` subcommand.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam local generate-event` command, see Introduction to testing with sam local generate-event.

The `sam local generate-event` subcommand generates event payload samples for supported AWS services.

Usage

```
$ sam local generate-event <options> <service> <event> <event-options>
```

Options

`--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.

`--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.

`--help`

Shows this message and exits.

Service

To see a list of supported services, run the following:

```
$ sam local generate-event
```

Event

To see a list of supported events that can be generated for each service, run the following:

```
$ sam local generate-event <service>
```

Event options

To see a list of supported event options that you can modify, run the following:

```
$ sam local generate-event <service> <event> --help
```

Examples

For examples on using the `sam local generate-event` subcommand, refer to Generate sample events.

sam local invoke

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam local invoke` subcommand.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam local invoke` subcommand, see Introduction to testing with sam local invoke.

The `sam local invoke` subcommand initiates a one-time invocation of an AWS Lambda function locally.

> **Note**
>
> For durable functions, `sam local invoke` supports stateful execution with automatic checkpointing and replay. The container remains running during durable function execution to handle state persistence and resumption.

Usage

```
$ sam local invoke <arguments> <options>
```

> **Note**
>
> If you have more than one function defined in your AWS SAM template, provide the function logical ID that you want to invoke.

Arguments

Resource ID

The ID of the Lambda function to invoke.

This argument is optional. If your application contains a single Lambda function, the AWS SAM CLI will invoke it. If your application contains multiple functions, provide the ID of the function to invoke.

Valid values: The resource's logical ID or resource ARN.

Options

`--add-host` *`LIST`*

Passes a hostname to IP address mapping to the Docker container's host file. This parameter can be passed multiple times.

Example

Example: `--add-host` *`example.com:127.0.0.1`*

`--beta-features | --no-beta-features`

Allow or deny beta features.

`--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.

`--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.

`--container-env-vars`

(Optional) Pass environment variables to the Lambda function image container when debugging locally.

`--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.

`--debug-args` *TEXT*

Additional arguments to pass to the debugger.

`--debug-port, -d` *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.

`--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.

`--docker-volume-basedir, -v` *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.

`--durable-execution-name` *TEXT*

Name for the durable execution (for durable functions only)

`--env-vars, -n` *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.

`--event, -e` *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*.

`--force-image-build`

Specifies whether the AWS SAM CLI should rebuild the image used for invoking Lambda functions with layers.

`--help`

Shows this message and exits.

`--hook-name TEXT`

The name of the hook that is used to extend AWS SAM CLI functionality.

Accepted values: `terraform`.

`--invoke-image` *TEXT*

The URI of the container image that you want to use for the local function invocation. By default, AWS SAM pulls the container image from Amazon ECR Public (which are listed in Image repositories for AWS SAM). Use this option to pull the image from another location.

For example, `sam local invoke MyFunction --invoke-image amazon/aws-sam-cli-emulation-image-python3.8`.

`--layer-cache-basedir` *DIRECTORY*

Specifies the location of the base directory where the layers that your template uses are downloaded to.

`--log-file, -l` *TEXT*

The log file to send runtime logs to.

`--mount-symlinks`

Ensures the AWS SAM CLI always mounts symlinks that are present in the files to build or invoke. This applies only to symlinks on the top level directory (that is, symlinks that are directly on the function's root). By default, symlinks are not mounted except for those needed to use `build-in-source` for `node_modules` in NodeJS.

`--no-event`

Invokes the function with an empty event.

`--no-memory-limit`

Removes the memory limitation in the container during local invoke, even when memory is configured in the AWS SAM template.

`--parameter-overrides`

A string that contains CloudFormation parameter overrides encoded as key-value pairs. Use the same format as the AWS Command Line Interface (AWS CLI). The AWS SAM CLI format is explicit key and value keywords, each override is separated by a space. Here are two examples:

- `--parameter-overrides ParameterKey=hello,ParameterValue=world`
- `--parameter-overrides ParameterKey=hello,ParameterValue=world ParameterKey=example1,ParameterValue=example2 ParameterKey=apple,ParameterValue=banana`

`--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.

`--runtime` *TEXT*

Uses the specified runtime to invoke a Lambda function locally. This overrides the runtime defined in the `template.yml` file. This also allows testing Lambda functions with different runtimes without modifying the original function configuration.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--shutdown`

Emulates a shutdown event after the invoke completes, in order to test extension handling of shutdown behavior.

`--skip-prepare-infra`

Skips the preparation stage if no infrastructure changes have been made. Use with the `--hook-name` option.

`--skip-pull-image`

By default, the AWS SAM CLI checks Lambda's latest remote runtime environment and updates your local image automatically to keep in sync.

Specify this option to skip pulling down the latest Docker image for your Lambda runtime environment.

`--template, -t` *PATH*

The AWS SAM template file.

This option is not compatible with `--hook-name`.

> **Note**
>
> If you specify this option, AWS SAM loads only the template and the local resources that it points to.

`--tenant-id TEXT`

The tenant ID for multi-tenant Lambda functions. Used to ensure compute isolation between different tenants. Required when invoking functions configured with tenant isolation mode.

`--terraform-plan-file`

The relative or absolute path to your local Terraform plan file when using the AWS SAM CLI with Terraform Cloud. This option requires that `--hook-name` be set to `terraform`.

Examples

The following example uses a generated event for local testing by using an `s3.json` event to invoke a Lambda function locally

```
$ sam local invoke --event events/s3.json S3JsonLoggerFunction
```

The following example tests the function `HelloWorldFunction` using Python 3.11 runtime

```
$ sam local invoke --runtime python3.11 HelloWorldFunction
```

The following example tests the function `HelloWorldFunction` with durable execution name

```
$ sam local invoke HelloWorldFunction --durable-execution-name my-execution
```

sam local start-api

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam local start-api` subcommand.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam local start-api` subcommand, see Introduction to testing with sam local start-api.

The `sam local start-api` subcommand runs your AWS Lambda functions locally to test through a local HTTP server host.

Usage

```
$ sam local start-api <options>
```

Options

`--add-host` *LIST*

Passes a hostname to IP address mapping to the Docker container's host file. This parameter can be passed multiple times.

Example

Example: `--add-host` *example.com:127.0.0.1*

`--beta-features | --no-beta-features`

Allow or deny beta features.

`--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.

`--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.

`--container-env-vars`

Optional. Pass environment variables to image container when locally debugging.

`--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.

`--debug-args` *TEXT*

Additional arguments to be passed to the debugger.

`--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`.

`--debug-port, -d` *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.

`--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.

`--docker-volume-basedir, -v` *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.

`--env-vars, -n` *PATH*

The JSON file that contains values for the Lambda function's environment variables.

`--force-image-build`

Specifies whether AWS SAM CLI should rebuild the image used for invoking functions with layers.

`--help`

Shows this message and exits.

`--hook-name` *TEXT*

The name of the hook that is used to extend AWS SAM CLI functionality.

Accepted values: `terraform`.

`--host` *TEXT*

The local hostname or IP address to bind to (default: '127.0.0.1').

`--invoke-image` *TEXT*

The URI of the container image that you want to use for your Lambda functions. 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 functions in your application. For example, `sam local start-api --invoke-image public.ecr.aws/sam/emu-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 local start-api --invoke-image public.ecr.aws/sam/emu-python3.8 --invoke-image Function1=amazon/aws-sam-cli-emulation-image-python3.8` . With key-value pairs, you can specify different container images for different resources.

`--layer-cache-basedir` *DIRECTORY*

Specifies the location basedir where the Layers your template uses are downloaded to.

`--log-file, -l` *TEXT*

The log file to send runtime logs to.

`--no-memory-limit`

Removes the memory limitation in the container during local invoke, even when memory is configured in the AWS SAM template.

`--parameter-overrides`

A string that contains CloudFormation parameter overrides encoded as key-value pairs. Use the same format as the AWS Command Line Interface (AWS CLI). The AWS SAM CLI format is explicit key and value keywords, each override is separated by a space. Here are two examples:

- `--parameter-overrides ParameterKey=hello,ParameterValue=world`
- `--parameter-overrides ParameterKey=hello,ParameterValue=world ParameterKey=example1,ParameterValue=example2 ParameterKey=apple,ParameterValue=banana`

`--port, -p` *`INTEGER`*

The local port number to listen on (default: '3000').

`--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.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--shutdown`

Emulates a shutdown event after the invoke completes, in order to test extension handling of shutdown behavior.

`--skip-prepare-infra`

Skips the preparation stage if no infrastructure changes have been made. Use with the `--hook-name` option.

`--skip-pull-image`

Specifies whether the CLI should skip pulling down the latest Docker image for the Lambda runtime.

`--ssl-cert-file` *`PATH`*

Path to SSL certificate file (default: None). When using this option, the `--ssl-key-file` option must also be used.

`--ssl-key-file` *PATH*

Path to SSL key file (default: None). When using this option, the `--ssl-cert-file` option must also be used.

`--static-dir, -s` *TEXT*

Any static asset (for example, CSS/JavaScript/HTML) files located in this directory are presented at `/`.

`--template, -t` *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.

`--terraform-plan-file`

The relative or absolute path to your local Terraform plan file when using the AWS SAM CLI with Terraform Cloud. This option requires that `--hook-name` be set to `terraform`.

`--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.

Example

The following example starts a local server, allowing you to test your application via API. For this command to work, the application must be installed and Docker must be running.

```
$ sam local start-api --port 3000
```

sam local start-lambda

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam local start-lambda` subcommand.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam local start-lambda` subcommand, see Introduction to testing with sam local start-lambda.

The `sam local start-lambda` subcommand starts a local endpoint to emulate AWS Lambda.

Usage

```
$ sam local start-lambda <options>
```

Options

`--add-host` *`LIST`*

Passes a hostname to IP address mapping to the Docker container's host file. This parameter can be passed multiple times.

Example

Example: `--add-host` *`example.com:127.0.0.1`*

`--beta-features | --no-beta-features`

Allow or deny beta features.

`--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.

`--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.

`--container-env-vars`

Optional. Pass environment variables to image container when locally debugging.

`--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.

`--debug-args` *TEXT*

Additional arguments to be passed to the debugger.

`--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`.

`--debug-port, -d` *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.

`--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.

`--docker-volume-basedir, -v` *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.

`--env-vars, -n` *PATH*

The JSON file that contains values for the Lambda function's environment variables.

`--force-image-build`

Specify whether the CLI should rebuild the image used for invoking functions with layers.

`--help`

Shows this message and exits.

`--hook-name` *TEXT*

The name of the hook that is used to extend AWS SAM CLI functionality.

Accepted values: `terraform`.

`--host` *TEXT*

The local hostname or IP address to bind to (default: '127.0.0.1').

`--invoke-image` *TEXT*

The URI of the container image that you want to use for the local function invocation. By default, AWS SAM pulls the container image from Amazon ECR Public. Use this option to pull the image from another location.

For example, `sam local start-lambda MyFunction --invoke-image amazon/aws-sam-cli-emulation-image-python3.8`.

`--layer-cache-basedir` *DIRECTORY*

Specifies the location basedir where the layers your template uses are downloaded to.

`--log-file, -l` *TEXT*

The log file to send runtime logs to.

`--no-memory-limit`

Removes the memory limitation in the container during local invoke, even when memory is configured in the AWS SAM template.

`--parameter-overrides`

A string that contains CloudFormation parameter overrides encoded as key-value pairs. Use the same format as the AWS Command Line Interface (AWS CLI). The AWS SAM CLI format is explicit key and value keywords, each override is separated by a space. Here are two examples:

- `--parameter-overrides ParameterKey=hello,ParameterValue=world`
- `--parameter-overrides ParameterKey=hello,ParameterValue=world ParameterKey=example1,ParameterValue=example2 ParameterKey=apple,ParameterValue=banana`

`--port, -p` *`INTEGER`*

The local port number to listen on (default: '3001').

`--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.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--shutdown`

Emulates a shutdown event after the invoke completes, in order to test extension handling of shutdown behavior.

`--skip-prepare-infra`

Skips the preparation stage if no infrastructure changes have been made. Use with the `--hook-name` option.

`--skip-pull-image`

Specifies whether the CLI should skip pulling down the latest Docker image for the Lambda runtime.

`--template, -t` *`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. This option is not compatible with `--hook-name`.

`--terraform-plan-file`

The relative or absolute path to your local Terraform plan file when using the AWS SAM CLI with Terraform Cloud. This option requires that `--hook-name` be set to `terraform`.

`--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.

Example

For a detailed example and in-depth walkthrough on using the `sam local start-lambda` subcommand, refer to Introduction to testing with sam local start-lambda.

sam logs

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam logs` command.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam logs` command fetches logs that are generated by your AWS Lambda functions.

Usage

```
$ sam logs <options>
```

Options

`--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.

`--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.

`--cw-log-group` *LIST*

Includes logs from the CloudWatch Logs log groups that you specify. If you specify this option along with `name`, AWS SAM includes logs from the specified log groups in addition to logs from the named resources.

`--debug`

Turns on debug logging to print debug message generated by the AWS SAM CLI and display timestamps.

`---end-time, e` *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'.

`--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.

`--help`

Shows this message and exits.

`--include-traces`

Includes X-Ray traces in the log output.

`--name, -n` *TEXT*

The name of the resource for which to fetch logs. If this resource is part of an CloudFormation stack, this can be the logical ID of the function resource in the CloudFormation/AWS SAM template. Multiple names can be provided by repeating the parameter again. If resource is in a nested stack, the name can be prepended by the name of the nested stack name to pull logs from that resource (NestedStackLogicalId/ResourceLogicalId). If the resource name isn't given, the given stack will be scanned and log information will be pulled for all supported resources. If you don't specify this option, AWS SAM fetches logs for all resources in the stack that you specify. The following resource types are supported:

- `AWS::Serverless::Function`
- `AWS::Lambda::Function`
- `AWS::Serverless::Api`
- `AWS::ApiGateway::RestApi`
- `AWS::Serverless::HttpApi`
- `AWS::ApiGatewayV2::Api`
- `AWS::Serverless::StateMachine`
- `AWS::StepFunctions::StateMachine`

`--output` *TEXT*

Specifies the output format for logs. To print formatted logs, specify `text`. To print the logs as JSON, specify `json`.

`--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.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--stack-name` *TEXT*

The name of the CloudFormation stack that the resource is a part of.

`--start-time, -s 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'.

`--tail, -t`

Tails the log output. This ignores the end time argument and continues to fetch logs as they become available.

Examples

When your functions are a part of an CloudFormation stack, you can fetch logs by using the function's logical ID when you specify the stack name.

```
$ sam logs -n HelloWorldFunction --stack-name myStack
```

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"
```

View the logs for a resource in a child stack.

```
$ sam logs --stack-name myStack -n childStack/HelloWorldFunction
```

Tail logs for all supported resources in your application.

```
$ sam logs --stack-name sam-app --tail
```

Fetch logs for a specific Lambda function and API Gateway API in your application.

```
$ sam logs --stack-name sam-app --name HelloWorldFunction --name HelloWorldRestApi
```

Fetch logs for all supported resources in your application, and additionally from the specified log groups.

```
$ sam logs --cw-log-group /aws/lambda/myfunction-123 --cw-log-group /aws/lambda/
myfunction-456
```

sam package

The AWS Serverless Application Model Command Line Interface (AWS SAM CLI) 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 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 now implicitly performs the functionality of `sam package`. You can use the sam deploy command directly to package and deploy your application.

Usage

```
$ sam package <arguments> <options>
```

Arguments

Resource ID

The ID of the Lambda function to package.

This argument is optional. If your application contains a single Lambda function, the AWS SAM CLI will package it. If your application contains multiple functions, provide the ID of the function to package a single function.

Valid values: The resource's logical ID or resource ARN.

Options

`--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.

`--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.

`--debug`

Turns on debug logging to print debug message generated by the AWS SAM CLI and display timestamps.

`--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.

`--help`

Shows this message and exits.

`--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.

`--metadata`

(Optional) A map of metadata to attach to all artifacts that are referenced in your template.

`--no-progressbar`

Do not display a progress bar when uploading artifacts to Amazon S3.

`--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.

`--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.

`--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.

`--s3-bucket` *TEXT*

The name of the Amazon S3 bucket where this command uploads your artifact. If your artifact 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.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--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`.

`--template-file, --template, -t 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.

`--use-json`

Output JSON for the CloudFormation template. YAML is used by default.

Example

The following example creates and packages artifacts for a Lambda function and CodeDeploy applications. Artifacts are uploaded to an Amazon S3 bucket. The output of the command is a new file called `package.yml`.

