

User Guide

Amazon Managed Workflows for Apache Airflow



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Amazon Managed Workflows for Apache Airflow: User Guide

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What Is Amazon Managed Workflows for Apache Airflow?

Use Amazon Managed Workflows for Apache Airflow, a managed orchestration service for <u>Apache</u> <u>Airflow</u>, to setup and operate data pipelines in the cloud at scale. Apache Airflow is an open-source tool used to programmatically author, schedule, and monitor sequences of processes and tasks referred to as *workflows*.

With Amazon MWAA, you can use Apache Airflow and Python to create workflows without having to manage the underlying infrastructure for scalability, availability, and security. Amazon MWAA automatically scales its workflow execution capacity to meet your needs, and integrates with AWS security services to help provide you with fast and secure access to your data.

Content

- Features
- <u>Architecture</u>
- Integration
- Supported versions
- What's next?

Features

Review the following features to learn how Amazon MWAA can simplify the management of your Apache Airflow workflows.

- Automatic Airflow setup Quickly setup Apache Airflow by choosing an <u>Apache Airflow version</u> when you create an Amazon MWAA environment. Amazon MWAA sets up Apache Airflow for you using the same Apache Airflow user interface and open-source code that you can download on the Internet.
- Automatic scaling Automatically scale Apache Airflow Workers by setting the minimum and maximum number of Workers that run in your environment. Amazon MWAA monitors the Workers in your environment and uses its <u>autoscaling component</u> to add Workers to meet demand, up to and until it reaches the maximum number of Workers you defined.
- Built-in authentication Enable role-based authentication and authorization for your Apache Airflow Web server by defining the access control policies in AWS Identity and Access

Management (IAM). The Apache Airflow *Workers* assume these policies for secure access to AWS services.

- Built-in security The Apache Airflow Workers and Schedulers run in <u>Amazon MWAA's Amazon</u> <u>VPC</u>. Data is also automatically encrypted using AWS Key Management Service, so your environment is secure by default.
- Public or private access modes Access your Apache Airflow Web server using a private, or public access mode. The Public network access mode uses a VPC endpoint for your Apache Airflow Web server that is accessible over the Internet. The Private network access mode uses a VPC endpoint for your Apache Airflow Web server that is accessible in your VPC. In both cases, access for your Apache Airflow users is controlled by the access control policy you define in AWS Identity and Access Management (IAM), and AWS SSO.
- **Streamlined upgrades and patches** Amazon MWAA provides new versions of Apache Airflow periodically. The Amazon MWAA team will update and patch the images for these versions.
- Workflow monitoring View Apache Airflow logs and <u>Apache Airflow metrics</u> in Amazon CloudWatch to identify Apache Airflow task delays or workflow errors without the need for additional third-party tools. Amazon MWAA automatically sends environment metrics—and if enabled—Apache Airflow logs to CloudWatch.
- AWS integration Amazon MWAA supports open-source integrations with Amazon Athena, AWS Batch, Amazon CloudWatch, Amazon DynamoDB, AWS DataSync, Amazon EMR, AWS Fargate, Amazon EKS, Amazon Data Firehose, AWS Glue, AWS Lambda, Amazon Redshift, Amazon SQS, Amazon SNS, Amazon SageMaker AI, and Amazon S3, as well as hundreds of built-in and community-created operators and sensors.
- Worker fleets Amazon MWAA offers support for using containers to scale the worker fleet on demand and reduce scheduler outages using <u>Amazon ECS on AWS Fargate</u>. Operators that invoke tasks on Amazon ECS containers, and Kubernetes operators that create and run pods on a Kubernetes cluster are supported.

Architecture

All of the components contained in the outer box (in the image below) appear as a single Amazon MWAA environment in your account. The Apache Airflow *Scheduler* and Workers are AWS Fargate containers that connect to the private subnets in the Amazon VPC for your environment. Each environment has its own Apache Airflow metadatabase managed by AWS that is accessible to the *Scheduler* and Workers Fargate containers via a privately-secured VPC endpoint.

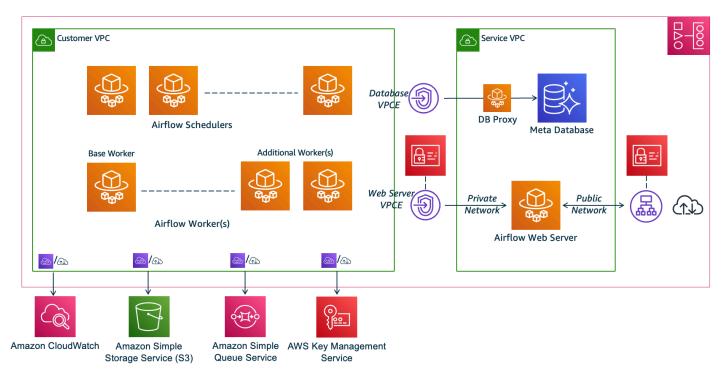
Amazon CloudWatch, Amazon S3, Amazon SQS, and AWS KMS are separate from Amazon MWAA and need to be accessible from the Apache Airflow *Scheduler(s)* and Workers in the Fargate containers.

The Apache Airflow *Web server* can be accessed either *over the Internet* by selecting the **Public network** Apache Airflow access mode, or *within your VPC* by selecting the **Private network** Apache Airflow access mode. In both cases, access for your Apache Airflow users is controlled by the access control policy you define in AWS Identity and Access Management (IAM).

🚯 Note

Multiple Apache Airflow *Schedulers* are only available with Apache Airflow v2 and above. Learn more about the Apache Airflow task lifecycle at <u>Concepts</u> in the *Apache Airflow reference guide*.

Amazon MWAA Architecture



Integration

The active and growing Apache Airflow open-source community provides operators (plugins that simplify connections to services) for Apache Airflow to integrate with AWS services. This includes services such as Amazon S3, Amazon Redshift, Amazon EMR, AWS Batch, and Amazon SageMaker AI, as well as services on other cloud platforms.

Using Apache Airflow with Amazon MWAA fully supports integration with AWS services and popular third-party tools such as Apache Hadoop, Presto, Hive, and Spark to perform data processing tasks. Amazon MWAA is committed to maintaining compatibility with the Apache Airflow API, and Amazon MWAA intends to provide reliable integrations to AWS services and make them available to the community, and be involved in community feature development.

For sample code, refer to Code examples for Amazon Managed Workflows for Apache Airflow.

Supported versions

Amazon MWAA supports multiple versions of Apache Airflow. For more information about the Apache Airflow versions we support and the Apache Airflow components included with each version, refer to Apache Airflow versions on Amazon Managed Workflows for Apache Airflow.

What's next?

- Get started with a single AWS CloudFormation template that creates an Amazon S3 bucket for your Airflow DAGs and supporting files, an Amazon VPC with public routing, and an Amazon MWAA environment in <u>Quick start tutorial for Amazon Managed Workflows for Apache Airflow</u>.
- Get started incrementally by creating an Amazon S3 bucket for your Airflow DAGs and supporting files, choosing from one of three Amazon VPC networking options, and creating an Amazon MWAA environment in <u>Get started with Amazon Managed Workflows for Apache</u> <u>Airflow</u>.

Quick start tutorial for Amazon Managed Workflows for Apache Airflow

This quick start tutorial uses an AWS CloudFormation template that creates the Amazon VPC infrastructure, an Amazon S3 bucket with a dags folder, and an Amazon Managed Workflows for Apache Airflow environment at the same time.

Topics

- In this tutorial
- Prerequisites
- Step one: Save the AWS CloudFormation template locally
- Step two: Create the stack using the AWS CLI
- Step three: Upload a DAG to Amazon S3 and run in the Apache Airflow UI
- <u>Step four: View logs in CloudWatch Logs</u>
- What's next?

In this tutorial

This tutorial walks you through three AWS Command Line Interface (AWS CLI) commands to upload a DAG to Amazon S3, run the DAG in Apache Airflow, and view logs in CloudWatch. It concludes by walking you through the steps to create an IAM policy for an Apache Airflow development team.

🚺 Note

The AWS CloudFormation template on this page creates an Amazon Managed Workflows for Apache Airflow environment for the latest version of Apache Airflow available in AWS CloudFormation. The latest version available is Apache Airflow v2.10.3.

The AWS CloudFormation template on this page creates the following:

 VPC infrastructure. The template uses <u>Public routing over the Internet</u>. It uses the <u>Public</u> <u>network access mode</u> for the Apache Airflow *Web server* in WebserverAccessMode: PUBLIC_ONLY.

- Amazon S3 bucket. The template creates an Amazon S3 bucket with a dags folder. It's configured to Block all public access, with Bucket Versioning enabled, as defined in <u>Create an</u> Amazon S3 bucket for Amazon MWAA.
- Amazon MWAA environment. The template creates an Amazon MWAA environment that's associated to the dags folder on the Amazon S3 bucket, an execution role with permission to AWS services used by Amazon MWAA, and the default for encryption using an <u>AWS owned key</u>, as defined in <u>Create an Amazon MWAA environment</u>.
- **CloudWatch Logs**. The template enables Apache Airflow logs in CloudWatch at the "INFO" level and up for the *Airflow scheduler log group*, *Airflow web server log group*, *Airflow worker log group*, *Airflow DAG processing log group*, and the *Airflow task log group*, as defined in <u>Viewing Airflow</u> logs in Amazon CloudWatch.

In this tutorial, you'll complete the following tasks:

- **Upload and run a DAG**. Upload Apache Airflow's tutorial DAG for the latest Amazon MWAA supported Apache Airflow version to Amazon S3, and then run in the Apache Airflow UI, as defined in Adding or updating DAGs.
- View logs. View the *Airflow web server log group* in CloudWatch Logs, as defined in <u>Viewing</u> Airflow logs in Amazon CloudWatch.
- **Create an access control policy**. Create an access control policy in IAM for your Apache Airflow development team, as defined in Accessing an Amazon MWAA environment.

Note

In the VPC that hosts the Amazon MWAA environment, set assignIpv6AddressOnCreation to true for all attached subnets. This setting ensures automatic Internet Protocol version 6 (IPv6) address assignment to the resources within these subnets.

Prerequisites

The AWS Command Line Interface (AWS CLI) is an open source tool that enables you to interact with AWS services using commands in your command-line shell. To complete the steps on this page, you need the following:

- AWS CLI Install version 2.
- AWS CLI Quick configuration with aws configure.

Step one: Save the AWS CloudFormation template locally

• Copy the contents of the following template and save locally as mwaa-publicnetwork.yml. You can also download the template.

```
AWSTemplateFormatVersion: "2010-09-09"
Parameters:
  EnvironmentName:
    Description: An environment name that is prefixed to resource names
   Type: String
    Default: MWAAEnvironment
 VpcCIDR:
    Description: The IP range (CIDR notation) for this VPC
   Type: String
    Default: 10.192.0.0/16
  PublicSubnet1CIDR:
    Description: The IP range (CIDR notation) for the public subnet in the first
Availability Zone
   Type: String
    Default: 10.192.10.0/24
 PublicSubnet2CIDR:
    Description: The IP range (CIDR notation) for the public subnet in the second
Availability Zone
   Type: String
    Default: 10.192.11.0/24
 PrivateSubnet1CIDR:
    Description: The IP range (CIDR notation) for the private subnet in the first
Availability Zone
   Type: String
    Default: 10.192.20.0/24
  PrivateSubnet2CIDR:
```

```
Description: The IP range (CIDR notation) for the private subnet in the second
Availability Zone
   Type: String
   Default: 10.192.21.0/24
 MaxWorkerNodes:
   Description: The maximum number of workers that can run in the environment
   Type: Number
   Default: 2
 DagProcessingLogs:
   Description: Log level for DagProcessing
   Type: String
   Default: INFO
 SchedulerLogsLevel:
   Description: Log level for SchedulerLogs
   Type: String
   Default: INFO
 TaskLogsLevel:
   Description: Log level for TaskLogs
   Type: String
   Default: INFO
 WorkerLogsLevel:
   Description: Log level for WorkerLogs
   Type: String
   Default: INFO
 WebserverLogsLevel:
   Description: Log level for WebserverLogs
   Type: String
   Default: INFO
Resources:
# CREATE VPC
VPC:
   Type: AWS::EC2::VPC
   Properties:
    CidrBlock: !Ref VpcCIDR
    EnableDnsSupport: true
    EnableDnsHostnames: true
    Tags:
      - Key: Name
```