```
$ sam package \
  --template-file template.yml \
  --output-template-file package.yml \
  --s3-bucket amzn-s3-demo-bucket
```

sam pipeline bootstrap

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam local pipeline bootstrap` subcommand.

For an introduction to the AWS SAM CLI, see [What is the AWS SAM CLI?]

The `sam pipeline bootstrap` subcommand 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 subcommand sets up the following AWS infrastructure resources:

- Option of configuring pipeline permissions through:
  - A pipeline IAM user with access key ID and secret key access credentials to be shared with the CI/CD system.

    > **Note**
    >
    > We recommend rotating access keys regularly. For more information, see Rotate access keys regularly for use cases that require long-term credentials in the *IAM User Guide*.

  - Supported CI/CD platforms through OIDC. For an introduction on using OIDC with AWS SAM pipeline, go to How to use OIDC authentication with AWS SAM pipelines.
- An CloudFormation execution IAM role assumed by 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

`--bitbucket-repo-uuid` *TEXT*

The UUID of the Bitbucket repository. This option is specific to using Bitbucket OIDC for permissions.

> **Note**
>
> This value can be found at https://bitbucket.org/*workspace*/*repository*/admin/addon/admin/pipelines/openid-connect

`--bucket` *TEXT*

The ARN of the Amazon S3 bucket that holds the AWS SAM artifacts.

`--cicd-provider` *TEXT*

The CI/CD platform for the AWS SAM pipeline.

`--cloudformation-execution-role` *TEXT*

The ARN of the IAM role to be assumed by CloudFormation while deploying the application's stack. Provide only if you want to use your own role. Otherwise, the command will create a new role.

`--config-env` *TEXT*

The environment name that specifies 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.

`--config-file` *PATH*

The path and file name of the configuration file containing the 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.

`--confirm-changeset | --no-confirm-changeset`

Prompt to confirm the deployment of your resources.

`--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`.

`--debug`

Turns on debug logging and prints debug messages that the AWS SAM CLI generates, and to display timestamps.

`--deployment-branch` *TEXT*

Name of the branch that deployments will occur from. This option is specific to using GitHub Actions OIDC for permissions.

`--github-org` *TEXT*

The GitHub organization that the repository belongs to. If no organization exists, enter the user name of the repository owner. This option is specific to using GitHub Actions OIDC for permissions.

`--github-repo` *TEXT*

Name of the GitHub repository that deployments will occur from. This option is specific to using GitHub Actions OIDC for permissions.

`--gitlab-group` *TEXT*

The GitLab group that the repository belongs to. This option is specific to using GitLab OIDC for permissions.

`--gitlab-project` *TEXT*

The GitLab project name. This option is specific to using GitLab OIDC for permissions.

`--help, -h`

Shows this message and exits.

`--image-repository` *TEXT*

The ARN of an Amazon ECR image repository that holds 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 creates one.

`--interactive | --no-interactive`

Disable interactive prompting for bootstrap parameters and fail if any required parameters are missing. The default value is `--interactive`. For this command, `--stage` is the only required parameter.

> **Note**
>
> If `--no-interactive` is specified along with `--use-oidc-provider`, all required parameters for your OIDC provider must be included.

`--oidc-client-id` *TEXT*

The client ID configured for use with your OIDC provider.

`--oidc-provider` *[github-actions | gitlab | bitbucket-pipelines]*

Name of the CI/CD provider that will be used for OIDC permissions. GitLab, GitHub, and Bitbucket are supported.

`--oidc-provider-url` *TEXT*

The URL for the OIDC provider. Value must begin with **`https://`**.

`--permissions-provider` *[oidc | iam]*

Choose a permissions provider to assume the pipeline execution role. The default value is **`iam`**.

`--pipeline-execution-role` *TEXT*

The ARN of the IAM role to be assumed by the pipeline user to operate on this stage. Provide only if you want to use your own role. If not provided, this command will create a new role.

`--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 an IAM user along with the access key ID and secret access key credentials.

`--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`.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--stage TEXT`

The name of the corresponding deployment stage. It is used as a suffix for the created AWS infrastructure resources.

Troubleshooting

Error: Missing required parameter

When `--no-interactive` is specified along with `--use-oidc-provider` and any of the required parameters are not provided, this error message will be displayed along with a description of the missing parameters.

Example

The following example creates the AWS resources required to create your CI/CD system, and it turns on debug logging and prints debug messages generated by the AWS SAM CLI: uses a generated event for local testing by using an `s3.json` event to invoke a Lambda function locally

```
$ sam pipeline bootstrap --debug
```

sam pipeline init

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam pipeline init` subcommand.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam pipeline init` subcommand 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

`--bootstrap`

Enable interactive mode that walks the user through creating necessary AWS infrastructure resources.

`--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.

`--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.

`--debug`

Turns on debug logging to print debug messages that the AWS SAM CLI generates, and to display timestamps.

`--help, -h`

Shows this message and exits.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

Example

The following example shows you how to use the `--bootstrap` option to allow you to walkthrough an interactive mode that walks you through creating necessary AWS infrastructure resources:

```
$ sam pipeline init --bootstrap
```

sam publish

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam publish` command.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam publish` command publishes an AWS SAM application to the AWS Serverless Application Repository. This command 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 your application with the AWS SAM CLI.

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>
```

Options

`--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.

`--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.

`--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.

`--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.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--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.

`--template, -t` *PATH*

The path of AWS SAM template file `[default: template.[yaml|yml]]`.

Examples

To publish an application:

```
$ sam publish --template packaged.yaml --region us-east-1
```

sam remote callback

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam remote callback` command.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam remote callback` command allows you to send callbacks to remote durable function executions running in AWS Lambda.

> **Note**
>
> These commands require access to AWS credentials.

Usage

```
$ sam remote callback <subcommand> <options>
```

Options

`--help, -h`

Show this message and exit.

Subcommands

`succeed`

Send a callback success to a remote durable function execution. For more information, see sam remote callback succeed.

`fail`

Send a callback failure to a remote durable function execution. For more information, see sam remote callback fail.

`heartbeat`

Send a callback heartbeat to a remote durable function execution. For more information, see sam remote callback heartbeat.

sam remote callback succeed

Send a callback success to a remote durable function execution.

> **Note**
>
> This command requires access to AWS credentials.

Usage

```
$ sam remote callback succeed CALLBACK_ID [OPTIONS]
```

Required Arguments

`CALLBACK_ID`

The unique identifier of the callback to send a success response to.

Options

`-r, --result TEXT`

Success result payload as string.

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Send success callback with no result:

```
$ sam remote callback succeed my-callback-id
```

Send success callback with result:

```
$ sam remote callback succeed my-callback-id --result 'Task completed successfully'
```

sam remote callback fail

Send a callback failure to a remote durable function execution.

> **Note**
> This command requires access to AWS credentials.

Usage

```
$ sam remote callback fail CALLBACK_ID [OPTIONS]
```

Required Arguments

`CALLBACK_ID`

The unique identifier of the callback to send a failure response to.

Options

`--error-data TEXT`

Additional error data.

`--stack-trace TEXT`

Stack trace entries. This option can be specified multiple times.

`--error-type TEXT`

Type of error.

`--error-message TEXT`

Detailed error message.

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Send failure callback with no parameters:

```
$ sam remote callback fail my-callback-id
```

Send failure callback with error message:

```
$ sam remote callback fail my-callback-id --error-message 'Task failed'
```

Send failure callback with all parameters:

```
$ sam remote callback fail my-callback-id --error-message 'Task failed' --error-type
 'ValidationError' --stack-trace 'at line 42' --error-data '{"code": 500}'
```

sam remote callback heartbeat

Send a callback heartbeat to a remote durable function execution.

> **Note**
> This command requires access to AWS credentials.

Usage

```
$ sam remote callback heartbeat CALLBACK_ID [OPTIONS]
```

Required Arguments

`CALLBACK_ID`

The unique identifier of the callback to send a heartbeat to.

Options

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Send heartbeat callback:

```
$ sam remote callback heartbeat my-callback-id
```

sam remote execution

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam remote execution` command.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam remote execution` command allows you to manage and inspect remote durable function executions running in AWS Lambda.

> **Note**
>
> These commands require access to AWS credentials.

Usage

```
$ sam remote execution <subcommand> <options>
```

Options

`--help, -h`

Show this message and exit.

Subcommands

`get`

Get details of a durable execution. For more information, see sam remote execution get.

`history`

Get execution history of a durable function execution. For more information, see sam remote execution history.

`stop`

Stop a durable function execution. For more information, see sam remote execution stop.

sam remote execution get

Retrieve the details of a specific durable function execution from AWS Lambda.

The execution ARN should be in the format returned by Invoke or found in execution logs.

> **Note**
>
> This command requires access to AWS credentials.

Usage

```
$ sam remote execution get DURABLE_EXECUTION_ARN [OPTIONS]
```

Required Arguments

`DURABLE_EXECUTION_ARN`

The Amazon Resource Name (ARN) of the durable function execution to retrieve details for.

Options

`--format [summary|json]`

Output format. Default: `summary`

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Get execution details with default summary format:

```
$ sam remote execution get 'arn:aws:lambda:us-east-1:123456789012:function:my-function:
$LATEST/durable-execution/c63eec67-3415-4eb4-a495-116aa3a86278/1d454231-a3ad-3694-aa03-
c917c175db55'
```

Get execution details in JSON format:

```
$ sam remote execution get 'arn:aws:lambda:us-east-1:123456789012:function:my-function:
$LATEST/durable-execution/c63eec67-3415-4eb4-a495-116aa3a86278/1d454231-a3ad-3694-aa03-
c917c175db55' --format json
```

> **Note**
>
> You must ensure that control characters in the execution ARN like $ are escaped properly when using shell commands.

sam remote execution history

Retrieve the execution history of a specific durable function execution from AWS Lambda.

The execution ARN should be in the format returned by StartDurableExecution or found in execution logs.

> **Note**
>
> This command requires access to AWS credentials.

Usage

```
$ sam remote execution history DURABLE_EXECUTION_ARN [OPTIONS]
```

Required Arguments

`DURABLE_EXECUTION_ARN`

The Amazon Resource Name (ARN) of the durable function execution to retrieve history for.

Options

`--format [table|json]`

Output format. Default: `table`

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Get execution history with default table format:

```
$ sam remote execution history arn:aws:lambda:us-
east-1:123456789012:function:MyFunction:$LATEST/durable-execution/my-execution-name/my-
execution-id
```

Get execution history in JSON format:

```
$ sam remote execution history arn:aws:lambda:us-
east-1:123456789012:function:MyFunction:$LATEST/durable-execution/my-execution-name/my-
execution-id --format json
```

sam remote execution stop

Stop a running durable function execution in AWS Lambda.

The execution ARN should be in the format returned by StartDurableExecution or found in execution logs.

> **Note**
>
> This command requires access to AWS credentials.

Usage

```
$ sam remote execution stop DURABLE_EXECUTION_ARN [OPTIONS]
```

Required Arguments

`DURABLE_EXECUTION_ARN`

The Amazon Resource Name (ARN) of the durable function execution to stop.

Options

`--error-message TEXT`

Error message to associate with the stopped execution.

`--error-type TEXT`

Error type to associate with the stopped execution.

`--error-data TEXT`

Error data to associate with the stopped execution.

`--stack-trace TEXT`

Stack trace entries. This option can be specified multiple times.

`--region TEXT`

Set the AWS Region of the service (for example, `us-east-1`).

`--profile TEXT`

Select a specific profile from your credential file to get AWS credentials.

`--config-env TEXT`

Environment name specifying default parameter values in the configuration file. Default: `default`

`--config-file TEXT`

Configuration file containing default parameter values. Default: `samconfig.toml`

`--save-params`

Save the parameters provided via the command line to the configuration file.

`--beta-features / --no-beta-features`

Enable/Disable beta features.

`--debug`

Turn on debug logging to print debug messages generated by AWS SAM CLI and display timestamps.

`-h, --help`

Shows this message and exits.

Examples

Stop execution without error details:

```
$ sam remote execution stop arn:aws:lambda:us-east-1:123456789012:function:MyFunction:
$LATEST/durable-execution/my-execution-name/my-execution-id
```

Stop execution with error message and type:

```
$ sam remote execution stop arn:aws:lambda:us-east-1:123456789012:function:MyFunction:
$LATEST/durable-execution/my-execution-name/my-execution-id --error-message "Execution
 cancelled" --error-type "UserCancellation"
```

Stop execution with full error details and stack trace:

```
$ sam remote execution stop arn:aws:lambda:us-east-1:123456789012:function:MyFunction:
$LATEST/durable-execution/my-execution-name/my-execution-id --error-message "Task
 failed" --error-type "TaskFailure" --error-data '{"reason":"timeout"}' --stack-trace
 "at function1()" --stack-trace "at function2()"
```

sam remote invoke

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam remote invoke` command.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam remote invoke` command, see Introduction to testing in the cloud with sam remote invoke.

The `sam remote invoke` command invokes supported resources in the AWS Cloud.

Usage

```
$ sam remote invoke <arguments> <options>
```

Arguments

Resource ID

The ID of the suppored resource to invoke.

This argument accepts the following values:

- **Amazon Resource Name (ARN)** – The ARN of the resource.

> **Tip**
>
> Use `sam list stack-outputs --stack-name <stack-name>` to obtain the ARN of your resources.

- **Logical ID** – The logical ID of the resource. You must also provide the AWS CloudFormation stack name using the `--stack-name` option.
- **Physical ID** – The physical ID of the resource. This ID gets created when you deploy a resource using CloudFormation.

> **Tip**
>
> Use `sam list resources --stack-name <stack-name>` to obtain the physical ID of your resources.

When you provide an ARN or physical ID:

If you provide an ARN or physical ID, do not provide a stack name. When the stack name is provided using the `--stack-name` option, or when the stack name is defined in your configuration file, the AWS SAM CLI will automatically process your resource ID as a logical ID value from the CloudFormation stack.

When you don't provide a resource ID:

If you don't provide a resource ID, but do provide a stack name with the `--stack-name` option, the AWS SAM CLI will attempt to automatically invoke a resource in your CloudFormation stack using the following logic:

1. The AWS SAM CLI will identify resource types in the following order and move to the next step once the resource type is found in your stack:
   a. Lambda
   b. Step Functions
   c. Amazon SQS
   d. Kinesis Data Streams
2. If the resource type has a single resource in your stack, the AWS SAM CLI will invoke it. If multiple resources of the resource type exists in your stack, the AWS SAM CLI will return an error.

The following are examples of what the AWS SAM CLI will do:

- **Stack that contains two Lambda functions and an Amazon SQS queue** – The AWS SAM CLI will locate the Lambda resource type and return and error since the stack contains more than one Lambda function.
- **Stack that contains a Lambda function and two Amazon Kinesis Data Streams applications** – The AWS SAM CLI will locate the Lambda function and invoke it since the stack contains a single Lambda resource.
- **Stack that contains a single Amazon SQS queue and two Kinesis Data Streams applications** – The AWS SAM CLI will locate the Amazon SQS queue and invoke it since the stack contains a single Amazon SQS queue.

Options

`--beta-features | --no-beta-features`

Allow or deny beta features.

`--config-env` *`TEXT`*

Specify the environment to use from your AWS SAM CLI configuration file.

Default: `default`

`--config-file` *`FILENAME`*

Specify the path and file name of your configuration file.

For more information about configuration files, see Configuring the AWS SAM CLI.

Default: `samconfig.toml` at the root of your project directory.

`--debug`

Activate debug logging. This prints debug messages and timestamps generated by the AWS SAM CLI.

`--event, -e` *`TEXT`*

The event to send to the target resource.

`--event-file` *`FILENAME`*

The path to a file that contains the event to send to the target resource.

`--help, -h`

Show the help message and exit.

`--output [ text | json ]`

Output the results of your invocation in a specific output format.

`json` – The request metadata and resource response are returned in JSON structure. The response contains the full SDK output.

`text` – The request metadata is returned in text structure. The resource response is returned in the output format of the invoked resource.

`--parameter`

Additional Boto3 parameters that you can pass to the resource being invoked.

Amazon Kinesis Data Streams

The following additional parameters can be used to put a record in the Kinesis data stream:

- `ExplicitHashKey='string'`
- `PartitionKey='string'`
- `SequenceNumberForOrdering='string'`
- `StreamARN='string'`

For a description of each parameter, see Kinesis.Client.put_record.

AWS Lambda

The following additional parameters can be used to invoke a Lambda resource and receive a buffered response:

- `ClientContext='base64-encoded string'`
- `InvocationType='[ DryRun | Event | RequestResponse ]'`
- `LogType='[ None | Tail ]'`
- `Qualifier='string'`

The following additional parameters can be used to invoke a Lambda resource with response streaming:

- `ClientContext='base64-encoded string'`
- `InvocationType='[ DryRun | RequestResponse ]'`

- `LogType='[ None | Tail ]'`
- `Qualifier='string'`

For a description of each parameter, see the following:

- Lambda with buffered response – Lambda.Client.invoke
- Lambda with response streaming – Lambda.Client.invoke_with_response_stream

Amazon Simple Queue Service (Amazon SQS)

The following additional parameters can be used to send a message to an Amazon SQS queue:

- `DelaySeconds=integer`
- `MessageAttributes='json string'`
- `MessageDeduplicationId='string'`
- `MessageGroupId='string'`
- `MessageSystemAttributes='json string'`

For a description of each parameter, see SQS.Client.send_message.

AWS Step Functions

The following additional parameters can be used to start a state machine execution:

- `name='string'`
- `traceHeader='string'`

For a description of each parameter, see SFN.Client.start_execution.

`--profile TEXT`

The specific profile from your credential file to get AWS credentials.

`--region TEXT`

The AWS Region of the resource. For example, `us-east-1`.

`--stack-name TEXT`

The name of the CloudFormation stack that the resource belongs to.

`--tenant-id TEXT`

The tenant ID for multi-tenant Lambda functions. Used to ensure compute isolation between different tenants. Required when invoking functions configured with tenant isolation mode.

`--test-event-name` *NAME*

The name of the shareable test event to pass to your Lambda function.

> **Note**
>
> This option only supports Lambda functions.

Example

The following example invokes supported resources in the AWS Cloud and activates debug logging, which prints debug messages and timestamps generated by the AWS SAM CLI:

```
$ sam remote invoke--debug
```

sam remote test-event

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam remote test-event` command.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam remote test-event` command, see Introduction to cloud testing with sam remote test-event.

The `sam remote test-event` command interacts with shareable test events in the Amazon EventBridge schema registry.

Usage

```
$ sam remote test-event <options> <subcommand>
```

Options

`--help, -h`

Show the help message and exit.

Subcommands

`delete`

Delete a shareable test event from the EventBridge schema registry. For more reference information, see sam remote test-event delete.

`get`

Get a shareable test event from the EventBridge schema registry. For more reference information, see sam remote test-event get.

`list`

List existing shareable test events for an AWS Lambda function. For more reference information, see sam remote test-event list.

`put`

Save an event from a local file to the EventBridge schema registry. For more reference information, see sam remote test-event put.

sam remote test-event delete

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam remote test-event delete` subcommand.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam remote test-event` command, see Introduction to cloud testing with sam remote test-event.

The `sam remote test-event delete` subcommand deletes a shareable test event from the Amazon EventBridge schema registry.

Usage

```
$ sam remote test-event delete <arguments> <options>
```

Arguments

Resource ID

The ID of the AWS Lambda function associated with the shareable test event.

If you provide a logical ID, you must also provide a value for the AWS CloudFormation stack associated with the Lambda function using the `--stack-name` option.

Valid values: The resource's logical ID or resource ARN.

Options

`--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.

`--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.

`--help, -h`

Show the help message and exit.

`--name` *TEXT*

The name of the shareable test event to delete.

`--stack-name` *TEXT*

The name of the CloudFormation stack associated with the Lambda function.

This option is required if you are providing the Lambda function logical ID as an argument.

sam remote test-event get

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam remote test-event get` subcommand.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam remote test-event` command, see Introduction to cloud testing with sam remote test-event.

The `sam remote test-event get` subcommand gets a shareable test event from the Amazon EventBridge schema registry.

Usage

```
$ sam remote test-event get <arguments> <options>
```

Arguments

Resource ID

The ID of the AWS Lambda function associated with the shareable test event to get.

If you provide a logical ID, you must also provide a value for the AWS CloudFormation stack associated with the Lambda function using the `--stack-name` option.

Valid values: The resource's logical ID or resource ARN.

Options

`--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.

`--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.

`--help, -h`

Show the help message and exit.

`--name` *TEXT*

The name of the shareable test event to get.