Value: MWAAEnvironment

```
InternetGateway:
  Type: AWS::EC2::InternetGateway
  Properties:
    Tags:
      - Key: Name
        Value: MWAAEnvironment
InternetGatewayAttachment:
  Type: AWS::EC2::VPCGatewayAttachment
  Properties:
    InternetGatewayId: !Ref InternetGateway
    VpcId: !Ref VPC
PublicSubnet1:
  Type: AWS::EC2::Subnet
  Properties:
    VpcId: !Ref VPC
   AvailabilityZone: !Select [ 0, !GetAZs '' ]
    CidrBlock: !Ref PublicSubnet1CIDR
    MapPublicIpOnLaunch: true
   Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Public Subnet (AZ1)
PublicSubnet2:
  Type: AWS::EC2::Subnet
  Properties:
    VpcId: !Ref VPC
   AvailabilityZone: !Select [ 1, !GetAZs '' ]
    CidrBlock: !Ref PublicSubnet2CIDR
   MapPublicIpOnLaunch: true
   Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Public Subnet (AZ2)
PrivateSubnet1:
  Type: AWS::EC2::Subnet
  Properties:
    VpcId: !Ref VPC
   AvailabilityZone: !Select [ 0, !GetAZs '' ]
    CidrBlock: !Ref PrivateSubnet1CIDR
    MapPublicIpOnLaunch: false
```

```
Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Private Subnet (AZ1)
PrivateSubnet2:
  Type: AWS::EC2::Subnet
  Properties:
   VpcId: !Ref VPC
   AvailabilityZone: !Select [ 1, !GetAZs '' ]
    CidrBlock: !Ref PrivateSubnet2CIDR
   MapPublicIpOnLaunch: false
   Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Private Subnet (AZ2)
NatGateway1EIP:
 Type: AWS::EC2::EIP
  DependsOn: InternetGatewayAttachment
  Properties:
    Domain: vpc
NatGateway2EIP:
  Type: AWS::EC2::EIP
  DependsOn: InternetGatewayAttachment
  Properties:
    Domain: vpc
NatGateway1:
  Type: AWS::EC2::NatGateway
  Properties:
    AllocationId: !GetAtt NatGateway1EIP.AllocationId
    SubnetId: !Ref PublicSubnet1
NatGateway2:
  Type: AWS::EC2::NatGateway
  Properties:
    AllocationId: !GetAtt NatGateway2EIP.AllocationId
    SubnetId: !Ref PublicSubnet2
PublicRouteTable:
  Type: AWS::EC2::RouteTable
  Properties:
   VpcId: !Ref VPC
    Tags:
```

```
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```

```
- Key: Name
        Value: !Sub ${EnvironmentName} Public Routes
DefaultPublicRoute:
  Type: AWS::EC2::Route
  DependsOn: InternetGatewayAttachment
  Properties:
    RouteTableId: !Ref PublicRouteTable
    DestinationCidrBlock: 0.0.0.0/0
    GatewayId: !Ref InternetGateway
PublicSubnet1RouteTableAssociation:
  Type: AWS::EC2::SubnetRouteTableAssociation
  Properties:
    RouteTableId: !Ref PublicRouteTable
    SubnetId: !Ref PublicSubnet1
PublicSubnet2RouteTableAssociation:
  Type: AWS::EC2::SubnetRouteTableAssociation
  Properties:
    RouteTableId: !Ref PublicRouteTable
    SubnetId: !Ref PublicSubnet2
PrivateRouteTable1:
  Type: AWS::EC2::RouteTable
  Properties:
    VpcId: !Ref VPC
    Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Private Routes (AZ1)
DefaultPrivateRoute1:
  Type: AWS::EC2::Route
  Properties:
    RouteTableId: !Ref PrivateRouteTable1
    DestinationCidrBlock: 0.0.0.0/0
    NatGatewayId: !Ref NatGateway1
PrivateSubnet1RouteTableAssociation:
  Type: AWS::EC2::SubnetRouteTableAssociation
  Properties:
    RouteTableId: !Ref PrivateRouteTable1
    SubnetId: !Ref PrivateSubnet1
```

```
PrivateRouteTable2:
  Type: AWS::EC2::RouteTable
  Properties:
    VpcId: !Ref VPC
   Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Private Routes (AZ2)
DefaultPrivateRoute2:
  Type: AWS::EC2::Route
  Properties:
    RouteTableId: !Ref PrivateRouteTable2
    DestinationCidrBlock: 0.0.0.0/0
    NatGatewayId: !Ref NatGateway2
PrivateSubnet2RouteTableAssociation:
  Type: AWS::EC2::SubnetRouteTableAssociation
  Properties:
    RouteTableId: !Ref PrivateRouteTable2
    SubnetId: !Ref PrivateSubnet2
SecurityGroup:
  Type: AWS::EC2::SecurityGroup
  Properties:
    GroupName: "mwaa-security-group"
    GroupDescription: "Security group with a self-referencing inbound rule."
    VpcId: !Ref VPC
SecurityGroupIngress:
  Type: AWS::EC2::SecurityGroupIngress
  Properties:
    GroupId: !Ref SecurityGroup
    IpProtocol: "-1"
    SourceSecurityGroupId: !Ref SecurityGroup
EnvironmentBucket:
  Type: AWS::S3::Bucket
  Properties:
    VersioningConfiguration:
      Status: Enabled
    PublicAccessBlockConfiguration:
      BlockPublicAcls: true
      BlockPublicPolicy: true
```

IgnorePublicAcls: true	
RestrictPublicBuckets: true	

# CREATE MWAA	
*****	#####
MwaaEnvironment:	
Type: AWS::MWAA::Environment	
DependsOn: MwaaExecutionPolicy	
Properties:	
Name: !Sub "\${AWS::StackName}-MwaaEnvironment"	
SourceBucketArn: !GetAtt EnvironmentBucket.Arn	
ExecutionRoleArn: !GetAtt MwaaExecutionRole.Arn	
DagS3Path: dags/	
NetworkConfiguration:	
SecurityGroupIds:	
<pre>- !GetAtt SecurityGroup.GroupId SubnetIds:</pre>	
- !Ref PrivateSubnet1	
- !Ref PrivateSubnet1	
WebserverAccessMode: PUBLIC_ONLY	
MaxWorkers: !Ref MaxWorkerNodes	
LoggingConfiguration: DagProcessingLogs:	
LogLevel: !Ref DagProcessingLogs	
Enabled: true	
SchedulerLogs:	
LogLevel: !Ref SchedulerLogsLevel	
Enabled: true	
TaskLogs:	
LogLevel: !Ref TaskLogsLevel	
Enabled: true	
WorkerLogs:	
LogLevel: !Ref WorkerLogsLevel	
Enabled: true	
WebserverLogs:	
LogLevel: !Ref WebserverLogsLevel	
Enabled: true	
MwaaExecutionRole:	
Type: AWS::IAM::Role	
Type. AwsIAHROIE	

```
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```
Properties:
     AssumeRolePolicyDocument:
        Version: 2012-10-17
        Statement:
          - Effect: Allow
            Principal:
              Service:
                - airflow-env.amazonaws.com
                - airflow.amazonaws.com
            Action:
             - "sts:AssumeRole"
      Path: "/service-role/"
 MwaaExecutionPolicy:
    DependsOn: EnvironmentBucket
    Type: AWS::IAM::ManagedPolicy
    Properties:
      Roles:
        - !Ref MwaaExecutionRole
      PolicyDocument:
        Version: 2012-10-17
        Statement:
          - Effect: Allow
            Action: airflow:PublishMetrics
            Resource:
              - !Sub "arn:aws:airflow:${AWS::Region}:${AWS::AccountId}:environment/
${EnvironmentName}"
          - Effect: Deny
            Action: s3:ListAllMyBuckets
            Resource:
              - !Sub "${EnvironmentBucket.Arn}"
              - !Sub "${EnvironmentBucket.Arn}/*"
          - Effect: Allow
            Action:
              - "s3:GetObject*"
              - "s3:GetBucket*"
              - "s3:List*"
            Resource:
              - !Sub "${EnvironmentBucket.Arn}"
              - !Sub "${EnvironmentBucket.Arn}/*"
          - Effect: Allow
            Action:
              - logs:DescribeLogGroups
```

```
Resource: "*"
          - Effect: Allow
            Action:
              - logs:CreateLogStream
              - logs:CreateLogGroup
              - logs:PutLogEvents
              - logs:GetLogEvents
              - logs:GetLogRecord
              - logs:GetLogGroupFields
              - logs:GetQueryResults
              - logs:DescribeLogGroups
            Resource:
              - !Sub "arn:aws:logs:${AWS::Region}:${AWS::AccountId}:log-
group:airflow-${AWS::StackName}*"
          - Effect: Allow
            Action: cloudwatch:PutMetricData
            Resource: "*"
          - Effect: Allow
            Action:
              - sqs:ChangeMessageVisibility
              - sqs:DeleteMessage
              - sqs:GetQueueAttributes
              - sqs:GetQueueUrl
              - sqs:ReceiveMessage
              - sqs:SendMessage
            Resource:
              - !Sub "arn:aws:sqs:${AWS::Region}:*:airflow-celery-*"
          - Effect: Allow
            Action:
              - kms:Decrypt
              - kms:DescribeKey
              - "kms:GenerateDataKey*"
              - kms:Encrypt
            NotResource: !Sub "arn:aws:kms:*:${AWS::AccountId}:key/*"
            Condition:
              StringLike:
                "kms:ViaService":
                  - !Sub "sqs.${AWS::Region}.amazonaws.com"
Outputs:
  VPC:
    Description: A reference to the created VPC
    Value: !Ref VPC
```

```
PublicSubnets:
  Description: A list of the public subnets
  Value: !Join [ ",", [ !Ref PublicSubnet1, !Ref PublicSubnet2 ]]
PrivateSubnets:
  Description: A list of the private subnets
 Value: !Join [ ",", [ !Ref PrivateSubnet1, !Ref PrivateSubnet2 ]]
PublicSubnet1:
  Description: A reference to the public subnet in the 1st Availability Zone
  Value: !Ref PublicSubnet1
PublicSubnet2:
  Description: A reference to the public subnet in the 2nd Availability Zone
  Value: !Ref PublicSubnet2
PrivateSubnet1:
  Description: A reference to the private subnet in the 1st Availability Zone
  Value: !Ref PrivateSubnet1
PrivateSubnet2:
  Description: A reference to the private subnet in the 2nd Availability Zone
  Value: !Ref PrivateSubnet2
SecurityGroupIngress:
  Description: Security group with self-referencing inbound rule
  Value: !Ref SecurityGroupIngress
MwaaApacheAirflowUI:
  Description: MWAA Environment
  Value: !Sub "https://${MwaaEnvironment.WebserverUrl}"
```

Step two: Create the stack using the AWS CLI

 In your command prompt, navigate to the directory where mwaa-public-network.yml is stored. For example:

```
cd mwaaproject
```

 Use the <u>aws cloudformation create-stack</u> command to create the stack using the AWS CLI.