`--output-file` *`FILENAME`*

The file path and name to save the event to on your local machine.

If you don't provide this option, the AWS SAM CLI will output the contents of the shareable test event to your console.

`--stack-name` *`TEXT`*

The name of the CloudFormation stack associated with the Lambda function.

This option is required if you are providing the Lambda function logical ID as an argument.

sam remote test-event list

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam remote test-event list` subcommand.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam remote test-event` command, see Introduction to cloud testing with sam remote test-event.

The `sam remote test-event list` subcommand lists the existing shareable test events for a specific AWS Lambda function from the Amazon EventBridge schema registry.

Usage

```
$ sam remote test-event list <arguments> <options>
```

Arguments

Resource ID

The ID of the Lambda function associated with the shareable test events.

If you provide a logical ID, you must also provide a value for the AWS CloudFormation stack associated with the Lambda function using the `--stack-name` option.

Valid values: The resource's logical ID or resource ARN.

Options

`--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.

`--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.

`--help, -h`

Show the help message and exit.

`--stack-name` *TEXT*

The name of the CloudFormation stack associated with the Lambda function.

This option is required if you are providing the Lambda function logical ID as an argument.

Examples

For examples on using this command, refer to Listing shareable test events.

sam remote test-event put

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam remote test-event put` subcommand.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI `sam remote test-event` command, see Introduction to cloud testing with sam remote test-event.

The `sam remote test-event put` subcommand saves a shareable test event from your local machine to the Amazon EventBridge schema registry.

Usage

```
$ sam remote test-event put <arguments> <options>
```

Arguments

Resource ID

The ID of the AWS Lambda function associated with the shareable test event.

If you provide a logical ID, you must also provide a value for the AWS CloudFormation stack associated with the Lambda function using the `--stack-name` option.

Valid values: The resource's logical ID or resource ARN.

Options

`--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.

`--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.

`--file` *FILENAME*

The file path and name to the event to on your local machine.

Provide `-` as the file name value to read from `stdin`.

This option is required.

`--force`, `-f`

Overwrite a shareable test event with the same name.

`--help, -h`

Show the help message and exit.

`--name` *TEXT*

The name to save the shareable test event as.

If a shareable test event with the same name exists in the EventBridge schema registry, the AWS SAM CLI will not overwrite it. To overwrite, add the `--force` option.

`--output-file` *FILENAME*

The file path and name to save the event to on your local machine.

If you don't provide this option, the AWS SAM CLI will output the contents of the shareable test event to your console.

`--stack-name` *TEXT*

The name of the CloudFormation stack associated with the Lambda function.

This option is required if you are providing the Lambda function logical ID as an argument.

Example

For an example on using this command, refer to Saving shareable test events.

sam sync

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam sync` command.

- For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?
- For documentation on using the AWS SAM CLI, see AWS SAM CLI.

The `sam sync` command syncs local application changes to the AWS Cloud.

Usage

```
$ sam sync <options>
```

Options

`--base-dir, -s` *`DIRECTORY`*

Resolves relative paths to the function's or layer's source code with respect to this directory. Use this option 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 that you're building, this option also applies to nested applications or stacks. Additionally, 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`

`--build-image` *`TEXT`*

The URI for the container image that you want to use when building your application. By default, AWS SAM uses the container image repository URI from Amazon Elastic Container Registry (Amazon ECR) Public. Specify this option to use a different image.

You can use this option multiple times in a single command. Each option accepts a string or a key-value pair.

- **String** – Specify the URI of the container image that all resources in your application will use. The following is an example:

```
$ sam sync --build-image amazon/aws-sam-cli-build-image-python3.8
```

- **Key-value pair** – Specify the resource name as the key and the container image URI to be used with that resource as the value. Use this format to specify a different container image URI for each resource in your application. The following is an example:

```
$ sam sync --build-image Function1=amazon/aws-sam-cli-build-image-python3.8
```

This option only applies if the `--use-container` option is specified, otherwise an error will result.

`--build-in-source | --no-build-in-source`

Provides `--build-in-source` to build your project directly in the source folder.

The `--build-in-source` option supports the following runtimes and build methods:

- **Runtimes** – Any Node.js runtime supported by the `sam init --runtime` option.
- **Build methods** – `Makefile`, `esbuild`.

The `--build-in-source` option is not compatible with the following options:

- `--use-container`

Default: `--no-build-in-source`

`--capabilities` *`LIST`*

A list of capabilities that you specify to allow 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. Specify this option to override the default values. Valid values include the following:

- CAPABILITY_IAM
- CAPABILITY_NAMED_IAM
- CAPABILITY_RESOURCE_POLICY
- CAPABILITY_AUTO_EXPAND

Default: `CAPABILITY_NAMED_IAM` and `CAPABILITY_AUTO_EXPAND`

`--code`

By default, AWS SAM syncs all resources in your application. Specify this option to sync only code resources, which include the following:

- `AWS::Serverless::Function`
- `AWS::Lambda::Function`
- `AWS::Serverless::LayerVersion`
- `AWS::Lambda::LayerVersion`
- `AWS::Serverless::Api`
- `AWS::ApiGateway::RestApi`

- `AWS::Serverless::HttpApi`
- `AWS::ApiGatewayV2::Api`
- `AWS::Serverless::StateMachine`
- `AWS::StepFunctions::StateMachine`

To sync code resources, AWS SAM uses AWS service APIs directly, instead of deploying through AWS CloudFormation. To update your CloudFormation stack, run **sam sync --watch** or **sam deploy**.

`--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.

`--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.

`--dependency-layer | --no-dependency-layer`

Specifies whether to separate dependencies of individual functions into another layer to speed up the sync process.

Default: `--dependency-layer`

`--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.

`--image-repositories` *TEXT*

A mapping of functions to their Amazon ECR repository URI. Reference functions by their logical ID. The following is an example:

```
$ sam sync --image-repositories Function1=123456789012.dkr.ecr.us-
east-1.amazonaws.com/my-repo
```

You can specify this option multiple times in a single command.

`--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 you don't specify this option, then AWS SAM uses Amazon S3-managed encryption keys.

`--metadata`

A map of metadata to attach to all artifacts that you reference in your template.

`--notification-arns` *LIST*

A list of Amazon Simple Notification Service (Amazon SNS) topic ARNs that CloudFormation associates with the stack.

`--no-use-container`

An option that allows you to use the IDE toolkit to set default behavior.

`--parameter-overrides`

A string that contains CloudFormation parameter overrides encoded as key-value pairs. Use the same format as the AWS Command Line Interface (AWS CLI). The AWS SAM CLI format is explicit key and value keywords, each override is separated by a space. Here are two examples:

- `--parameter-overrides ParameterKey=hello,ParameterValue=world`
- `--parameter-overrides ParameterKey=hello,ParameterValue=world ParameterKey=example1,ParameterValue=example2 ParameterKey=apple,ParameterValue=banana`

`--resource` *TEXT*

Specifies the resource type to sync. To sync multiple resources, you can specify this option multiple times. This option is supported with the `--code` option. The value must be one of the listed resources under `--code`. For example, `--resource AWS::Serverless::Function --resource AWS::Serverless::LayerVersion`.

`--resource-id` *TEXT*

Specifies the resource ID to sync. To sync multiple resources, you can specify this option multiple times. This option is supported with the `--code` option. For example, `--resource-id Function1 --resource-id Function2`.

`--role-arn` *TEXT*

The Amazon Resource Name (ARN) of an IAM role that CloudFormation assumes when applying the changeset.

`--s3-bucket` *TEXT*

The name of the Amazon Simple Storage Service (Amazon S3) bucket where this command uploads your 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 occurs.

`--s3-prefix` *TEXT*

The prefix added to the names of the artifacts that you upload to the Amazon S3 bucket. The prefix name is a path name (folder name) for the Amazon S3 bucket. This applies only to functions declared with the `Zip` package type.

`--save-params`

Saves the parameters that you provide at the command line to the AWS SAM configuration file.

`--skip-deploy-sync | --no-skip-deploy-sync`

Specifies `--skip-deploy-sync` to skip the initial infrastructure sync if it isn't required. The AWS SAM CLI will compare your local AWS SAM template with the deployed CloudFormation template and perform a deployment only if a change is detected.

Specifies `--no-skip-deploy-sync` to perform an CloudFormation deployment every time `sam sync` is run.

To learn more, see Skip the initial CloudFormation deployment.

Default: `--skip-deploy-sync`

`--stack-name` *TEXT*

The name of the CloudFormation stack for your application.

This option is required.

`--tags` *LIST*

A list of tags to associate with the stack that is created or updated. CloudFormation also propagates these tags to resources in the stack that support it.

`--template-file, --template, -t` *PATH*

The path and file name where your AWS SAM template is located.

> **Note**
>
> If you specify this option, then AWS SAM deploys only the template and the local resources that it points to.

`--use-container, -u`

If your functions depend on packages that have natively compiled dependencies, use this option to build your function inside an AWS Lambda-like Docker container.

> **Note**
>
> Currently, this option is not compatible with `--dependency-layer`. If you use `--use-container` with `--dependency-layer`, the AWS SAM CLI informs you and continues with `--no-dependency-layer`.

`--watch`

Starts a process that watches your local application for changes and automatically syncs them to the AWS Cloud. By default, when you specify this option, AWS SAM syncs all resources in your application as you update them. With this option, AWS SAM performs an initial CloudFormation deployment. Then, AWS SAM uses AWS service APIs to update code resources. AWS SAM uses CloudFormation to update infrastructure resources when you update your AWS SAM template.

`--watch-exclude` *TEXT*

Excludes a file or folder from being observed for file changes. To use this option, `--watch` must also be provided.

This option receives a key-value pair:

- **Key** – The logical ID of a Lambda function in your application.
- **Value** – The associated file name or folder to exclude.

When you update any files or folders specified with the `--watch-exclude` option, the AWS SAM CLI will not initiate a sync. However, when an update to other files or folders initiates a sync, these files or folders will be included in that sync.

You can provide this option multiple times in a single command.

Examples

For examples on using this command, refer to Options for the sam sync command.

sam traces

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam traces` command.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam traces` command fetches AWS X-Ray traces in your AWS account in the AWS Region.

Usage

```
$ sam traces <options>
```

Options

`--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.

`--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.

`--end-time` *TEXT*

Fetches traces 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'.

`--output` *TEXT*

Specifies the output format for logs. To print formatted logs, specify `text`. To print the logs as JSON, specify `json`.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--start-time` *TEXT*

Fetches traces 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'.

`--tail`

Tails the trace output. This ignores the end time argument and continues to display traces as they become available.

`--trace-id` *TEXT*

The unique identifier for an X-Ray trace.

Examples

Run the following command to fetch X-Ray traces by ID.

```
$ sam traces --trace-id tracing-id-1 --trace-id tracing-id-2
```

Run the following command to tail X-Ray traces as they become available.

```
$ sam traces --tail
```

sam validate

This page provides reference information for the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) `sam validate` command.

For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?

The `sam validate` command verifies whether an AWS SAM template file is valid.

Usage

```
$ sam validate <options>
```

Options

`--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.

`--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.

`--debug`

Turns on debug logging to print debug message generated by the AWS SAM CLI and display timestamps.

`--lint`

Run linting validation on template through **cfn-lint**. Create a `cfnlintrc` config file to specify additional parameters. For more information, see cfn-lint in the *CloudFormation GitHub repository*.

`--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.

`--save-params`

Save the parameters that you provide at the command line to the AWS SAM configuration file.

`--template-file, --template, -t` *PATH*

The AWS SAM template file. Default value is `template.[yaml|yml]`.

If your template is in your current working directory and is named `template.[yaml|yml|json]`, this option is not required.

If you just ran **sam build**, this option is not required.

Example

For an example on using this command to validate a template, refer to Validate AWS SAM template files.

For an example on using this command with cfn-lint, refer to Validate your AWS SAM applications with CloudFormation Linter.

AWS SAM CLI management

This section contains information on ways you can manage and customize your version of the AWS SAM CLI. This includes information on how you can configure AWS SAM CLI command parameter values using a project-level configuration file. It also includes information on managing different versions of your AWS SAM CLI, setting AWS credentials so that AWS SAM can make calls to AWS services on your behalf, and different ways you can customize AWS SAM. This section ends with a section on general AWS SAM troubleshooting.

Topics

- AWS SAM CLI configuration file
- Managing AWS SAM CLI versions
- Setting up AWS credentials
- Telemetry in the AWS SAM CLI
- AWS SAM CLI troubleshooting

AWS SAM CLI configuration file

The AWS Serverless Application Model Command Line Interface (AWS SAM CLI) supports a project-level configuration file that you can use to configure AWS SAM CLI command parameter values.

For documentation on creating and using configuration files, see Configuring the AWS SAM CLI.

Topics

- Default configuration file settings
- Supported configuration file formats
- Specify a configuration file
- Configuration file basics
- Parameter value rules
- Configuration precedence
- Creating and modifying configuration files

Default configuration file settings

AWS SAM uses the following default configuration file settings:

- **Name** – `samconfig`.
- **Location** – At the root of your project. This is the same location as your `template.yaml` file.
- **Format** – `TOML`. To learn more, see TOML in the *TOML documentation*.

The following is an example project structure that includes the default configuration file name and location:

```
sam-app
### README.md
### __init__.py
### events
### hello_world
### samconfig.toml
### template.yaml
### tests
```

The following is an example `samconfig.toml` file:

```
...
version = 0.1

[default]
[default.global]
[default.global.parameters]
stack_name = "sam-app"
```

```
[default.build.parameters]
cached = true
parallel = true

[default.deploy.parameters]
capabilities = "CAPABILITY_IAM"
confirm_changeset = true
resolve_s3 = true

[default.sync.parameters]
watch = true

[default.local_start_api.parameters]
warm_containers = "EAGER"

[prod]
[prod.sync]
[prod.sync.parameters]
watch = false
```

Supported configuration file formats

`TOML` and `[YAML|YML]` formats are supported. See the following basic syntax:

TOML

```
version = 0.1
[environment]
[environment.command]
[environment.command.parameters]
option = parameter value
```

YAML

```
version: 0.1
environment:
  command:
    parameters:
      option: parameter value
```

Specify a configuration file

By default, the AWS SAM CLI looks for a configuration file in the following order:

1. **Custom configuration file** – If you use the `--config-file` option to specify a file name and location, the AWS SAM CLI looks for this file first.
2. **Default `samconfig.toml` file** – This is the default configuration file name and format, located at the root of your project. If you don't specify a custom configuration file, the AWS SAM CLI looks for this file next.
3. **`samconfig.[yaml|yml]` file** – If the `samconfig.toml` does not exist at the root of your project, the AWS SAM CLI looks for this file.

The following is an example of specifying a custom configuration file using the `--config-file` option:

```
$ sam deploy --config-file myconfig.yaml
```

> **Note**
>
> The `--config-file` parameter must be relative to the location of the AWS SAM template file because the AWS SAM CLI needs to determine the context in which the configuration is applied. The `samconfig.toml` file manages configuration settings for your version of the AWS SAM CLI, and the CLI looks for the `samconfig.toml` file (or the overriden config file parameter) in the relative the folder of the `template.yaml` file.

Configuration file basics

Environment

An **environment** is a named identifier that contains a unique set of configuration settings. You can have multiple environments in a single AWS SAM application.

The default environment name is `default`.

Use the AWS SAM CLI `--config-env` option to specify the environment to use.

Command

The **command** is the AWS SAM CLI command to specify parameter values for.

To specify parameter values for all commands, use the `global` identifier.

When referencing an AWS SAM CLI command, replace spaces ( ) and hyphens (–) with underscores (_). See the following examples:

- `build`
- `local_invoke`
- `local_start_api`

Parameters

Parameters are specified as key-value pairs.

- The **key** is the AWS SAM CLI command option name.
- The **value** is the value to specify.

When specifying keys, use the long-form command option name and replace hyphens (–) with underscores (_). The following are examples:

- `region`
- `stack_name`
- `template_file`

Parameter value rules

TOML

- Boolean values can be `true` or `false`. For example, `confirm_changeset = true`.
- For string values, use quotation marks (`""`). For example, `region = "us-west-2"`.
- For list values, use quotation marks (`""`) and separate each value using a space ( ). For example: `capabilities = "CAPABILITY_IAM CAPABILITY_NAMED_IAM"`.
- For values that contain 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 parameter values that can be specified 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"]`.

YAML

- Boolean values can be `true` or `false`. For example, `confirm_changeset: true`.
- For entries that contain a single string value, quotation marks (`""`) are optional. For example, `region: us-west-2`. This includes entries that contain multiple key-value pairs that are provided as a single string. The following is an example:

```
$ sam deploy --tags "foo=bar hello=world"
```

```
default:
  deploy:
    parameters:
      tags: foo=bar hello=world
```

- For entries that contain a list of values, or entries that can be used multiple times in a single command, specify them as a list of strings.

  The following is an example:

```
$ sam remote invoke --parameter "InvocationType=Event" --parameter "LogType=None"
```

```
default:
  remote_invoke:
    parameters:
        parameter:
        - InvocationType=Event
        - LogType=None
```

Configuration precedence

When configuring values, the following precedence takes place:

- Parameter values that you provide at the command line take precedence over corresponding values in the configuration file and `Parameters` section of the template file.
- If the `--parameter-overrides` option is used at the command line or in your configuration file with the `parameter_overrides` key, its values take precedence over values in the `Parameters` section of the template file.

- In your configuration file, entries provided for a specific command take precedence over global entries. In the following example, the `sam deploy` command will use the stack name `my-app-stack`.

  TOML

  ```
  [default.global.parameters]
  stack_name = "common-stack"

  [default.deploy.parameters]
  stack_name = "my-app-stack"
  ```

  YAML

  ```
  default:
    global:
      parameters:
        stack_name: common-stack
    deploy:
      parameters:
        stack_name: my-app-stack
  ```

Creating and modifying configuration files

Creating configuration files

When you create an application using `sam init`, a default `samconfig.toml` file is created. You can also manually create your configuration file.

Modifying configuration files

You can manually modify your configuration files. Also, during any AWS SAM CLI interactive flow, configured values will be displayed in brackets (`[ ]`). If you modify these values, the AWS SAM CLI will update your configuration file.