```
aws cloudformation create-stack --stack-name mwaa-environment-public-network --
template-body file://mwaa-public-network.yml --capabilities CAPABILITY_IAM
```

Note

It takes over 30 minutes to create the Amazon VPC infrastructure, Amazon S3 bucket, and Amazon MWAA environment.

Step three: Upload a DAG to Amazon S3 and run in the Apache Airflow UI

- Copy the contents of the tutorial.py file for the <u>latest supported Apache Airflow version</u> and save locally as tutorial.py.
- 2. In your command prompt, navigate to the directory where tutorial.py is stored. For example:

cd mwaaproject

3. Use the following command to list all of your Amazon S3 buckets.

```
aws s3 ls
```

4. Use the following command to list the files and folders in the Amazon S3 bucket for your environment.

```
aws s3 ls s3://YOUR_S3_BUCKET_NAME
```

5. Use the following script to upload the tutorial.py file to your dags folder. Substitute the sample value in *amzn-s3-demo-bucket*.

aws s3 cp tutorial.py s3://amzn-s3-demo-bucket/dags/

- 6. Open the Environments page on the Amazon MWAA console.
- 7. Choose an environment.
- 8. Choose **Open Airflow UI**.

- 9. On the Apache Airflow UI, from the list of available DAGs, choose the tutorial DAG.
- 10. On the DAG details page, choose the **Pause/Unpause DAG** toggle next to your DAG name to unpause the DAG.
- 11. Choose **Trigger DAG**.

Step four: View logs in CloudWatch Logs

You can view Apache Airflow logs in the CloudWatch console for all of the Apache Airflow logs that were enabled by the AWS CloudFormation stack. The following section shows how to view logs for the *Airflow web server log group*.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose the **Airflow web server log group** on the **Monitoring** pane.
- 4. Choose the webserver_console_ip log in Log streams.

What's next?

- Learn more about how to upload DAGs, specify Python dependencies in a requirements.txt and custom plugins in a plugins.zip in <u>Working with DAGs on Amazon MWAA</u>.
- Learn more about the best practices we recommend to tune the performance of your environment in Performance tuning for Apache Airflow on Amazon MWAA.
- Create a monitoring dashboard for your environment in <u>Monitoring dashboards and alarms on</u> <u>Amazon MWAA</u>.
- Run some of the DAG code samples in <u>Code examples for Amazon Managed Workflows for</u> <u>Apache Airflow</u>.

Get started with Amazon Managed Workflows for Apache Airflow

Amazon Managed Workflows for Apache Airflow uses the Amazon VPC, DAG code and supporting files in your Amazon S3 storage bucket to create an environment. This chapter describes the prerequisites and AWS resources needed to get started with Amazon MWAA.

Topics

- Prerequisites
- About this guide
- Before you begin
- Available regions
- Create an Amazon S3 bucket for Amazon MWAA
- <u>Create the VPC network</u>
- <u>Create an Amazon MWAA environment</u>
- What's next?

Prerequisites

To create an Amazon MWAA environment, you may want to take additional steps to ensure you have permission to the AWS resources you need to create.

 AWS account – An AWS account with permission to use Amazon MWAA and the AWS services and resources used by your environment.

About this guide

This section describes the AWS infrastructure and resources you'll create in this guide.

 Amazon VPC – The Amazon VPC networking components required by an Amazon MWAA environment. You can configure an existing VPC that meets these requirements (advanced) as seen in <u>About networking on Amazon MWAA</u>, or create the VPC and networking components, as defined in the section called "Create the VPC network".

- Amazon S3 bucket An Amazon S3 bucket to store your DAGs and associated files, such as plugins.zip and requirements.txt. Your Amazon S3 bucket must be configured to Block all public access, with Bucket Versioning enabled, as defined in Create an Amazon S3 bucket for Amazon MWAA.
- Amazon MWAA environment An Amazon MWAA environment configured with the location of your Amazon S3 bucket, the path to your DAG code and any custom plugins or Python dependencies, and your Amazon VPC and its security group, as defined in <u>Create an Amazon</u> MWAA environment.

Before you begin

To create an Amazon MWAA environment, you may want to take additional steps to create and configure other AWS resources before you create your environment.

To create an environment, you need the following:

- AWS KMS key An AWS KMS key for data encryption on your environment. You can choose the default option on the Amazon MWAA console to create an <u>AWS owned key</u> when you create an environment, or specify an existing <u>Customer managed key</u> with permissions to other AWS services used by your environment configured (advanced). To learn more, refer to <u>Using customer managed keys for encryption</u>.
- Execution role An execution role that allows Amazon MWAA to access AWS resources in your environment. You can choose the default option on the Amazon MWAA console to create an execution role when you create an environment. To learn more, refer to <u>Amazon MWAA</u> execution role.
- VPC security group A VPC security group that allows Amazon MWAA to access other AWS
 resources in your VPC network. You can choose the default option on the Amazon MWAA console
 to create a security group when you create an environment, or provide a security group with the
 appropriate inbound and outbound rules (advanced). To learn more, refer to Security in your VPC
 on Amazon MWAA.

Available regions

Amazon MWAA is available in the following AWS Regions.

• Europe (Stockholm) - eu-north-1

- Europe (Frankfurt) eu-central-1
- Europe (Ireland) eu-west-1
- Europe (London) eu-west-2
- Europe (Paris) eu-west-3
- Asia Pacific (Mumbai) ap-south-1
- Asia Pacific (Singapore) ap-southeast-1
- Asia Pacific (Sydney) ap-southeast-2
- Asia Pacific (Tokyo) ap-northeast-1
- Asia Pacific (Seoul) ap-northeast-2
- US East (N. Virginia) us-east-1
- US East (Ohio) us-east-2
- US West (Oregon) us-west-2
- Canada (Central) ca-central-1
- South America (São Paulo) sa-east-1

Create an Amazon S3 bucket for Amazon MWAA

This guide describes the steps to create an Amazon S3 bucket to store your Apache Airflow Directed Acyclic Graphs (DAGs), custom plugins in a plugins.zip file, and Python dependencies in a requirements.txt file.

Contents

- Before you begin
- Create the bucket
- What's next?

Before you begin

- The Amazon S3 bucket name can't be changed after you create the bucket. To learn more, refer to Rules for bucket naming in the Amazon Simple Storage Service User Guide.
- An Amazon S3 bucket used for an Amazon MWAA environment must be configured to Block all public access, with Bucket Versioning enabled.

 An Amazon S3 bucket used for an Amazon MWAA environment must be located in the same AWS Region as an Amazon MWAA environment. To view a list of AWS Regions for Amazon MWAA, refer to Amazon MWAA endpoints and quotas in the AWS General Reference.

Create the bucket

This section describes the steps to create the Amazon S3 bucket for your environment.

To create a bucket

- 1. Sign in to the AWS Management Console and open the Amazon S3 console at https://console.aws.amazon.com/s3/.
- 2. Choose Create bucket.
- 3. In **Bucket name**, enter a DNS-compliant name for your bucket.

The bucket name must:

- Be unique across all of Amazon S3.
- Be between 3 and 63 characters long.
- Not contain uppercase characters.
- Start with a lowercase letter or number.

🔥 Important

Avoid including sensitive information, such as account numbers, in the bucket name. The bucket name is visible in the URLs that point to the objects in the bucket.

- 4. Choose an AWS Region in **Region**. This must be the same AWS Region as your Amazon MWAA environment.
 - We recommend choosing a region close to you to minimize latency and costs and address regulatory requirements.
- 5. Choose **Block all public access**.
- 6. Choose **Enable** in **Bucket Versioning**.
- 7. **Optional** *Tags*. Add key-value tag pairs to identify your Amazon S3 bucket in **Tags**. For example, Bucket : Staging.

- 8. **Optional** *Server-side encryption*. You can optionally **Enable** one of the following encryption options on your Amazon S3 bucket.
 - a. Choose **Amazon S3 key (SSE-S3)** in **Server-side encryption** to enable server-side encryption for the bucket.
 - b. Choose **AWS Key Management Service key (SSE-KMS)** to use an AWS KMS key for encryption on your Amazon S3 bucket:
 - AWS managed key (aws/s3) If you choose this option, you can either use an <u>AWS</u> owned key managed by Amazon MWAA, or specify a <u>Customer managed key</u> for encryption of your Amazon MWAA environment.
 - ii. Choose from your AWS KMS keys or Enter AWS KMS key ARN If you choose to specify a <u>Customer managed key</u> in this step, you must specify an AWS KMS key ID or ARN. <u>AWS KMS aliases and multi-region keys are not supported by Amazon MWAA</u>. The AWS KMS key you specify must also be used for encryption on your Amazon MWAA environment.
- 9. **Optional** *Advanced settings*. If you want to enable Amazon S3 Object Lock:
 - a. Choose Advanced settings, Enable.

🛕 Important

Enabling Object Lock will permanently allow objects in this bucket to be locked. To learn more, refer to <u>Locking Objects Using Amazon S3 Object Lock</u> in the *Amazon Simple Storage Service User Guide*.

- b. Choose the acknowledgement.
- 10. Choose **Create bucket**.

What's next?

- Learn how to create the required Amazon VPC network for an environment in <u>Create the VPC</u> network.
- Learn how to how to manage access permissions in How do I set ACL bucket permissions?
- Learn how to delete a storage bucket in <u>How do I delete an S3 Bucket?</u>.

Create the VPC network

Amazon Managed Workflows for Apache Airflow requires an Amazon VPC and specific networking components to support an environment. This guide describes the different options to create the Amazon VPC network for an Amazon Managed Workflows for Apache Airflow environment.

🚺 Note

Apache Airflow works best in a low-latency network environment. If you are using an existing Amazon VPC which routes traffic to another region or to an on-premise environment, we recommended adding AWS PrivateLink endpoints for Amazon SQS, CloudWatch, Amazon S3, and AWS KMS. For more information about configuring AWS PrivateLink for Amazon MWAA, refer to <u>Creating an Amazon VPC network without internet</u> access.

Contents

- Prerequisites
- Before you begin
- Options to create the Amazon VPC network
 - Option one: Creating the VPC network on the Amazon MWAA console
 - Option two: Creating an Amazon VPC network with Internet access
 - Option three: Creating an Amazon VPC network without Internet access
- What's next?

Prerequisites

The AWS Command Line Interface (AWS CLI) is an open source tool that enables you to interact with AWS services using commands in your command-line shell. To complete the steps on this page, you need the following:

- AWS CLI Install version 2.
- AWS CLI Quick configuration with aws configure.

- The <u>VPC network</u> you specify for your environment can't be changed after the environment is created.
- You can use private or public routing for your Amazon VPC and Apache Airflow *Web server*. To view a list of options, refer to <u>the section called "Example use cases for an Amazon VPC and</u> Apache Airflow access mode".

Options to create the Amazon VPC network

The following section describes the options available to create the Amazon VPC network for an environment.

🚯 Note

Amazon MWAA does not support the use of use1-az3 Availability Zone (AZ) in the US East (N. Virginia) Region. When creating the VPC for Amazon MWAA in the US East (N. Virginia) region, you must explicitly assign the AvailabilityZone in the AWS CloudFormation (CFN) template. The assigned availability zone name must not be mapped to use1-az3. You can retrieve the detailed mapping of AZ names to their corresponding AZ IDs by running the following command:

aws ec2 describe-availability-zones --region us-east-1

Option one: Creating the VPC network on the Amazon MWAA console

The following section shows how to create an Amazon VPC network on the Amazon MWAA console. This option uses <u>Public routing over the Internet</u>. It can be used for an Apache Airflow *Web server* with the **Private network** or **Public network** access modes.

The following image shows where you can find the **Create MWAA VPC** button on the Amazon MWAA console.

tual private cloud (\	√PC)
5	frastructure setup of your Airflow environment. An environment needs 2 private subnets in different availability C with private subnets, choose Create MWAA VPC. Learn more 🔀
hoose VPC	▼ C Create MWAA VPC Z

Option two: Creating an Amazon VPC network with Internet access

The following AWS CloudFormation template creates an Amazon VPC network *with Internet access* in your default AWS Region. This option uses <u>Public routing over the Internet</u>. This template can be used for an Apache Airflow *Web server* with the **Private network** or **Public network** access modes.

1. Copy the contents of the following template and save locally as cfn-vpc-publicprivate.yaml. You can also download the template.