The following is an example interactive flow using the `sam deploy --guided` command:

```
$ sam deploy --guided

Configuring SAM deploy
======================
```

```
    Looking for config file [samconfig.toml] :  Found
    Reading default arguments  :  Success

    Setting default arguments for 'sam deploy'
    =========================================
    Stack Name [sam-app]: ENTER
    AWS Region [us-west-2]: ENTER
    #Shows you resources changes to be deployed and require a 'Y' to initiate deploy
    Confirm changes before deploy [Y/n]: n
    #SAM needs permission to be able to create roles to connect to the resources in
 your template
    Allow SAM CLI IAM role creation [Y/n]: ENTER
    #Preserves the state of previously provisioned resources when an operation fails
    Disable rollback [y/N]: ENTER
    HelloWorldFunction may not have authorization defined, Is this okay? [y/N]: y
    Save arguments to configuration file [Y/n]: ENTER
    SAM configuration file [samconfig.toml]: ENTER
    SAM configuration environment [default]: ENTER
```

When modifying your configuration file, the AWS SAM CLI handles global values as follows:

- If the parameter value exists in the `global` section of your configuration file, the AWS SAM CLI doesn't write the value to the specific command section.
- If the parameter value exists in both the `global` and specific command sections, the AWS SAM CLI deletes the specific entry in favor of the global value.

Managing AWS SAM CLI versions

Manage your AWS Serverless Application Model Command Line Interface (AWS SAM CLI) versions through upgrading, downgrading, and uninstalling. Optionally, you can download and install the AWS SAM CLI nightly build.

Topics

- Upgrading the AWS SAM CLI
- Uninstalling the AWS SAM CLI
- Switch from using Homebrew to manage the AWS SAM CLI
- Managing the AWS SAM CLI nightly build
- Installing the AWS SAM CLI into a virtual environment using pip

- Managing the AWS SAM CLI with Homebrew
- Troubleshooting

Upgrading the AWS SAM CLI

Linux

To upgrade the AWS SAM CLI on Linux, follow the installation instructions in Installing the AWS SAM CLI, but add the `--update` option to the install command, as follows:

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

macOS

The AWS SAM CLI must be upgraded through the same method used to install it. We recommend that you use the package installer to install and upgrade the AWS SAM CLI.

To upgrade the AWS SAM CLI using the package installer, install the latest package version. For instructions, see Installing the AWS SAM CLI.

Windows

To upgrade the AWS SAM CLI, repeat the Windows installation steps in Install the AWS SAM CLI again.

Uninstalling the AWS SAM CLI

Linux

To uninstall the AWS SAM CLI on Linux, 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
```

macOS

Uninstall the AWS SAM CLI through the same method that was used to install it. We recommend that you use the package installer to install the AWS SAM CLI.

If you installed the AWS SAM CLI using the package installer, follow these steps to uninstall.

To uninstall the AWS SAM CLI

1. Remove the AWS SAM CLI program by modifying and running the following:

```
$ sudo rm -rf /path-to/aws-sam-cli
```

   a. *sudo* – If your user has write permissions to where the AWS SAM CLI program is installed, **sudo** is not required. Otherwise, **sudo** is required.

   b. */path-to* – Path to where you installed the AWS SAM CLI program. The default location is `/usr/local`.

2. Remove the AWS SAM CLI `$PATH` by modifying and running the following:

```
$ sudo rm -rf /path-to-symlink-directory/sam
```

a. *sudo* – If your user has write permissions to $PATH, **sudo** is not required. Otherwise, **sudo** is required.

b. *path-to-symlink-directory* – Your $PATH environment variable. The default location is /usr/local/bin.

3. Verify that the AWS SAM CLI is uninstalled by running the following:

```
$ sam --version
command not found: sam
```

Windows

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

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

Switch from using Homebrew to manage the AWS SAM CLI

If you use Homebrew to install and upgrade the AWS SAM CLI, we recommend using an AWS supported method. Follow these instructions to switch to a supported method.

To switch from using Homebrew

1. Follow instructions at Uninstalling a Homebrew installed AWS SAM CLI to uninstall the Homebrew managed version.
2. Follow instructions at Install the AWS SAM CLI to install the AWS SAM CLI using a supported method.

Managing the AWS SAM CLI nightly build

You can download and install the AWS SAM CLI nightly build. It contains a pre-release version of the AWS SAM CLI code that may be less stable than the production version. When installed, you can use the nightly build with 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.

> **Note**
>
> The nightly build does not contain a pre-release version of the build image. Because of that, building your serverless application with the **--use-container** option uses the latest production version of the build image.

Installing the AWS SAM CLI nightly build

To install the AWS SAM CLI nightly build, follow these instructions.

Linux

You can install the nightly build version of the AWS SAM CLI on the Linux x86_64 platform using the package installer.

To install the AWS SAM CLI nightly build

1. Download the package installer from sam-cli-nightly in the *aws-sam-cli GitHub repository*.
2. Follow the steps for installing the AWS SAM CLI to install the nightly build package.

macOS

You can install the nightly build version of the AWS SAM CLI on macOS, using the nightly build package installer.

To install the AWS SAM CLI nightly build

1. Download the package installer for your platform from sam-cli-nightly in the *aws-sam-cli GitHub repository*.
2. Follow the steps for installing the AWS SAM CLI to install the nightly build package.

Windows

The nightly build version of the AWS SAM CLI is available with this download link: AWS SAM CLI nightly build. To install the nightly build on Windows, perform the same steps as in the Install the AWS SAM CLI, but use the nightly build download link instead.

To verify that 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
```

Switch from Homebrew to the package installer

If you are using Homebrew to install and upgrade the AWS SAM CLI nightly build and would like to switch to using the package installer, follow these steps.

To switch from Homebrew to the package installer

1. Uninstall the Homebrew installed AWS SAM CLI nightly build.

   ```
   $ brew uninstall aws-sam-cli-nightly
   ```

2. Verify that the AWS SAM CLI nightly build is uninstalled by running the following:

   ```
   $ sam-nightly --version
   zsh: command not found: sam-nightly
   ```

3. Follow steps in the previous section to install the AWS SAM CLI nightly build.

Installing the AWS SAM CLI into a virtual environment using pip

We recommend using the native package installer to install the AWS SAM CLI. If you must use pip, we recommend that you install the AWS SAM CLI into a virtual environment. This ensures a clean installation environment and an isolated environment if errors occur.

> **Note**
>
> As of October 24, 2023, the AWS SAM CLI is discontinuing support for Python 3.7. To learn more, see AWS SAM CLI discontinuing support for Python 3.7.

To install the AWS SAM CLI into a virtual environment

1. From a starting directory of your choice, create a virtual environment and name it.

   Linux / macOS

   ```
   $ mkdir project
   $ cd project
   $ python3 -m venv venv
   ```

   Windows

   ```
   > mkdir project
   > cd project
   > py -3 -m venv venv
   ```

2. Activate the virtual environment

   Linux / macOS

   ```
   $ . venv/bin/activate
   ```

   The prompt changes to show you that your virtual environment is active.

   ```
   (venv) $
   ```

   Windows

   ```
   > venv\Scripts\activate
   ```

   The prompt changes to show you that your virtual environment is active.

   ```
   (venv) >
   ```

3. Install the AWS SAM CLI into your virtual environment.

   ```
   (venv) $ pip install --upgrade aws-sam-cli
   ```

4. Verify that the AWS SAM CLI is installed correctly.

```
(venv) $ sam --version
SAM CLI, version 1.94.0
```

5. You can use the `deactivate` command to exit the virtual environment. Whenever you start a new session, you must reactivate the environment.

Managing the AWS SAM CLI with Homebrew

> **Note**
>
> Starting September 2023, AWS will no longer maintain the AWS managed Homebrew installer for the AWS SAM CLI (`aws/tap/aws-sam-cli`). To continue using Homebrew, you can use the community managed installer (`aws-sam-cli`). From September 2023, any Homebrew command that references `aws/tap/aws-sam-cli` will redirect to `aws-sam-cli`.
> We recommend that you use our supported installation and upgrade methods.

Installing the AWS SAM CLI using Homebrew

> **Note**
>
> These instructions use the community managed AWS SAM CLI Homebrew installer. For further support, see the *homebrew-core repository*.

To install the AWS SAM CLI

1. Run the following:

```
$ brew install aws-sam-cli
```

2. Verify the installation:

```
$ sam --version
```

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

```
SAM CLI, version 1.94.0
```

Upgrading the AWS SAM CLI using Homebrew

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

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

Uninstalling a Homebrew installed AWS SAM CLI

If the AWS SAM CLI was installed using Homebrew, follow these steps to uninstall it.

To uninstall the AWS SAM CLI

1. Run the following:

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

2. Verify that the AWS SAM CLI is uninstalled by running the following:

   ```
   $ sam --version
   command not found: sam
   ```

Switching to the community managed Homebrew installer

If you are using the AWS managed Homebrew installer (`aws/tap/aws-sam-cli`) and prefer to continue using Homebrew, we recommend switching to the community managed Homebrew installer (`aws-sam-cli`).

To switch in a single command, run the following:

```
$ brew uninstall aws-sam-cli && brew untap aws/tap && brew cleanup aws/tap && brew
 update && brew install aws-sam-cli
```

Follow these instructions to run each command individually.

To switch to the community managed Homebrew installer

1. Uninstall the AWS managed Homebrew version of the AWS SAM CLI:

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

2. Verify that the AWS SAM CLI has been uninstalled:

```
$ which sam
sam not found
```

3. Remove the AWS managed AWS SAM CLI tap:

```
$ brew untap aws/tap
```

If you receive an error like the following, add the `--force` option and try again.

```
Error: Refusing to untap aws/tap because it contains the following installed
 formulae or casks:
aws-sam-cli-nightly
```

4. Remove cached files for the AWS managed installer:

```
$ brew cleanup aws/tap
```

5. Update Homebrew and all formulae:

```
$ brew update
```

6. Install the community managed version of the AWS SAM CLI:

```
$ brew install aws-sam-cli
```

7. Verify that the AWS SAM CLI is successfully installed:

```
$ sam --version
SAM CLI, version 1.94.0
```

Troubleshooting

If you come across errors when installing or using the AWS SAM CLI, see AWS SAM CLI troubleshooting.

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 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
  ```

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 command line interface (CLI) collects telemetry, such as generic usage metrics, system and environment information, and errors. For details about the types of telemetry collected, see Types of information collected.

The AWS SAM CLI does **not** collect personal information, such as user names or email addresses. It also does not extract sensitive project-level information.

Customers control whether telemetry is turned on, and they can change their settings at any point of time. If telemetry remains on, the AWS SAM CLI sends telemetry data in the background without requiring any additional customer interaction.

Turn off telemetry for a session

In macOS and Linux operating systems, you can turn off telemetry for a single session. To turn off telemetry for your current session, run the following command to set the environment variable `SAM_CLI_TELEMETRY` to `false`. Repeat the command for each new terminal or session.

```
export SAM_CLI_TELEMETRY=0
```

Turn off telemetry for your profile in all sessions

Run the following commands to turn off telemetry for all sessions when you're running the AWS SAM CLI on your operating system.

To turn off telemetry in Linux

1. Run:

   ```
   echo "export SAM_CLI_TELEMETRY=0" >>~/.profile
   ```

2. Run:

   ```
   source ~/.profile
   ```

To turn off telemetry in macOS

1. Run:

   ```
   echo "export SAM_CLI_TELEMETRY=0" >>~/.profile
   ```

2. Run:

   ```
   source ~/.profile
   ```

To turn off telemetry in Windows

You can set the environment variable temporarily for the lifetime of the terminal window with the following command:

If using Command Prompt:

```
set SAM_CLI_TELEMETRY=0
```

If using PowerShell:

```
$env:SAM_CLI_TELEMETRY=0
```

To set the environment variable permanently in either the Command Prompt or PowerShell, use the following command:

```
setx SAM_CLI_TELEMETRY 0
```

> **Note**
> Changes will not go into effect until the terminal has been closed and reopened.

Types of information collected

- **Usage information** – The generic commands and subcommands that customers run.
- **Errors and diagnostic information** – The status and duration of commands that customers 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), environment in which the AWS SAM CLI runs (for example, AWS CodeBuild, an AWS IDE toolkit, or a terminal), and hash values of usage attributes.

Learn more

The telemetry data that the AWS SAM CLI collects adheres to the AWS data privacy policies. For more information, see the following:

- AWS Service Terms
- Data Privacy FAQ

AWS SAM CLI troubleshooting

This section provides details on how to troubleshoot error messages when using, installing, and managing the AWS Serverless Application Model Command Line Interface (AWS SAM CLI).

Topics

- Troubleshooting
- Error messages
- Warning messages

Troubleshooting

For troubleshooting guidance related to AWS SAM CLI, see Troubleshooting installation errors.

Error messages

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 a domain that's not valid. 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 CloudFormation console or the AWS CLI, and verify that your **curl** command is correct.

Error: Can't find exact resource information with given stack name

When running the `sam remote invoke` command on an application that contains a single Lambda function resource, you see the following error:

```
Error: Can't find exact resource information with given <stack-name>. Please provide
 full resource ARN or --stack-name to resolve the ambiguity.
```

Possible cause: You didn't provide the `--stack-name` option.

If a function ARN is not provided as an argument, the `sam remote invoke` command requires that the `--stack-name` option is provided.

Solution: Provide the `--stack-name` option.

The following is an example:

```
$ sam remote invoke --stack-name sam-app
```

```
Invoking Lambda Function HelloWorldFunction



START RequestId: 40593abb-e1ad-4d99-87bd-ac032e364e82 Version: $LATEST
END RequestId: 40593abb-e1ad-4d99-87bd-ac032e364e82
REPORT RequestId: 40593abb-e1ad-4d99-87bd-ac032e364e82  Duration: 11.31 ms
  Billed Duration: 12 ms  Memory Size: 128 MB     Max Memory Used: 67 MB  Init
 Duration: 171.71 ms
{"statusCode":200,"body":"{\"message\":\"hello world\"}"}%
```

Error: Can’t find resource information from stack name

When running the `sam remote invoke` command and passing a Lambda function ARN as an argument, you see the following error:

```
Error: Can't find resource information from stack name (<stack-name>) and resource id
 (<function-id>)
```

Possible cause: You have the stack name value defined in your `samconfig.toml` file.

The AWS SAM CLI first checks your `samconfig.toml` file for a stack name. If specified, the argument is passed as a logical ID value.

Solution: Pass the function’s logical ID instead.

You can pass the function’s logical ID as an argument instead of the function’s ARN.

Solution: Remove the stack name value from your configuration file.

You can remove the stack name value from your configuration file. This prevents the AWS SAM CLI from passing your function ARN as a logical ID value.

Run `sam build` after modifying your configuration file.

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

When running the **sam deploy** command, 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.

Error: FileNotFoundError in Windows

When running commands in AWS SAM CLI on Windows, you may see the following error:

```
Error: FileNotFoundError
```

Possible cause: The AWS SAM CLI might interact with filepaths that exceed the Windows max path limitation.

Solution: To resolve this issue, the new long paths behavior must enabled. To do this, see Enable Long Paths in Windows 10, Version 1607, and Later in the *Microsoft Windows App Development Documentation*.

Error: pip's dependency resolver ...

Example error text:

```
ERROR: pip's dependency resolver does not currently take into account all the packages
 that are installed. This behaviour is the source of the following dependency
 conflicts.
aws-sam-cli 1.58.0 requires aws-sam-translator==1.51.0, but you have aws-sam-translator
 1.58.0 which is incompatible.
aws-sam-cli 1.58.0 requires typing-extensions==3.10.0.0, but you have typing-extensions
 4.4.0 which is incompatible.
```

Possible cause: If you use pip to install packages, dependencies between packages may conflict.

Each version of the `aws-sam-cli` package depends on a version of the `aws-sam-translator` package. For example, `aws-sam-cli` v1.58.0 may depend on `aws-sam-translator` v1.51.0.

If you install the AWS SAM CLI using pip, then install another package which depends on a newer version of `aws-sam-translator`, the following will occur:

- The newer version of `aws-sam-translator` will install.
- The current version of `aws-sam-cli` and the newer version of `aws-sam-translator` may not be compatible.

- When you use the AWS SAM CLI, the dependency resolver error will occur.

Solutions:

1. Use the AWS SAM CLI native package installer.
   a. Uninstall the AWS SAM CLI using pip. For instructions, see Uninstalling the AWS SAM CLI.
   b. Install the AWS SAM CLI using the native package installer. For instructions, see Install the AWS SAM CLI.
   c. When necessary, upgrade the AWS SAM CLI using the native package installer. For instructions, see Upgrading the AWS SAM CLI.
2. If you must use pip, we recommend that you install the AWS SAM CLI into a virtual environment. This ensures a clean installation environment and an isolated environment if errors occur. For instructions, see Installing the AWS SAM CLI into a virtual environment using pip.

Error: No such command 'remote'

When running the `sam remote invoke` command, you see the following error:

```
$ sam remote invoke ...
2023-06-20 08:15:07 Command remote not available
Usage: sam [OPTIONS] COMMAND [ARGS]...
Try 'sam -h' for help.