```
Description: This template deploys a VPC, with a pair of public and private
subnets spread
  across two Availability Zones. It deploys an internet gateway, with a default
 route on the public subnets. It deploys a pair of NAT gateways (one in each AZ),
  and default routes for them in the private subnets.
Parameters:
  EnvironmentName:
    Description: An environment name that is prefixed to resource names
   Type: String
    Default: mwaa-
 VpcCIDR:
    Description: Please enter the IP range (CIDR notation) for this VPC
   Type: String
    Default: 10.192.0.0/16
 PublicSubnet1CIDR:
    Description: Please enter the IP range (CIDR notation) for the public subnet in
 the first Availability Zone
```

```
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```

```
Type: String
   Default: 10.192.10.0/24
  PublicSubnet2CIDR:
    Description: Please enter the IP range (CIDR notation) for the public subnet in
the second Availability Zone
   Type: String
    Default: 10.192.11.0/24
 PrivateSubnet1CIDR:
    Description: Please enter the IP range (CIDR notation) for the private subnet
 in the first Availability Zone
   Type: String
   Default: 10.192.20.0/24
 PrivateSubnet2CIDR:
    Description: Please enter the IP range (CIDR notation) for the private subnet
 in the second Availability Zone
   Type: String
    Default: 10.192.21.0/24
Resources:
 VPC:
   Type: AWS::EC2::VPC
    Properties:
      CidrBlock: !Ref VpcCIDR
      EnableDnsSupport: true
      EnableDnsHostnames: true
      Tags:
        - Key: Name
          Value: !Ref EnvironmentName
 InternetGateway:
    Type: AWS::EC2::InternetGateway
    Properties:
      Tags:
        - Key: Name
          Value: !Ref EnvironmentName
 InternetGatewayAttachment:
   Type: AWS::EC2::VPCGatewayAttachment
    Properties:
      InternetGatewayId: !Ref InternetGateway
      VpcId: !Ref VPC
```

```
PublicSubnet1:
  Type: AWS::EC2::Subnet
  Properties:
    VpcId: !Ref VPC
   AvailabilityZone: !Select [ 0, !GetAZs '' ]
    CidrBlock: !Ref PublicSubnet1CIDR
   MapPublicIpOnLaunch: true
   Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Public Subnet (AZ1)
PublicSubnet2:
  Type: AWS::EC2::Subnet
  Properties:
    VpcId: !Ref VPC
    AvailabilityZone: !Select [ 1, !GetAZs '' ]
    CidrBlock: !Ref PublicSubnet2CIDR
   MapPublicIpOnLaunch: true
   Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Public Subnet (AZ2)
PrivateSubnet1:
  Type: AWS::EC2::Subnet
  Properties:
    VpcId: !Ref VPC
    AvailabilityZone: !Select [ 0, !GetAZs '' ]
    CidrBlock: !Ref PrivateSubnet1CIDR
   MapPublicIpOnLaunch: false
   Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Private Subnet (AZ1)
PrivateSubnet2:
  Type: AWS::EC2::Subnet
  Properties:
    VpcId: !Ref VPC
    AvailabilityZone: !Select [ 1, !GetAZs '' ]
    CidrBlock: !Ref PrivateSubnet2CIDR
    MapPublicIpOnLaunch: false
    Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Private Subnet (AZ2)
```

```
NatGateway1EIP:
  Type: AWS::EC2::EIP
  DependsOn: InternetGatewayAttachment
  Properties:
    Domain: vpc
NatGateway2EIP:
  Type: AWS::EC2::EIP
  DependsOn: InternetGatewayAttachment
  Properties:
    Domain: vpc
NatGateway1:
  Type: AWS::EC2::NatGateway
  Properties:
    AllocationId: !GetAtt NatGateway1EIP.AllocationId
    SubnetId: !Ref PublicSubnet1
NatGateway2:
  Type: AWS::EC2::NatGateway
  Properties:
    AllocationId: !GetAtt NatGateway2EIP.AllocationId
    SubnetId: !Ref PublicSubnet2
PublicRouteTable:
  Type: AWS::EC2::RouteTable
  Properties:
    VpcId: !Ref VPC
   Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Public Routes
DefaultPublicRoute:
  Type: AWS::EC2::Route
  DependsOn: InternetGatewayAttachment
  Properties:
    RouteTableId: !Ref PublicRouteTable
    DestinationCidrBlock: 0.0.0.0/0
    GatewayId: !Ref InternetGateway
PublicSubnet1RouteTableAssociation:
  Type: AWS::EC2::SubnetRouteTableAssociation
  Properties:
```

```
RouteTableId: !Ref PublicRouteTable
    SubnetId: !Ref PublicSubnet1
PublicSubnet2RouteTableAssociation:
  Type: AWS::EC2::SubnetRouteTableAssociation
  Properties:
    RouteTableId: !Ref PublicRouteTable
    SubnetId: !Ref PublicSubnet2
PrivateRouteTable1:
  Type: AWS::EC2::RouteTable
  Properties:
    VpcId: !Ref VPC
    Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Private Routes (AZ1)
DefaultPrivateRoute1:
  Type: AWS::EC2::Route
  Properties:
    RouteTableId: !Ref PrivateRouteTable1
    DestinationCidrBlock: 0.0.0.0/0
    NatGatewayId: !Ref NatGateway1
PrivateSubnet1RouteTableAssociation:
  Type: AWS::EC2::SubnetRouteTableAssociation
  Properties:
    RouteTableId: !Ref PrivateRouteTable1
    SubnetId: !Ref PrivateSubnet1
PrivateRouteTable2:
  Type: AWS::EC2::RouteTable
  Properties:
    VpcId: !Ref VPC
    Tags:
      - Key: Name
        Value: !Sub ${EnvironmentName} Private Routes (AZ2)
DefaultPrivateRoute2:
  Type: AWS::EC2::Route
  Properties:
    RouteTableId: !Ref PrivateRouteTable2
    DestinationCidrBlock: 0.0.0.0/0
```

```
NatGatewayId: !Ref NatGateway2
  PrivateSubnet2RouteTableAssociation:
   Type: AWS::EC2::SubnetRouteTableAssociation
    Properties:
      RouteTableId: !Ref PrivateRouteTable2
      SubnetId: !Ref PrivateSubnet2
  SecurityGroup:
   Type: AWS::EC2::SecurityGroup
    Properties:
      GroupName: "mwaa-security-group"
      GroupDescription: "Security group with a self-referencing inbound rule."
      VpcId: !Ref VPC
 SecurityGroupIngress:
   Type: AWS::EC2::SecurityGroupIngress
    Properties:
      GroupId: !Ref SecurityGroup
      IpProtocol: "-1"
      SourceSecurityGroupId: !Ref SecurityGroup
Outputs:
 VPC:
    Description: A reference to the created VPC
   Value: !Ref VPC
  PublicSubnets:
    Description: A list of the public subnets
   Value: !Join [ ",", [ !Ref PublicSubnet1, !Ref PublicSubnet2 ]]
  PrivateSubnets:
    Description: A list of the private subnets
   Value: !Join [ ",", [ !Ref PrivateSubnet1, !Ref PrivateSubnet2 ]]
  PublicSubnet1:
    Description: A reference to the public subnet in the 1st Availability Zone
   Value: !Ref PublicSubnet1
  PublicSubnet2:
    Description: A reference to the public subnet in the 2nd Availability Zone
   Value: !Ref PublicSubnet2
  PrivateSubnet1:
```

```
Description: A reference to the private subnet in the 1st Availability Zone
Value: !Ref PrivateSubnet1
PrivateSubnet2:
Description: A reference to the private subnet in the 2nd Availability Zone
Value: !Ref PrivateSubnet2
SecurityGroupIngress:
Description: Security group with self-referencing inbound rule
```