Error: No such command 'remote'.
```

Possible cause: Your version of the AWS SAM CLI is out of date.

The AWS SAM CLI `sam remote invoke` command was released with AWS SAM CLI version 1.88.0. You can check your version by running the `sam --version` command.

Solution: Upgrade your AWS SAM CLI to the latest version.

For instructions, see Upgrading the AWS SAM CLI.

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

When running the **sam local start-api** command, 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. For more information, see Installing Docker.

Error: Security Constraints Not Satisfied

When running **sam deploy --guided**, you're prompted with the question `Function 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 a publicly accessible 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 Control API access with your AWS SAM template.
- If your intention is to have a publicly accessible API endpoint without authorization, restart your deployment and respond to this question with **Y** to indicate that you're OK with deploying.

message: 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.

Warning messages

Warning: ... AWS will no longer maintain the Homebrew installer for AWS SAM ...

When installing the AWS SAM CLI using Homebrew, you see the following warning message:

```
Warning: ... AWS will no longer maintain the Homebrew installer for AWS SAM (aws/tap/
aws-sam-cli).
    For AWS supported installations, use the first party installers ...
```

Potential cause: AWS no longer maintaining Homebrew support.

Starting September 2023, AWS will no longer maintain the Homebrew installer for the AWS SAM CLI.

Solution: Use an AWS supported installation method.

- You can find AWS supported installation methods at Install the AWS SAM CLI.

Solution: To continue using Homebrew, use the community managed installer.

- You can use the community managed Homebrew installer at your discretion. For instructions, see Managing the AWS SAM CLI with Homebrew.

AWS SAM connector reference

This section contains reference information for the AWS Serverless Application Model (AWS SAM) connector resource type. For an introduction to connectors, see Managing resource permissions with AWS SAM connectors.

Supported source and destination resource types for connectors

The `AWS::Serverless::Connector` resource type supports a select number of connections between source and destination resources. When configuring connectors in your AWS SAM template, use the following table to reference supported connections and the properties that need to be defined for each source and destination resource type. For more information about configuring connectors in your template, see AWS::Serverless::Connector.

For both source and destination resources, when defined within the same template, use the `Id` property. Optionally, a `Qualifier` can be added to narrow the scope of your defined resource. When the resource is not within the same template, use a combination of supported properties.

To request new connections, submit a new issue at the *serverless-application-model AWS GitHub repository*.

Source type	Destination type	Permissions	Source properties	Destination properties
AWS::ApiGateway::RestApi	AWS::Lambda::Function	Write	Id or Qualifier , ResourceId , and Type	Id or Arn and Type
AWS::ApiGateway::RestApi	AWS::Serverless::Function	Write	Id or Qualifier , ResourceId , and Type	Id or Arn and Type
AWS::ApiGatewayV2::Api	AWS::Lambda::Function	Write	Id or Qualifier , ResourceId , and Type	Id or Arn and Type
AWS::ApiGatewayV2::Api	AWS::Serverless::Function	Write	Id or Qualifier , ResourceId , and Type	Id or Arn and Type
AWS::AppSync::DataSource	AWS::DynamoDB::Table	Read	Id or RoleName and Type	Id or Arn and Type
AWS::AppSync::DataSource	AWS::DynamoDB::Table	Write	Id or RoleName and Type	Id or Arn and Type
AWS::AppSync::DataSource	AWS::Events::EventBus	Write	Id or RoleName and Type	Id or Arn and Type
AWS::AppSync::DataSource	AWS::Lambda::Function	Write	Id or RoleName and Type	Id or Arn and Type

Source type	Destination type	Permissions	Source properties	Destination properties
AWS::AppSync::DataSource	AWS::Serverless::Function	Write	Id or RoleName and Type	Id or Arn and Type
AWS::AppSync::DataSource	AWS::Serverless::SimpleTable	Read	Id or RoleName and Type	Id or Arn and Type
AWS::AppSync::DataSource	AWS::Serverless::SimpleTable	Write	Id or RoleName and Type	Id or Arn and Type
AWS::AppSync::GraphQLApi	AWS::Lambda::Function	Write	Id or ResourceId and Type	Id or Arn and Type
AWS::AppSync::GraphQLApi	AWS::Serverless::Function	Write	Id or ResourceId and Type	Id or Arn and Type
AWS::DynamoDB::Table	AWS::Lambda::Function	Read	Id or Arn and Type	Id or RoleName and Type
AWS::DynamoDB::Table	AWS::Serverless::Function	Read	Id or Arn and Type	Id or RoleName and Type
AWS::Events::Rule	AWS::Events::EventBus	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Events::Rule	AWS::Lambda::Function	Write	Id or Arn and Type	Id or Arn and Type

Source type	Destination type	Permissions	Source properties	Destination properties
AWS::Events::Rule	AWS::Serverless::Function	Write	Id or Arn and Type	Id or Arn and Type
AWS::Events::Rule	AWS::Serverless::StateMachine	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Events::Rule	AWS::SNS::Topic	Write	Id or Arn and Type	Id or Arn and Type
AWS::Events::Rule	AWS::SQS::Queue	Write	Id or Arn and Type	Id or Arn, QueueUrl, and Type
AWS::Events::Rule	AWS::StepFunctions::StateMachine	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Lambda::Function	AWS::DynamoDB::Table	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::Lambda::Function	AWS::Events::EventBus	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Lambda::Function	AWS::Lambda::Function	Write	Id or RoleName and Type	Id or Arn and Type

Source type	Destination type	Permissions	Source properties	Destination properties
AWS::Lambda::Function	AWS::Location::PlaceIndex	Read	Id or RoleName and Type	Id or Arn and Type
AWS::Lambda::Function	AWS::S3::Bucket	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::Lambda::Function	AWS::Serverless::Function	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Lambda::Function	AWS::Serverless::SimpleTable	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::Lambda::Function	AWS::Serverless::StateMachine	Read, Write	Id or RoleName and Type	Id or Arn, Name, and Type
AWS::Lambda::Function	AWS::SNS::Topic	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Lambda::Function	AWS::SQS::Queue	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::Lambda::Function	AWS::StepFunctions::StateMachine	Read, Write	Id or RoleName and Type	Id or Arn, Name, and Type

Source type	Destination type	Permissions	Source properties	Destination properties
AWS::S3::Bucket	AWS::Lambda::Function	Write	Id or Arn and Type	Id or Arn and Type
AWS::S3::Bucket	AWS::Serverless::Function	Write	Id or Arn and Type	Id or Arn and Type
AWS::Serverless::Api	AWS::Lambda::Function	Write	Id or Qualifier , ResourceId , and Type	Id or Arn and Type
AWS::Serverless::Api	AWS::Serverless::Function	Write	Id or Qualifier , ResourceId , and Type	Id or Arn and Type
AWS::Serverless::Function	AWS::DynamoDB::Table	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::Function	AWS::Events::EventBus	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::Function	AWS::Lambda::Function	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::Function	AWS::S3::Bucket	Read, Write	Id or RoleName and Type	Id or Arn and Type

Source type	Destination type	Permissions	Source properties	Destination properties
AWS::Serverless::Function	AWS::Serverless::Function	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::Function	AWS::Serverless::SimpleTable	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::Function	AWS::Serverless::StateMachine	Read, Write	Id or RoleName and Type	Id or Arn, Name, and Type
AWS::Serverless::Function	AWS::SNS::Topic	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::Function	AWS::SQS::Queue	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::Function	AWS::StepFunctions::StateMachine	Read, Write	Id or RoleName and Type	Id or Arn, Name, and Type
AWS::Serverless::HttpApi	AWS::Lambda::Function	Write	Id or Qualifier , ResourceId , and Type	Id or Arn and Type
AWS::Serverless::HttpApi	AWS::Serverless::Function	Write	Id or Qualifier , ResourceId , and Type	Id or Arn and Type

Source type	Destination type	Permissions	Source properties	Destination properties
AWS::Serverless::SimpleTable	AWS::Lambda::Function	Read	Id or Arn and Type	Id or RoleName and Type
AWS::Serverless::SimpleTable	AWS::Serverless::Function	Read	Id or Arn and Type	Id or RoleName and Type
AWS::Serverless::StateMachine	AWS::DynamoDB::Table	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::StateMachine	AWS::Events::EventBus	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::StateMachine	AWS::Lambda::Function	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::StateMachine	AWS::S3::Bucket	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::StateMachine	AWS::Serverless::Function	Write	Id or RoleName and Type	Id or Arn and Type

Source type	Destination type	Permissions	Source properties	Destination properties
AWS::Serverless::StateMachine	AWS::Serverless::SimpleTable	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::StateMachine	AWS::Serverless::StateMachine	Read, Write	Id or RoleName and Type	Id or Arn, Name, and Type
AWS::Serverless::StateMachine	AWS::SNS::Topic	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::StateMachine	AWS::SQS::Queue	Write	Id or RoleName and Type	Id or Arn and Type
AWS::Serverless::StateMachine	AWS::StepFunctions::StateMachine	Read, Write	Id or RoleName and Type	Id or Arn, Name, and Type
AWS::SNS::Topic	AWS::Lambda::Function	Write	Id or Arn and Type	Id or Arn and Type
AWS::SNS::Topic	AWS::Serverless::Function	Write	Id or Arn and Type	Id or Arn and Type

Source type	Destination type	Permissions	Source properties	Destination properties
AWS::SNS::Topic	AWS::SQS::Queue	Write	Id or Arn and Type	Id or Arn, QueueUrl, and Type
AWS::SQS::Queue	AWS::Lambda::Function	Read, Write	Id or Arn and Type	Id or RoleName and Type
AWS::SQS::Queue	AWS::Serverless::Function	Read, Write	Id or Arn and Type	Id or RoleName and Type
AWS::StepFunctions::StateMachine	AWS::DynamoDB::Table	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::StepFunctions::StateMachine	AWS::Events::EventBus	Write	Id or RoleName and Type	Id or Arn and Type
AWS::StepFunctions::StateMachine	AWS::Lambda::Function	Write	Id or RoleName and Type	Id or Arn and Type
AWS::StepFunctions::StateMachine	AWS::S3::Bucket	Read, Write	Id or RoleName and Type	Id or Arn and Type

Source type	Destination type	Permissions	Source properties	Destination properties
AWS::StepFunctions::StateMachine	AWS::Serverless::Function	Write	Id or RoleName and Type	Id or Arn and Type
AWS::StepFunctions::StateMachine	AWS::Serverless::SimpleTable	Read, Write	Id or RoleName and Type	Id or Arn and Type
AWS::StepFunctions::StateMachine	AWS::Serverless::StateMachine	Read, Write	Id or RoleName and Type	Id or Arn, Name, and Type
AWS::StepFunctions::StateMachine	AWS::SNS::Topic	Write	Id or RoleName and Type	Id or Arn and Type
AWS::StepFunctions::StateMachine	AWS::SQS::Queue	Write	Id or RoleName and Type	Id or Arn and Type
AWS::StepFunctions::StateMachine	AWS::StepFunctions::StateMachine	Read, Write	Id or RoleName and Type	Id or Arn, Name, and Type

IAM policies created by connectors

This section documents the AWS Identity and Access Management (IAM) policies that are created by AWS SAM when using connectors.

AWS::DynamoDB::Table to AWS::Lambda::Function

Policy type

Customer managed policy attached to the AWS::Lambda::Function role.

Access categories

Read

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "dynamodb:DescribeStream",
        "dynamodb:GetRecords",
        "dynamodb:GetShardIterator",
        "dynamodb:ListStreams"
      ],
      "Resource": [
        "%{Source.Arn}/stream/*"
      ]
    }
  ]
}
```

AWS::Events::Rule to AWS::SNS::Topic

Policy type

AWS::SNS::TopicPolicy attached to the AWS::SNS::Topic.

Access categories

Write

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "events.amazonaws.com"
      },
```

```
      "Resource": "%{Destination.Arn}",
      "Action": "sns:Publish",
      "Condition": {
        "ArnEquals": {
          "aws:SourceArn": "%{Source.Arn}"
        }
      }
    }
  ]
}
```

`AWS::Events::Rule` to `AWS::Events::EventBus`

Policy type

Customer managed policy attached to the `AWS::Events::Rule` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "events:PutEvents"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`AWS::Events::Rule` to `AWS::StepFunctions::StateMachine`

Policy type

Customer managed policy attached to the `AWS::Events::Rule` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "states:StartExecution"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`AWS::Events::Rule` to `AWS::Lambda::Function`

Policy type

`AWS::Lambda::Permission` attached to the `AWS::Lambda::Function`.

Access categories

`Write`

```
{
  "Action": "lambda:InvokeFunction",
  "Principal": "events.amazonaws.com",
  "SourceArn": "%{Source.Arn}"
}
```

`AWS::Events::Rule` to `AWS::SQS::Queue`

Policy type

`AWS::SQS::QueuePolicy` attached to the `AWS::SQS::Queue`.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
```

```
      "Principal": {
        "Service": "events.amazonaws.com"
      },
      "Resource": "%{Destination.Arn}",
      "Action": "sqs:SendMessage",
      "Condition": {
        "ArnEquals": {
          "aws:SourceArn": "%{Source.Arn}"
        }
      }
    }
  ]
}
```

`AWS::Lambda::Function` to `AWS::Lambda::Function`

Policy type

Customer managed policy attached to the `AWS::Lambda::Function` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "lambda:InvokeAsync",
        "lambda:InvokeFunction"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`AWS::Lambda::Function` to `AWS::S3::Bucket`

Policy type

Customer managed policy attached to the `AWS::Lambda::Function` role.

Access categories

Read

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:GetObject",
        "s3:GetObjectAcl",
        "s3:GetObjectLegalHold",
        "s3:GetObjectRetention",
        "s3:GetObjectTorrent",
        "s3:GetObjectVersion",
        "s3:GetObjectVersionAcl",
        "s3:GetObjectVersionForReplication",
        "s3:GetObjectVersionTorrent",
        "s3:ListBucket",
        "s3:ListBucketMultipartUploads",
        "s3:ListBucketVersions",
        "s3:ListMultipartUploadParts"
      ],
      "Resource": [
        "%{Destination.Arn}",
        "%{Destination.Arn}/*"
      ]
    }
  ]
}
```

Write

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:AbortMultipartUpload",
        "s3:DeleteObject",
        "s3:DeleteObjectVersion",
        "s3:PutObject",
        "s3:PutObjectLegalHold",
```

```
        "s3:PutObjectRetention",
        "s3:RestoreObject"
      ],
      "Resource": [
        "%{Destination.Arn}",
        "%{Destination.Arn}/*"
      ]
    }
  ]
}
```

`AWS::Lambda::Function` to `AWS::DynamoDB::Table`

Policy type

Customer managed policy attached to the `AWS::Lambda::Function` role.

Access categories

`Read`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "dynamodb:GetItem",
        "dynamodb:Query",
        "dynamodb:Scan",
        "dynamodb:BatchGetItem",
        "dynamodb:ConditionCheckItem",
        "dynamodb:PartiQLSelect"
      ],
      "Resource": [
        "%{Destination.Arn}",
        "%{Destination.Arn}/index/*"
      ]
    }
  ]
}
```

`Write`

```
{
```

```
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "dynamodb:PutItem",
        "dynamodb:UpdateItem",
        "dynamodb:DeleteItem",
        "dynamodb:BatchWriteItem",
        "dynamodb:PartiQLDelete",
        "dynamodb:PartiQLInsert",
        "dynamodb:PartiQLUpdate"
      ],
      "Resource": [
        "%{Destination.Arn}",
        "%{Destination.Arn}/index/*"
      ]
    }
  ]
}
```

`AWS::Lambda::Function` to `AWS::SQS::Queue`

Policy type

Customer managed policy attached to the `AWS::Lambda::Function` role.

Access categories

`Read`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "sqs:ReceiveMessage",
        "sqs:GetQueueAttributes"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "sqs:DeleteMessage",
        "sqs:SendMessage",
        "sqs:ChangeMessageVisibility",
        "sqs:PurgeQueue"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`AWS::Lambda::Function` to `AWS::SNS::Topic`

Policy type

Customer managed policy attached to the `AWS::Lambda::Function` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "sns:Publish"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`AWS::Lambda::Function` to `AWS::StepFunctions::StateMachine`

Policy type

Customer managed policy attached to the `AWS::Lambda::Function` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "states:StartExecution",
        "states:StartSyncExecution"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    },
    {
      "Effect": "Allow",
      "Action": [
        "states:StopExecution"
      ],
      "Resource": [
        "arn:${AWS::Partition}:states:${AWS::Region}:${AWS::AccountId}:execution:
%{Destination.Name}:*"
      ]
    }
  ]
}
```

`Read`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "states:DescribeStateMachine",
        "states:ListExecutions"
```

```
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    },
    {
      "Effect": "Allow",
      "Action": [
        "states:DescribeExecution",
        "states:DescribeStateMachineForExecution",
        "states:GetExecutionHistory"
      ],
      "Resource": [
        "arn:${AWS::Partition}:states:${AWS::Region}:${AWS::AccountId}:execution:
%{Destination.Name}:*"
      ]
    }
  ]
}
```

`AWS::Lambda::Function` to `AWS::Events::EventBus`

Policy type

Customer managed policy attached to the `AWS::Lambda::Function` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "events:PutEvents"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`AWS::Lambda::Function` to `AWS::Location::PlaceIndex`

Policy type

Customer managed policy attached to the `AWS::Lambda::Function` role.

Access categories

`Read`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "geo:DescribePlaceIndex",
        "geo:GetPlace",
        "geo:SearchPlaceIndexForPosition",
        "geo:SearchPlaceIndexForSuggestions",
        "geo:SearchPlaceIndexForText"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`AWS::ApiGatewayV2::Api` to `AWS::Lambda::Function`

Policy type

`AWS::Lambda::Permission` attached to the `AWS::Lambda::Function`.

Access categories

`Write`

```
{
  "Action": "lambda:InvokeFunction",
  "Principal": "apigateway.amazonaws.com",
  "SourceArn": "arn:${AWS::Partition}:execute-api:${AWS::Region}:${AWS::AccountId}:
%{Source.ResourceId}/%{Source.Qualifier}"
}
```

AWS::ApiGateway::RestApi to AWS::Lambda::Function

Policy type

AWS::Lambda::Permission attached to the AWS::Lambda::Function.

Access categories

Write

```
{
  "Action": "lambda:InvokeFunction",
  "Principal": "apigateway.amazonaws.com",
  "SourceArn": "arn:${AWS::Partition}:execute-api:${AWS::Region}:${AWS::AccountId}:
%{Source.ResourceId}/%{Source.Qualifier}"
}
```

AWS::SNS::Topic to AWS::SQS::Queue

Policy type

AWS::SQS::QueuePolicy attached to the AWS::SQS::Queue.

Access categories

Write

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "sns.amazonaws.com"
      },
      "Resource": "%{Destination.Arn}",
      "Action": "sqs:SendMessage",
      "Condition": {
        "ArnEquals": {
          "aws:SourceArn": "%{Source.Arn}"
        }
      }
    }
  ]
}
```

`AWS::SNS::Topic` to `AWS::Lambda::Function`

Policy type

`AWS::Lambda::Permission` attached to the `AWS::Lambda::Function`.

Access categories

`Write`

```
{
  "Action": "lambda:InvokeFunction",
  "Principal": "sns.amazonaws.com",
  "SourceArn": "%{Source.Arn}"
}
```

`AWS::SQS::Queue` to `AWS::Lambda::Function`

Policy type

Customer managed policy attached to the `AWS::Lambda::Function` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "sqs:DeleteMessage"
      ],
      "Resource": [
        "%{Source.Arn}"
      ]
    }
  ]
}
```

`Read`

```
{
  "Statement": [
```

```
    {
      "Effect": "Allow",
      "Action": [
        "sqs:ReceiveMessage",
        "sqs:GetQueueAttributes"
      ],
      "Resource": [
        "%{Source.Arn}"
      ]
    }
  ]
}
```

`AWS::S3::Bucket` to `AWS::Lambda::Function`

Policy type

`AWS::Lambda::Permission` attached to the `AWS::Lambda::Function`.

Access categories

`Write`

```
{
  "Action": "lambda:InvokeFunction",
  "Principal": "s3.amazonaws.com",
  "SourceArn": "%{Source.Arn}",
  "SourceAccount": "${AWS::AccountId}"
}
```

`AWS::StepFunctions::StateMachine` to `AWS::Lambda::Function`

Policy type

Customer managed policy attached to the `AWS::StepFunctions::StateMachine` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
```

```
      "Action": [
        "lambda:InvokeAsync",
        "lambda:InvokeFunction"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`AWS::StepFunctions::StateMachine` to `AWS::SNS::Topic`

Policy type

Customer managed policy attached to the `AWS::StepFunctions::StateMachine` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "sns:Publish"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`AWS::StepFunctions::StateMachine` to `AWS::SQS::Queue`

Policy type

Customer managed policy attached to the `AWS::StepFunctions::StateMachine` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "sqs:SendMessage"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`AWS::StepFunctions::StateMachine` to `AWS::S3::Bucket`

Policy type

Customer managed policy attached to the `AWS::StepFunctions::StateMachine` role.

Access categories

`Read`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:GetObject",
        "s3:GetObjectAcl",
        "s3:GetObjectLegalHold",
        "s3:GetObjectRetention",
        "s3:GetObjectTorrent",
        "s3:GetObjectVersion",
        "s3:GetObjectVersionAcl",
        "s3:GetObjectVersionForReplication",
        "s3:GetObjectVersionTorrent",
        "s3:ListBucket",
        "s3:ListBucketMultipartUploads",
        "s3:ListBucketVersions",
        "s3:ListMultipartUploadParts"
      ],
```

```
      "Resource": [
        "%{Destination.Arn}",
        "%{Destination.Arn}/*"
      ]
    }
  ]
}
```

Write

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:AbortMultipartUpload",
        "s3:DeleteObject",
        "s3:DeleteObjectVersion",
        "s3:PutObject",
        "s3:PutObjectLegalHold",
        "s3:PutObjectRetention",
        "s3:RestoreObject"
      ],
      "Resource": [
        "%{Destination.Arn}",
        "%{Destination.Arn}/*"
      ]
    }
  ]
}
```

`AWS::StepFunctions::StateMachine` to `AWS::DynamoDB::Table`

Policy type

Customer managed policy attached to the `AWS::StepFunctions::StateMachine` role.

Access categories

Read

```
{
  "Statement": [
    {
```

```
      "Effect": "Allow",
      "Action": [
        "dynamodb:GetItem",
        "dynamodb:Query",
        "dynamodb:Scan",
        "dynamodb:BatchGetItem",
        "dynamodb:ConditionCheckItem",
        "dynamodb:PartiQLSelect"
      ],
      "Resource": [
        "%{Destination.Arn}",
        "%{Destination.Arn}/index/*"
      ]
    }
  ]
}
```

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "dynamodb:PutItem",
        "dynamodb:UpdateItem",
        "dynamodb:DeleteItem",
        "dynamodb:BatchWriteItem",
        "dynamodb:PartiQLDelete",
        "dynamodb:PartiQLInsert",
        "dynamodb:PartiQLUpdate"
      ],
      "Resource": [
        "%{Destination.Arn}",
        "%{Destination.Arn}/index/*"
      ]
    }
  ]
}
```

`AWS::StepFunctions::StateMachine` to `AWS::StepFunctions::StateMachine`

Policy type

Customer managed policy attached to the `AWS::StepFunctions::StateMachine` role.

Access categories

`Read`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "states:DescribeExecution"
      ],
      "Resource": [
        "arn:${AWS::Partition}:states:${AWS::Region}:${AWS::AccountId}:execution:
%{Destination.Name}:*"
      ]
    },
    {
      "Effect": "Allow",
      "Action": [
        "events:DescribeRule"
      ],
      "Resource": [
        "arn:${AWS::Partition}:events:${AWS::Region}:${AWS::AccountId}:rule/
StepFunctionsGetEventsForStepFunctionsExecutionRule"
      ]
    }
  ]
}
```

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "states:StartExecution"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
```

```
    },
    {
      "Effect": "Allow",
      "Action": [
        "states:StopExecution"
      ],
      "Resource": [
        "arn:${AWS::Partition}:states:${AWS::Region}:${AWS::AccountId}:execution:
%{Destination.Name}:*"
      ]
    },
    {
      "Effect": "Allow",
      "Action": [
        "events:PutTargets",
        "events:PutRule"
      ],
      "Resource": [
        "arn:${AWS::Partition}:events:${AWS::Region}:${AWS::AccountId}:rule/
StepFunctionsGetEventsForStepFunctionsExecutionRule"
      ]
    }
  ]
}
```

`AWS::StepFunctions::StateMachine` to `AWS::Events::EventBus`

Policy type

Customer managed policy attached to the `AWS::StepFunctions::StateMachine` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "events:PutEvents"
      ],
      "Resource": [
        "%{Destination.Arn}"
```

```
      ]
    }
  ]
}
```

`AWS::AppSync::DataSource` to `AWS::DynamoDB::Table`

Policy type

Customer managed policy attached to the `AWS::AppSync::DataSource` role.

Access categories

`Read`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "dynamodb:GetItem",
        "dynamodb:Query",
        "dynamodb:Scan",
        "dynamodb:BatchGetItem",
        "dynamodb:ConditionCheckItem",
        "dynamodb:PartiQLSelect"
      ],
      "Resource": [
        "%{Destination.Arn}",
        "%{Destination.Arn}/index/*"
      ]
    }
  ]
}
```

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "dynamodb:PutItem",
```

```
        "dynamodb:UpdateItem",
        "dynamodb:DeleteItem",
        "dynamodb:BatchWriteItem",
        "dynamodb:PartiQLDelete",
        "dynamodb:PartiQLInsert",
        "dynamodb:PartiQLUpdate"
      ],
      "Resource": [
        "%{Destination.Arn}",
        "%{Destination.Arn}/index/*"
      ]
    }
  ]
}
```

`AWS::AppSync::DataSource` to `AWS::Lambda::Function`

Policy type

Customer managed policy attached to the `AWS::AppSync::DataSource` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "lambda:InvokeAsync",
        "lambda:InvokeFunction"
      ],
      "Resource": [
        "%{Destination.Arn}",
        "%{Destination.Arn}:*"
      ]
    }
  ]
}
```

`AWS::AppSync::DataSource` to `AWS::Events::EventBus`

Policy type

Customer managed policy attached to the `AWS::AppSync::DataSource` role.

Access categories

`Write`

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "events:PutEvents"
      ],
      "Resource": [
        "%{Destination.Arn}"
      ]
    }
  ]
}
```

`AWS::AppSync::GraphQLApi` to `AWS::Lambda::Function`

Policy type

`AWS::Lambda::Permission` attached to the `AWS::Lambda::Function`.

Access categories

`Write`

```
{
  "Action": "lambda:InvokeFunction",
  "Principal": "appsync.amazonaws.com",
  "SourceArn": "arn:${AWS::Partition}:appsync:${AWS::Region}:${AWS::AccountId}:apis/
%{Source.ResourceId}"
}
```

Installing Docker to use with the AWS SAM CLI

Docker is an application that runs containers on your machine. With Docker, AWS SAM can provide a local environment similar to AWS Lambda as a container to build, test, and debug your serverless applications.

> **Note**
>
> Docker is required only for testing your applications locally and for building deployment packages using the `--use-container` option.

Topics

- Installing Docker
- Next steps

Installing Docker

Follow these instructions to install Docker on your operating system.

Linux

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

To install Docker on Amazon Linux 2 or Amazon Linux 2023

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

```
$ sudo yum update -y
```

2. Install the most recent Docker Community Edition package.

   - For Amazon Linux 2, run the following:

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

   - For Amazon Linux 2023, run the following:

```
$ sudo yum install -y 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, there are 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 Troubleshooting installation errors. Or, see the Troubleshooting section of **Post-installation steps for Linux** on the Docker Docs website.

macOS

> **Note**
>
> Docker Desktop is officially supported, but starting with AWS SAM CLI version 1.47.0, you can use alternatives as long as they use the Docker runtime.

1. Install Docker

   The AWS SAM CLI supports Docker running on macOS Sierra 10.12 or later. For how to install Docker, see Install Docker Desktop for Mac on the Docker Docs website.

2. Configure your shared drives

   The AWS SAM CLI requires that the project directory, or any parent directory, is listed in a shared drive. This may require file sharing. For more information, see the Volume mounting requires file sharing troubleshooting topic at *Docker docs*.

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, for more troubleshooting tips, see the Troubleshoot and diagnose section of the Docker Docs website.

Windows

> **Note**
>
> AWS SAM officially supports Docker Desktop. However, starting with AWS SAM CLI version 1.47.0, you can use alternatives as long as they use the Docker runtime.

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 on the Docker Docs website.
   - To install Docker for earlier versions of Windows, see The Docker Toolbox on the Docker Toolbox GitHub repository.

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 for Docker to function properly.

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, for more troubleshooting tips, see the Troubleshoot and diagnose section of the Docker Docs website.

Next steps

For how to install the AWS SAM CLI, see Install the AWS SAM CLI.

Installing Finch to use with the AWS SAM CLI

Finch is AWS's container development tool that provides an alternative to Docker, particularly beneficial on macOS and Linux systems. For more information, see Finch on GitHub. With Finch, AWS SAM can provide a local environment similar to AWS Lambda as a container to build, test, and debug your serverless applications.

> **Note**
>
> You need Finch for testing your applications locally, for building deployment packages using the `--use-container` option, and building OCI image functions. Starting with AWS SAM CLI version 1.145.0, AWS SAM CLI supports Finch as an alternative container runtime to Docker.

Topics

- Installing Finch
- Configuring Finch with AWS SAM CLI
- Verifying the installation
- Stopping Finch
- Troubleshooting

- Next steps

Installing Finch

Follow these instructions to install Finch on your operating system.

Prerequisites

> **Note**
>
> Finch integration in AWS SAM CLI is available on macOS and Linux systems. For Windows users, consider using a virtual machine or Linux environment for Finch functionality.

macOS versions:

- macOS 15 Sequoia
- macOS 14 Sonoma

> **Note**
>
> Finch supports the latest two versions of macOS.

Linux:

- Linux Kernel v4.x+

Installing Finch

macOS

To install Finch on macOS

1. Install Finch using the `brew` CLI. If prompted, enter your macOS password.

```
$ brew install finch
```

2. Check the installed Finch version.

```
$ finch --version
```

3. Initialize Finch virtual machine (first time setup).

```
$ finch vm init
```

4. Start Finch virtual machine.

```
$ finch vm start
```

5. Check the status of the Finch virtual machine.

```
$ finch vm status
```

6. Verify that Finch runs correctly.

```
$ finch --info
$ finch ps
```

For more information, see Installing Finch on macOS.

Linux

You can install Finch on Amazon Linux, Ubuntu, or by using a generic installation method. For more information, see Installing Finch on Linux.

Configuring Finch with AWS SAM CLI

After you install Finch, the AWS SAM CLI automatically detects and uses Finch as a container runtime when Docker does not run.

> **Note**
>
> Finch serves as a fallback to Docker. If you have both Docker and Finch installed and running, AWS SAM CLI prioritizes Docker by default.

Administrator preference configuration (macOS)

You can configure AWS SAM CLI to use a specific container runtime as the default by creating an administrator preference file. This system-wide preference overrides the default fallback behavior.

Available configuration options

- **Set Finch as preferred container runtime:**

```
$ sudo /usr/libexec/PlistBuddy -c "Add :DefaultContainerRuntime string finch" /
Library/Preferences/com.amazon.samcli.plist
```

- **Set Docker as preferred container runtime:**

```
$ sudo /usr/libexec/PlistBuddy -c "Add :DefaultContainerRuntime string docker" /
Library/Preferences/com.amazon.samcli.plist
```

- **Remove preference (return to default behavior):**

```
$ sudo /usr/libexec/PlistBuddy -c "Remove :DefaultContainerRuntime" /Library/
Preferences/com.amazon.samcli.plist
```

> **Note**
>
> When no administrator preference is set, AWS SAM CLI uses Docker by default when available, with Finch as a fallback when Docker is not running.

Directory mounting differences (macOS)

On macOS, AWS SAM local commands fail if you locate your project outside your home directory (~) or `/Volumes`. This design restricts automatic directory mounting for security reasons without your knowledge.

Mitigation options

- **Option 1:** Open the Finch configuration in a text editor `~/.finch/finch.yaml` and add your project path under the `additional_directories` section, then restart the Finch virtual machine. For additional information, see Finch documentation.

```
$ finch vm stop
$ finch vm start
```

- **Option 2:** Move your project to your home directory.

Verifying the installation

After you install and start Finch, verify that it works with AWS SAM CLI.

Basic verification

Run the following command to verify that AWS SAM CLI can use Finch:

```
$ sam build --use-container
```

You should see AWS SAM CLI using Finch to build your application in a container environment.

> **Note**
>
> Finch serves as a fallback to Docker. If Docker is running, AWS SAM CLI will prioritize Docker by default.

Testing Finch as a fallback

To test Finch as a fallback when Docker is running, you need to stop Docker first.

To test Finch fallback functionality

1. Stop Docker using the appropriate commands for your operating system.

   macOS:

   ```
   $ docker stop $(docker ps -q)
   $ pkill -f "Docker Desktop"
   ```

   Verify Docker is stopped.

   ```
   $ docker ps
   ```

Linux:

```
$ docker stop $(docker ps -q)
$ sudo systemctl stop docker
```

Verify Docker is stopped.

```
$ sudo systemctl status docker
```

2. Run the `sam build --use-container` command to verify AWS SAM CLI automatically uses Finch as a fallback.

Stopping Finch

If you need to stop Finch, use the following commands:

macOS:

```
$ finch vm stop
$ sudo pkill -f finch
```

Verify Finch is stopped.

```
$ finch vm status
```

Linux:

```
$ sudo systemctl stop finch
$ sudo pkill -f finch
```

Verify Finch is stopped.

```
$ sudo systemctl status finch
```

Troubleshooting

If you encounter issues with Finch:

- Verify that your operating system meets the prerequisites.

- Verify that you have enabled virtualization on your system.
- For macOS, verify that you have sufficient disk space for the virtual machine.
- For Linux, verify that you have proper permissions to run `systemctl` commands.
- If you encounter CloudFormation deployment failures with "media type not supported" errors when you push multi-architecture images to Amazon Elastic Container Registry (Amazon ECR), create a single image artifact instead of using multi-architecture images. This occurs because Finch pushes both the image index and image to Amazon ECR, while Docker pushes only the image.
- If cross-platform building fails when the target function architecture doesn't match the host machine architecture on Linux, enable cross-platform emulation by running `sudo finch run --privileged --rm tonistiigi/binfmt:master --install all`.

For additional troubleshooting, see the Finch documentation or the AWS SAM CLI troubleshooting.

Next steps

Now that you have Finch installed, you can use it with AWS SAM CLI to:

- Build serverless applications using containers with `sam build --use-container`. For more information, see the section called “sam build”.
- Test Lambda functions locally with `sam local invoke`. For more information, see the section called “sam local invoke”.
- Start a local API Gateway with `sam local start-api`. For more information, see the section called “sam local start-api”.
- Start a local Lambda endpoint with `sam local start-lambda`. For more information, see the section called “sam local start-lambda”.

For more information about using AWS SAM CLI with containers, see Default build with AWS SAM.

Image repositories for AWS SAM

AWS SAM simplifies continuous integration and continuous delivery (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 Deploy with CI/CD systems and pipelines.

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-nodejs20.x` uses the latest image. However, `public.ecr.aws/sam/build-nodejs20.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** 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.

> **Note**
>
> Amazon ECR Public replaced DockerHub starting with the AWS SAM CLI version 1.22.0. If you are using an earlier version of the AWS SAM CLI, we recommend that you upgrade.

Runtime	Amazon ECR Public
Custom runtime (AL2023)	public.ecr.aws/sam/build-provided.al2023
Custom runtime (AL2)	public.ecr.aws/sam/build-provided.al2

Runtime	Amazon ECR Public
Custom runtime	public.ecr.aws/sam/build-provided
Java 25	public.ecr.aws/sam/build-java25
Java 21	public.ecr.aws/sam/build-java21
Java 17	public.ecr.aws/sam/build-java17
Java 11	public.ecr.aws/sam/build-java11
Java 8	public.ecr.aws/sam/build-java8
.NET 9	public.ecr.aws/sam/build-dotnet9
.NET 8	public.ecr.aws/sam/build-dotnet8
.NET 7	public.ecr.aws/sam/build-dotnet7
.NET 6	public.ecr.aws/sam/build-dotnet6
Node.js 24	public.ecr.aws/sam/build-nodejs24.x
Node.js 22	public.ecr.aws/sam/build-nodejs22.x
Node.js 20	public.ecr.aws/sam/build-nodejs20.x
Node.js 18	public.ecr.aws/sam/build-nodejs18.x
Node.js 16	public.ecr.aws/sam/build-nodejs16.x
Python 3.14	public.ecr.aws/sam/build-python3.14
Python 3.13	public.ecr.aws/sam/build-python3.13
Python 3.12	public.ecr.aws/sam/build-python3.12
Python 3.11	public.ecr.aws/sam/build-python3.11
Python 3.10	public.ecr.aws/sam/build-python3.10

Runtime	Amazon ECR Public
Python 3.9	public.ecr.aws/sam/build-python3.9
Python 3.8	public.ecr.aws/sam/build-python3.8
Ruby 3.4	public.ecr.aws/sam/build-ruby3.4
Ruby 3.3	public.ecr.aws/sam/build-ruby3.3
Ruby 3.2	public.ecr.aws/sam/build-ruby3.2

Examples

The following two example commands build applications using container images from the image repository:

Build a Node.js 24 application using a container image pulled from Amazon ECR:

```
$ sam build --use-container --build-image public.ecr.aws/sam/build-nodejs24.x
```

Build a function resource using the Python 3.14 container image pulled from Amazon ECR:

```
$ sam build --use-container --build-image Function1=public.ecr.aws/sam/build-python3.14
```

Deploying serverless applications gradually with AWS SAM

AWS Serverless Application Model (AWS SAM) comes built-in with CodeDeploy to provide gradual AWS 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. If an update doesn't work correctly, you can roll back the changes.
- Defines pre-traffic and post-traffic test functions to verify that the newly deployed code is configured correctly and that your application operates as expected.

- Automatically 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 the use of CodeDeploy to gradually shift customers to your newly deployed version of Lambda function:

```
Resources:
MyLambdaFunction:
  Type: AWS::Serverless::Function
  Properties:
    Handler: index.handler
    Runtime: nodejs20.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-traffic or post-traffic tests fail, or if a CloudWatch alarm is triggered, CodeDeploy rolls back your deployment. You can specify how traffic should be shifted between versions in the following ways:
  - `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.
  - `AllAtOnce`: All traffic is shifted from the original Lambda function to the updated Lambda function version at once.

  The following table outlines other traffic-shifting options that are available beyond the one used in the example.

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. When encountered, they automatically roll back your deployment. For example, if the updated code you're deploying causes 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 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 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.

Gradually deploying a Lambda function for the first time

When deploying a Lambda function gradually, CodeDeploy requires a previously deployed function version to shift traffic from. Therefore, your first deployment should be accomplished in two steps:

- **Step 1**: Deploy your Lambda function and automatically create aliases with `AutoPublishAlias`.
- **Step 2**: Perform your gradual deployment with `DeploymentPreference`.

Performing your first gradual deployment in two steps gives CodeDeploy a previous Lambda function version to shift traffic from.

Step 1: Deploy your Lambda function

```
Resources:
MyLambdaFunction:
  Type: AWS::Serverless::Function
  Properties:
    Handler: index.handler
    Runtime: nodejs20.x
    CodeUri: s3://bucket/code.zip

    AutoPublishAlias: live
```

Step 2: Perform your gradual deployment

```
Resources:
MyLambdaFunction:
  Type: AWS::Serverless::Function
  Properties:
    Handler: index.handler
    Runtime: nodejs20.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 and after traffic shifting
        PreTraffic: !Ref PreTrafficLambdaFunction
        PostTraffic: !Ref PostTrafficLambdaFunction
```

Learn more

For a hands-on example of configuring a gradual deployment, see Module 5 - Canary Deployments in *The Complete AWS SAM Workshop*.

Important reference notes for AWS SAM

This section contains important notes and announcements for AWS Serverless Application Model (AWS SAM).

Topics

- Important notes for 2023

Important notes for 2023

October 2023

AWS SAM CLI discontinuing support for Python 3.7

Published on 2023-10-20

Python 3.7 received end-of-life status in June of 2023. The AWS SAM CLI will discontinue support for Python 3.7 on October 24, 2023. For more information, see the announcement at the *aws-sam-cli GitHub repository*.

This change impacts the following users:

- If you use Python 3.7 and install the AWS SAM CLI through `pip`.
- If you use the `aws-sam-cli` as a library and build your application with Python 3.7.

If you install and manage the AWS SAM CLI through another method, you are not affected.

For impacted users, we recommend that you upgrade your development environment to Python 3.8 or newer.

This change does not affect support for the Python 3.7 AWS Lambda runtime environment. For more information, see Runtime deprecation policy in the *AWS Lambda Developer Guide*.

AWS SAM CLI Terraform support

This section covers using the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) with your Terraform projects and Terraform Cloud.

To provide feedback and submit feature requests, create a GitHub Issue.

Topics

- Getting started with Terraform support for AWS SAM CLI
- Using the AWS SAM CLI with Terraform for local debugging and testing
- Using the AWS SAM CLI with Serverless.tf for local debugging and testing
- AWS SAM CLI with Terraform reference
- What is AWS SAM CLI support for Terraform?

Getting started with Terraform support for AWS SAM CLI

This topic covers how to get started with using the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) with Terraform.

To provide feedback and submit feature requests, create a GitHub Issue.

Topics

- AWS SAM CLI Terraform prerequisites
- Using AWS SAM CLI commands with Terraform
- Set up for Terraform projects
- Set up for Terraform Cloud

AWS SAM CLI Terraform prerequisites

Complete all prerequisites to begin using the AWS SAM CLI with your Terraform projects.

1. **Install or upgrade the AWS SAM CLI**

   To check if you have the AWS SAM CLI installed, run the following:

```
$ sam --version
```

If the AWS SAM CLI is already installed, the output will display a version. To upgrade to the newest version, see Upgrading the AWS SAM CLI.

For instructions on installing the AWS SAM CLI along with all of its prerequisites, see Install the AWS SAM CLI.

2. **Install Terraform**

   To check if you have Terraform installed, run the following:

   ```
   $ terraform -version
   ```

   To install Terraform, see Install Terraform in the *Terraform registry*.

3. **Install Docker for local testing**

   The AWS SAM CLI requires Docker for local testing. To install Docker, see Installing Docker to use with the AWS SAM CLI.

Using AWS SAM CLI commands with Terraform

When you run a supported AWS SAM CLI command, use the `--hook-name` option and provide the `terraform` value. The following is an example:

```
$ sam local invoke --hook-name terraform
```

You can configure this option in your AWS SAM CLI configuration file with the following:

```
hook_name = "terraform"
```

Set up for Terraform projects

Complete steps in this topic to use the AWS SAM CLI with Terraform projects.

No additional setup is required if you build your AWS Lambda artifacts outside of your Terraform project. See Using the AWS SAM CLI with Terraform for local debugging and testing to start using the AWS SAM CLI.

If you build your Lambda artifacts within your Terraform projects, you must do the following:

1. Install Python 3.8 or newer
2. Install the Make tool.
3. Define your Lambda artifacts build logic within your Terraform project.
4. Define a `sam metadata` resource to inform the AWS SAM CLI of your build logic.
5. Use the AWS SAM CLI `sam build` command to build your Lambda artifacts.

Install Python 3.8 or newer

Python 3.8 or newer is required for use with the AWS SAM CLI. When you run `sam build`, the AWS SAM CLI creates `makefiles` that contain Python commands to build your Lambda artifacts.

For installation instructions, see Downloading Python in Python's *Beginners Guide*.

Verify that Python 3.8 or newer is added to your machine path by running:

```
$ python --version
```

The output should display a version of Python that is 3.8 or newer.

Install the Make tool

GNU Make is a tool that controls the generation of executables and other non-source files for your project. The AWS SAM CLI creates `makefiles` which rely on this tool to build your Lambda artifacts.

If you do not have Make installed on your local machine, install it before moving forward.

For Windows, you can install using Chocolatey. For instructions, see Using Chocolatey in *How to Install and Use "Make" in Windows*

Define the Lambda artifacts build logic

Use the `null_resource` Terraform resource type to define your Lambda build logic. The following is an example that uses a custom build script to build a Lambda function.

```
resource "null_resource" "build_lambda_function" {
    triggers = {
        build_number = "${timestamp()}"
```

```
    }

    provisioner "local-exec" {
        command =  substr(pathexpand("~"), 0, 1) == "/"? "./
py_build.sh \"${local.lambda_src_path}\" \"${local.building_path}\"
 \"${local.lambda_code_filename}\" Function" : "powershell.exe -File .\\PyBuild.ps1
 ${local.lambda_src_path} ${local.building_path} ${local.lambda_code_filename}
 Function"
    }
}
```

Define a sam metadata resource

The `sam metadata` resource is a `null_resource` Terraform resource type that provides the AWS SAM CLI with the information it needs to locate your Lambda artifacts. A unique `sam metadata` resource is required for each Lambda function or layer in your project. To learn more about this resource type, see null_resource in the *Terraform registry*.

To define a sam metadata resource

1. Name your resource starting with `sam_metadata_` to identify the resource as a sam metadata resource.
2. Define your Lambda artifact properties within the `triggers` block of your resource.
3. Specify your `null_resource` that contains your Lambda build logic with the `depends_on` argument.

   The following is an example template:

   ```
   resource "null_resource" "sam_metadata_..." {
     triggers = {
       resource_name = resource_name
       resource_type = resource_type
       original_source_code = original_source_code
       built_output_path = built_output_path
     }
     depends_on = [
       null_resource.build_lambda_function # ref to your build logic
     ]
   }
   ```

   The following is an example `sam metadata` resource:

```
resource "null_resource" "sam_metadata_aws_lambda_function_publish_book_review" {
    triggers = {
        resource_name = "aws_lambda_function.publish_book_review"
        resource_type = "ZIP_LAMBDA_FUNCTION"
        original_source_code = "${local.lambda_src_path}"
        built_output_path = "${local.building_path}/${local.lambda_code_filename}"
    }
    depends_on = [
        null_resource.build_lambda_function
    ]
}
```

The contents of your `sam metadata` resource will vary based on the Lambda resource type (function or layer), and the packaging type (ZIP or image). For more information, along with examples, see sam metadata resource.

When you configure a `sam metadata` resource and use a supported AWS SAM CLI command, the AWS SAM CLI will generate the metadata file before running the AWS SAM CLI command. Once you have generated this file, you can use the `--skip-prepare-infra` option with future AWS SAM CLI commands to skip the metadata generation process and save time. This option should only be used if you haven't made any infrastructure changes, such as creating new Lambda functions or new API endpoints.

Use the AWS SAM CLI to build your Lambda artifacts

Use the AWS SAM CLI `sam build` command to build your Lambda artifacts. When you run `sam build`, the AWS SAM CLI does the following:

1. Looks for `sam metadata` resources in your Terraform project to learn about and locate your Lambda resources.
2. Initiates your Lambda build logic to build your Lambda artifacts.
3. Creates an `.aws-sam` directory that organizes your Terraform project for use with the AWS SAM CLI `sam local` commands.

To build with sam build

1. From the directory containing your Terraform root module, run the following:

```
$ sam build --hook-name terraform
```

2. To build a specific Lambda function or layer, run the following

```
$ sam build --hook-name terraform lambda-resource-id
```

The Lambda resource ID can be the Lambda function name or full Terraform resource address, such as `aws_lambda_function.list_books` or `module.list_book_function.aws_lambda_function.this[0]`.

If your function source code or other Terraform configuration files are located outside of the directory containing your Terraform root module, you need to specify the location. Use the `--terraform-project-root-path` option to specify the absolute or relative path to the top-level directory containing these files. The following is an example:

```
$ sam build --hook-name terraform --terraform-project-root-path ~/projects/terraform/
demo
```

Build using a container

When running the AWS SAM CLI `sam build` command, you can configure the AWS SAM CLI to build your application using a local Docker container.

> **Note**
>
> You must have Docker installed and configured. For instructions, see Installing Docker to use with the AWS SAM CLI.

To build using a container

1. Create a `Dockerfile` that contains the Terraform, Python, and Make tools. You should also include your Lambda function runtime.

   The following is an example `Dockerfile`:

```
FROM public.ecr.aws/amazonlinux/amazonlinux:2
```

```
RUN yum -y update \
    && yum install -y unzip tar gzip bzip2-devel ed gcc gcc-c++ gcc-gfortran \
    less libcurl-devel openssl openssl-devel readline-devel xz-devel \
    zlib-devel glibc-static libcxx libcxx-devel llvm-toolset-7 zlib-static \
    && rm -rf /var/cache/yum

RUN yum -y install make \
    && yum -y install zip

RUN yum install -y yum-utils \
    && yum-config-manager --add-repo https://rpm.releases.hashicorp.com/
AmazonLinux/hashicorp.repo \
    && yum -y install terraform \
    && terraform --version

# AWS Lambda Builders
RUN amazon-linux-extras enable python3.8
RUN yum clean metadata && yum -y install python3.8
RUN curl -L get-pip.io | python3.8
RUN pip3 install aws-lambda-builders
RUN ln -s /usr/bin/python3.8 /usr/bin/python3
RUN python3 --version

VOLUME /project
WORKDIR /project

ENTRYPOINT ["sh"]
```

2. Use docker build to build your Docker image.

   The following is an example:

```
$ docker build --tag terraform-build:v1 <path-to-directory-containing-Dockerfile>
```

3. Run the AWS SAM CLI `sam build` command with the `--use-container` and `--build-image` options.

   The following is an example:

```
$ sam build --use-container --build-image terraform-build:v1
```

Next steps

To start using the AWS SAM CLI with your Terraform projects, see Using the AWS SAM CLI with Terraform for local debugging and testing.

Set up for Terraform Cloud

We recommend that you use Terraform v1.6.0 or newer. If you are using an older version, you must generate a Terraform plan file locally. The local plan file provides the AWS SAM CLI with the information it needs to perform local testing and debugging.

To generate a local plan file

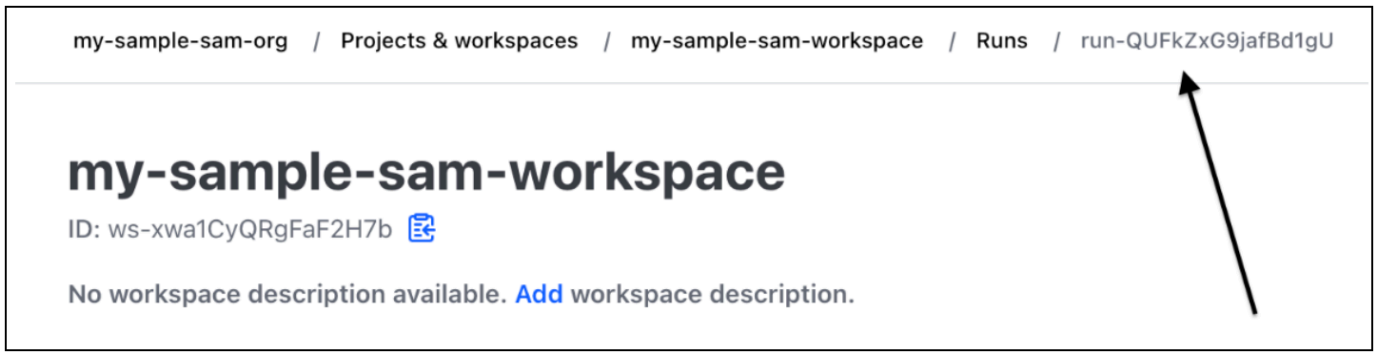
> **Note**
>
> These steps are not required for Terraform v1.6.0 or newer. To start using the AWS SAM CLI with Terraform Cloud, see Using AWS SAM CLI with Terraform.

1. **Configure an API token** – The type of token will depend on your access level. To learn more, see API Tokens in the *Terraform Cloud documentation*.
2. **Set your API token environment variable** – The following is an example from the command line:

   ```
   $ export TOKEN="<api-token-value>"
   ```

3. **Obtain your run ID** – From the Terraform Cloud console, locate the run ID for the Terraform run that you'd like to use with the AWS SAM CLI.

   The run ID is located in the breadcrumb path of your run.



4. **Fetch the plan file** – Using your API token, obtain your local plan file. The following is an example from the command line:

```
curl \
   --header "Authorization: Bearer $TOKEN" \
   --header "Content-Type: application/vnd.api+json" \
   --location \
   https://app.terraform.io/api/v2/runs/<run ID>/plan/json-output \
   > custom_plan.json
```

You are now ready to use the AWS SAM CLI with Terraform Cloud. When using a supported AWS SAM CLI command, use the `--terraform-plan-file` option to specify the name and path of your local plan file. The following is an example:

```
$ sam local invoke --hook-name terraform --terraform-plan-file custom-plan.json
```

The following is an example, using the `sam local start-api` command:

```
$ sam local start-api --hook-name terraform --terraform-plan-file custom-plan.json
```

For a sample application that you can use with these examples, see api_gateway_v2_tf_cloud in the *aws-samples GitHub repository*.

Next steps

To start using the AWS SAM CLI with Terraform Cloud, see Using the AWS SAM CLI with Terraform for local debugging and testing.

Using the AWS SAM CLI with Terraform for local debugging and testing

This topic covers how to use supported AWS Serverless Application Model Command Line Interface (AWS SAM CLI) commands with your Terraform projects and Terraform Cloud.

To provide feedback and submit feature requests, create a GitHub Issue.

Topics

- Local testing with sam local invoke

- Local testing with sam local start-api
- Local testing with sam local start-lambda
- Terraform limitations

Local testing with sam local invoke

> **Note**
>
> To use the AWS SAM CLI to test locally, you must have Docker installed and configured. For instructions, see Installing Docker to use with the AWS SAM CLI.

The following is an example of testing your Lambda function locally by passing in an event:

```
$ sam local invoke --hook-name terraform hello_world_function -e events/event.json -
```

To learn more about using this command, see Introduction to testing with sam local invoke.

Local testing with sam local start-api

To use `sam local start-api` with Terraform, run the following:

```
$ sam local start-api --hook-name terraform
```

The following is an example:

```
$ sam local start-api --hook-name terraform





Running Prepare Hook to prepare the current application


Executing prepare hook of hook "terraform"
```

```
Initializing Terraform application



...
Creating terraform plan and getting JSON output



....
Generating metadata file





Unresolvable attributes discovered in project, run terraform apply to resolve them.





Finished generating metadata file. Storing in...
Prepare hook completed and metadata file generated at: ...
Mounting HelloWorldFunction at http://127.0.0.1:3000/hello [GET]


Mounting None at http://127.0.0.1:3000/hello [POST]


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. If you
used sam build before running local commands, you will need to re-run sam build for the
 changes to be picked up. You only need to restart SAM CLI if you update your AWS SAM
 template
2023-06-26 13:21:20  * Running on http://127.0.0.1:3000/ (Press CTRL+C to quit)
```

To learn more about this command, see Introduction to testing with sam local start-api.

Lambda functions that use Lambda authorizers

For Lambda functions configured to use Lambda authorizers, the AWS SAM CLI will automatically invoke your Lambda authorizer before invoking your Lambda function endpoint.

- To learn more about this feature in the AWS SAM CLI, see Lambda functions that use Lambda authorizers.
- For more information on using Lambda authorizers in Terraform, see Resource: aws_api_gateway_authorizer in the *Terraform registry*.

Local testing with sam local start-lambda

The following is an example of testing your Lambda function locally with the AWS Command Line Interface (AWS CLI):

1. Use the AWS SAM CLI to create a local testing environment:

```
$ sam local start-lambda --hook-name terraform hello_world_function
```

2. Use the AWS CLI to invoke your function locally:

```
$ aws lambda invoke --function-name hello_world_function --endpoint-
url http://127.0.0.1:3001/ response.json --cli-binary-format raw-in-base64-out --
payload file://events/event.json
```

To learn more about this command, see Introduction to testing with sam local start-lambda.

Terraform limitations

The following are limitations when using the AWS SAM CLI with Terraform:

- Lambda functions linked to multiple layers.
- Terraform local variables that define links between resources.
- Referencing a Lambda function that hasn't been created yet. This includes functions that are defined in the body attribute of the REST API resource.

To avoid these limitations, you can run `terraform apply` when a new resource is added.

Using the AWS SAM CLI with Serverless.tf for local debugging and testing

The AWS Serverless Application Model Command Line Interface (AWS SAM CLI) can be used with Serverless.tf modules for local debugging and testing of your AWS Lambda functions and layers. The following AWS SAM CLI commands are supported:

- `sam build`
- `sam local invoke`
- `sam local start-api`
- `sam local start-lambda`

> **Note**
>
> Serverless.tf version 4.6.0 and newer supports AWS SAM CLI integration.

To begin using the AWS SAM CLI with your Serverless.tf modules, update to the latest version of Serverless.tf and the AWS SAM CLI.

Starting from **serverless.tf version 6.0.0**, you must set the `create_sam_metadata` parameter as `true`. This generates the metadata resources that the AWS SAM CLI `sam build` command requires.

To learn more about Serverless.tf, see the terraform-aws-lambda-module.

AWS SAM CLI with Terraform reference

This section is the reference for using the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) with Terraform for local debugging and testing.

To provide feedback and submit feature requests, create a GitHub Issue.

AWS SAM supported features reference

Reference documentation for AWS SAM CLI features that are supported for use with Terraform can be found here:

- sam build
- sam local invoke
- sam local start-api
- sam local start-lambda

Terraform specific reference

Reference documentation specific to using AWS SAM CLI with Terraform can be found here:

- sam metadata resource

sam metadata resource

This page contains reference information for the **sam metadata resource** resource type used with Terraform projects.

- For an introduction to using the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) with Terraform, see What is AWS SAM CLI support for Terraform?.
- To use the AWS SAM CLI with Terraform, see Using the AWS SAM CLI with Terraform for local debugging and testing.

Topics

- Arguments
- Examples

Arguments

Argument	Description
`built_output_path`	The path to your AWS Lambda function's built artifacts.
`docker_build_args`	Decoded string of the Docker build arguments JSON object. This argument is optional.

Argument	Description
`docker_context`	The path to the directory containing the Docker image build context.
`docker_file`	The path to the Docker file. This path is relative to the `docker_context` path. This argument is optional. Default value is `Dockerfile` .
`docker_tag`	The value of the created Docker image tag. This value is optional.
`depends_on`	The path to the building resource for your Lambda function or layer. To learn more, see The **depends_on** argument in the *Terraform registry*.
`original_source_code`	The path to where your Lambda function is defined. This value can be a string, array of strings, or a decoded JSON object as a string. • For string arrays, only the first value is used since multiple code paths are not supported. • For JSON objects, the `source_code_property` must also be defined.
`resource_name`	The Lambda function name.
`resource_type`	The format of your Lambda function package type. Accepted values are: • `IMAGE_LAMBDA_FUNCTION` • `LAMBDA_LAYER` • `ZIP_LAMBDA_FUNCTION`
`source_code_property`	The path to the Lambda resource code in the JSON object. Define this property when `original_source_code` is a JSON object.

Examples

sam metadata resource referencing a Lambda function using the ZIP package type

```
# Lambda function resource
resource "aws_lambda_function" "tf_lambda_func" {
  filename = "${path.module}/python/hello-world.zip"
  handler = "index.lambda_handler"
  runtime = "python3.8"
  function_name = "function_example"
  role = aws_iam_role.iam_for_lambda.arn
  depends_on = [
    null_resource.build_lambda_function # function build logic
  ]
}

# sam metadata resource
resource "null_resource" "sam_metadata_function_example" {
  triggers = {
    resource_name = "aws_lambda_function.function_example"
    resource_type = "ZIP_LAMBDA_FUNCTION"
    original_source_code = "${path.module}/python"
    built_output_path = "${path.module}/building/function_example"
  }
  depends_on = [
    null_resource.build_lambda_function # function build logic
  ]
}
```

sam metadata resource referencing a Lambda function using the image package type

```
resource "null_resource" "sam_metadata_function {
  triggers = {
    resource_name = "aws_lambda_function.image_function"
    resource_type = "IMAGE_LAMBDA_FUNCTION"
    docker_context = local.lambda_src_path
    docker_file = "Dockerfile"
    docker_build_args = jsonencode(var.build_args)
    docker_tag = "latest"
  }
}
```

sam metadata resource referencing a Lambda layer

```
resource "null_resource" "sam_metadata_layer1" {
  triggers = {
    resource_name = "aws_lambda_layer_version.layer"
    resource_type = "LAMBDA_LAYER"
    original_source_code = local.layer_src
    built_output_path = "${path.module}/${layer_build_path}"
  }
  depends_on = [null_resource.layer_build]
}
```

What is AWS SAM CLI support for Terraform?

Use the AWS Serverless Application Model Command Line Interface (AWS SAM CLI) with your Terraform projects or Terraform Cloud to perform local debugging and testing of:

- AWS Lambda functions and layers.
- Amazon API Gateway APIs.

For an introduction to Terraform, see What is Terraform? at the *HashiCorp Terraform website*.

To provide feedback and submit feature requests, create a GitHub Issue.

> **Note**
>
> As part of the parsing step of AWS SAM CLI's integration, AWS SAM CLI processes user commands generate project files and data. The command output should remain unchanged, but in certain environments, the environment or runner may inject additional logs or information in the output.

Topics

- What is the AWS SAM CLI?
- How do I use the AWS SAM CLI with Terraform?
- Next steps

What is the AWS SAM CLI?

The AWS SAM CLI is a command line tool that you can use with AWS SAM templates and supported third-party integrations, such as Terraform, to build and run your serverless applications. For an introduction to the AWS SAM CLI, see What is the AWS SAM CLI?.

The AWS SAM CLI supports the following commands for Terraform:

- `sam local invoke` – Initiate a one-time invocation of an AWS Lambda function resource locally. To learn more about this command, see Introduction to testing with sam local invoke.
- `sam local start-api` – Run your Lambda resources locally and test through a local HTTP server host. This type of testing is helpful for Lambda functions that are invoked by an API Gateway endpoint. To learn more about this command, see Introduction to testing with sam local start-api.
- `sam local start-lambda` – Start a local endpoint for your Lambda function in order to invoke your function locally using AWS Command Line Interface (AWS CLI) or SDKs. To learn more about this command, see Introduction to testing with sam local start-lambda.

How do I use the AWS SAM CLI with Terraform?

The core Terraform workflow consists of three stages: **Write**, **Plan**, and **Apply**. With AWS SAM CLI support for Terraform, you can take advantage of the AWS SAM CLI `sam local` set of commands while continuing to use your Terraform workflows to manage your applications on AWS. Generally, this means the following:

- **Write** – Author your infrastructure as code using Terraform.
- **Test and debug** – Use the AWS SAM CLI to locally test and debug your applications.
- **Plan** – Preview changes before applying.
- **Apply** – Provision your infrastructure.

For an example of using the AWS SAM CLI with Terraform, see Better together: AWS SAM CLI and HashiCorp Terraform at the *AWS Compute Blog*.

Next steps

To complete all prerequisites and set up Terraform, see Getting started with Terraform support for AWS SAM CLI.

Publishing your application with 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.

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 Install the AWS SAM CLI. 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*.

   JSON

```
{
    "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.

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 --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/fbd77a3647a4f47a352fc0ObjectGUID

...
```

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

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**
>
> 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 update this property after your application has been published. So, to add a license to

Property	Type	Required	Description
			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 applicati on—for example, the location of your GitHub repository for the application.
`SemanticV ersion`	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
```

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:** June 20, 2024

Change	Description	Date
Restructured and updated content throughout the developer guide	Reorganized and restructured the guide to improve discoverability and usability. Updated and improved titles. Provided additional details when introducting topics and concepts.	June 20, 2024
Added AWS SAM CLI support for for Ruby 3.3	Ruby 3.3 is now available as a runtime and image repository. See Image repositories and sam init for details.	April 4, 2024
Added AWS SAM CLI command options	New options are available for the command sam local start-api: `--ssl-cert-file PATH`, `--ssl-key-file PATH`. Additionally the new command line option `--add-host LIST` is available for sam local invoke, sam local start-api, and sam local start-lambda	March 20, 2024
Added AWS SAM CLI support for .NET 8	.NET 8 is now available as a runtime and image repositor	February 22, 2024

	y. Run times and image repositories for .NET Core 3.1, Node.js 14, Node.js 12, Python 3.7, Ruby 2.7 are no longer supported. See Image repositories and sam init.	
Added AWS SAM CLI arm64 package installer for Linux	For instructions, see Installing the AWS SAM CLI.	December 6, 2023
Added --watch-exclude option for the AWS SAM CLI sam sync command	Exclude files and folders from initiating a sync. To learn more, see Specify files and folders that won't initiate a sync.	December 6, 2023
Added --build-in-source option for the AWS SAM CLI sam sync command	Build your project in your source folder to speed up the build process. To learn more, see Speed up build times by building your project in the source folder.	December 6, 2023
Added --build-in-source option for the AWS SAM CLI sam build command	Build your project in your source folder to speed up the build process. To learn more, see Speed up build times by building your project in the source folder.	December 6, 2023
Added new resource support for AWS SAM CLI remote invoke command	Use `sam remote invoke` with Kinesis Data Streams applications, Amazon SQS queues, and Step Functions state machines. To learn more, see Using sam remote invoke.	November 15, 2023

Added new AWS SAM CLI remote test-event command for shareable test events	Use the AWS SAM CLI to access and manage shareable test events from the EventBridge schema registry to test your Lambda functions in the AWS Cloud. To learn more, see Using sam remote test-event.	October 3, 2023
AWS SAM CLI support for Terraform is now generally available	To learn more about AWS SAM CLI support for Terraform, see AWS SAM CLITerraform support.	September 5, 2023
Added AWS SAM CLI support for Terraform Cloud	The AWS SAM CLI now supports local testing for Terraform Cloud. To learn more, see Set up for Terraform Cloud.	September 5, 2023
Added YAML file format support for the AWS SAM CLI configuration file	The AWS SAM CLI now supports the `[.yaml|.yml]` file format. Configuring the AWS SAM CLI and AWS SAM CLI configuration file pages have been updated.	July 18, 2023
Added AWS SAM CLI sam local start-api command support for Terraform	The What is AWS SAM CLI support for Terraform? section has been updated to include AWS SAM CLI `sam local start-api` command support for Terraform.	July 6, 2023

Added new AWS SAM CLI remote invoke command	To start using `sam remote invoke`, see Using sam remote invoke.	June 22, 2023
Added AWS AppSync GraphQL API serverless resource type	Create new `AWS::Serverless::GraphQLApi` section that describes how to define a GraphQL API resource with AWS SAM.	June 22, 2023
Added AWS SAM CLI support for Ruby 3.2	Update sam init page to include new base image and runtime values. Update Image repositories page with Ruby 3.2 Amazon ECR URI.	June 6, 2023
Added optional steps for integrity verification of the AWS SAM CLI package installer	Update Installing the AWS SAM CLI page to reflect optional step. Create Verify the integrity of the AWS SAM CLI installer page to document steps.	May 31, 2023
Added sam sync option to skip infrastructure sync	Customize whether an CloudFormation deployment is required each time `sam sync` is run. To learn more, see Skip the initial CloudFormation deployment.	March 23, 2023
Added support for DocumentDB event source type	The AWS SAM template specification now supports `DocumentDB` event source type for the `AWS::Serverless::Function` resource. To learn more, see DocumentDB.	March 10, 2023

Build Rust Lambda functions with Cargo Lambda	Use the AWS SAM CLI to build your Rust Lambda functions using Cargo Lambda. To learn more, see Building Rust Lambda functions with Cargo Lambda.	February 23, 2023
Build function resources outside of AWS SAM	Added guidance on skipping functions when using the **sam build** command. To learn more, see Building functions outside of AWS SAM.	February 14, 2023
New embedded connectors syntax	Use the new embedded connectors syntax to define your `AWS::Serverless::Connector` resources. To learn more, see Managing resource permissions with AWS SAM connectors.	February 8, 2023
Added new sam list command for the AWS SAM CLI	Use **sam list** to view important information about the resources in your serverless application. To learn more, see sam list.	February 2, 2023
Added Format and OutExtension build properties for esbuild	Building Node.js Lambda functions with esbuild now supports `Format` and `OutExtension` build properties. To learn more, see Building Node.js Lambda functions with esbuild.	February 2, 2023

Added runtime management options to the AWS SAM template specification	Configure runtime management options for your Lambda functions. To learn more, see `RuntimeManagementConfig`.	January 24, 2023
Target property added to EventSource for AWS::Serverless::StateMachine resource.	`AWS::Serverless::StateMachine` resource type supports the `Target` property for `EventBridgeRule` and `Schedule` event sources.	January 13, 2023
Configure scaling of SQS pollers for Lambda functions	Configure scaling of SQS pollers with the `ScalingConfig` property for `AWS::Serverless::Function`. To learn more, see `ScalingConfig`.	January 12, 2023
Validate AWS SAM applications with cfn-lint	You can use cfn-lint to validate your AWS SAM templates through the AWS SAM CLI. To learn more, see Validate with cfn-lint.	January 11, 2023
Monitor your serverless applications with CloudWatch Application Insights	Configure Amazon CloudWatch Application Insights to monitor your AWS SAM applications. To learn more, see Monitor your serverless applications with CloudWatch Application Insights.	December 19, 2022

Added AWS SAM CLI package installer for macOS	Install the AWS SAM CLI using the new macOS package installer. To learn more, see Installing the AWS SAM CLI.	December 6, 2022
Added support for Lambda SnapStart	Configure SnapStart for your Lambda functions to create snapshots, which are cached states of your initialized functions. To learn more, see `AWS::Serverless::Function`.	November 28, 2022
Added AWS SAM CLI support for nodejs18.x	AWS SAM CLI now supports nodejs18.x runtime. To learn more, see sam init.	November 17, 2022
Added guidance on configuring access and permissions	AWS SAM provides two options that simplify management of access and permissions for your serverless applications.To learn more, see Managing resource access and permissions.	November 17, 2022
Added support for building .NET 7 Lambda functions with Native AOT compilation	Build and package your .NET 7 Lambda functions with AWS SAM, utilizing Native Ahead-of-Time (AOT) compilation to improve Lambda cold-start times. To learn more, see Building .NET 7 Lambda functions with Native AOT compilation.	November 15, 2022

Added AWS SAM CLI Terraform support for local debugging and testing	Use the AWS SAM CLI within your Terraform projects to perform local debugging and testing of your Lambda functions and layers. To learn more, see AWS SAM CLI Terraform support.	November 14, 2022
Added AWS SAM support for EventBridge Scheduler	The AWS Serverless Application Model (AWS SAM) template specification provides a simple, short-hand syntax that you can use to schedule events with EventBridge Scheduler for AWS Lambda and AWS Step Functions. For more information, see Scheduling events with EventBridge Scheduler.	November 10, 2022
Simplified the AWS SAM CLI installation instructions	AWS SAM CLI prerequisites and optional steps have been moved to separate pages. Installation steps for supported operating systems can be found at Installing the AWS SAM CLI.	November 4, 2022
Added fix to allow long paths for Windows 10 users	The AWS SAM CLI app templates repository contains some long file paths which may cause errors when running `sam init` due to Windows 10 **MAX_PATH** limitations. For more information, see Installing the AWS SAM CLI	November 4, 2022

Updated gradual deployment process for first time deployments	Gradually deploying a Lambda function with AWS CodeDeploy requires two steps. To learn more, see Gradually deploying a Lambda function for the first time.	October 13, 2022
Additional Lambda event filtering support for more types of events	`FilterCritera` property added to `MSK`, `MQ`, and `SelfManagedKafka` event source types.	October 13, 2022
Added OpenID Connect (OIDC) support for AWS SAM pipeline	AWS SAM supports OpenID Connect (OIDC) user authentication for Bitbucket, GitHub Actions, and GitLab continuous integration and continuous delivery (CI/CD) platforms. To learn more, see Using OIDC User Accounts with AWS SAM pipeline.	October 13, 2022
Note on JwtConfiguration properties	Added note on defining `issuer` and `audience` properties under `JwtConfiguration` for `OAuth2Authorizer`.	October 7, 2022

New properties for Function and StateMachine EventSource	`Enabled` and `State` properties added to `CloudWatchEvent` event source for `AWS::Serverless::Function`. `State` property added to `Schedule` event source for `AWS::Serverless::Function` and `AWS::Serverless::StateMachine`.	October 6, 2022
AWS SAM connectors now generally available	Connectors are an AWS SAM abstract resource type, identified as `AWS::Serverless::Connector`, that provides a simple and secure method of provisioning permissions between your serverless application resources. To learn more, see Managing resource permissions with AWS Serverless Application Model connectors.	October 6, 2022
Added new sam sync options to the AWS SAM CLI	`--dependency-layer` and `--use-container` options added to **sam sync**.	September 20, 2022
Added new sam deploy options to the AWS SAM CLI	`--on-failure` option added to **sam deploy**.	September 9, 2022
esbuild support now generally available	To build and package Node.js Lambda functions, you can use the AWS SAM CLI with the esbuild JavaScript bundler.	September 1, 2022

Updated AWS SAM CLI telemetry	Description of **system and environment information** collected has been updated to include hash values of usage attributes.	September 1, 2022
Added local environment variable support to AWS SAM CLI	Use environment variables with AWS SAM CLI when invoking Lambda functions locally and when running API Gateway locally.	September 1, 2022
Support for Lambda instruction set architectures	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	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)	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 usin g the AWS SAM CLI. For more information, see AWS Cloud Development Kit (AWS CDK) (Preview).	July 13, 2021
Support for RabbitMQ as an event source for functions	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	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	AWS Toolkits now supports step-through debugging with more combinations of integrated developme nt environments (IDEs) and runtimes. For more informati on, see Using AWS Toolkits.	May 20, 2021
AWS SAM CLI AWS CDK integration (preview)	You can now use the AWS SAM CLI to locally test and build AWS CDK applicati ons. This is a public preview release. For more information, see AWS Cloud Development Kit (AWS CDK) (Preview).	April 29, 2021
Default container image repository changed to Amazon ECR Public	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	You can now install a pre-release version of the AWS SAM CLI, which is built nightly. For more informati on, see the **Nightly build** section of the OS subtopic of your choice under Installing t he AWS SAM CLI.	March 25, 2021

Build container environment variables support	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	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	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	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	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	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	Added support for Lambda container images. For more information, see Building applications.	December 1, 2020
Support for code signing	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	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	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	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	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	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	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	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	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	Added the ability to build custom runtimes. For more information, see Building custom runtimes.	May 21, 2020
Building layers	Added the ability to build individual `LayerVersion` resources. For more information, see Building layers.	May 19, 2020

Generated CloudFormation resources	Provided details about the CloudFormation resources that AWS SAM generates and how to reference them. For more information, see Generated CloudFormation resources.	April 8, 2020
Setting up AWS credentials	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	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	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	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	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	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	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	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	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	This is the first release of the *AWS Serverless Application Model Developer Guide*.	October 17, 2018