2. In your command prompt, navigate to the directory where cfn-vpc-public-private.yaml is stored. For example:

```
cd mwaaproject
```

Value: !Ref SecurityGroupIngress

3. Use the <u>aws cloudformation create-stack</u> command to create the stack using the AWS CLI.

```
aws cloudformation create-stack --stack-name mwaa-environment --template-body
file://cfn-vpc-public-private.yaml
```

🚯 Note

It takes about 30 minutes to create the Amazon VPC infrastructure.

Option three: Creating an Amazon VPC network without Internet access

The following AWS CloudFormation template creates an Amazon VPC network *without Internet access* in your default AWS region.

This option uses <u>Private routing without Internet access</u>. This template can be used for an Apache Airflow *Web server* with the **Private network** access mode only. It creates the required <u>VPC</u> endpoints for the AWS services used by an environment.

 Copy the contents of the following template and save locally as cfn-vpc-private.yaml. You can also download the template.

AWSTemplateFormatVersion: "2010-09-09"

```
Parameters:
  VpcCIDR:
     Description: The IP range (CIDR notation) for this VPC
    Type: String
    Default: 10.192.0.0/16
  PrivateSubnet1CIDR:
     Description: The IP range (CIDR notation) for the private subnet in the first
Availability Zone
     Type: String
     Default: 10.192.10.0/24
  PrivateSubnet2CIDR:
     Description: The IP range (CIDR notation) for the private subnet in the second
Availability Zone
    Type: String
     Default: 10.192.11.0/24
Resources:
  VPC:
     Type: AWS::EC2::VPC
     Properties:
       CidrBlock: !Ref VpcCIDR
       EnableDnsSupport: true
       EnableDnsHostnames: true
      Tags:
        - Key: Name
          Value: !Ref AWS::StackName
   RouteTable:
     Type: AWS::EC2::RouteTable
     Properties:
      VpcId: !Ref VPC
      Tags:
        - Key: Name
          Value: !Sub "${AWS::StackName}-route-table"
  PrivateSubnet1:
     Type: AWS::EC2::Subnet
     Properties:
       VpcId: !Ref VPC
       AvailabilityZone: !Select [ 0, !GetAZs '' ]
       CidrBlock: !Ref PrivateSubnet1CIDR
       MapPublicIpOnLaunch: false
```

```
Tags:
       - Key: Name
        Value: !Sub "${AWS::StackName} Private Subnet (AZ1)"
  PrivateSubnet2:
   Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref VPC
      AvailabilityZone: !Select [ 1, !GetAZs '' ]
      CidrBlock: !Ref PrivateSubnet2CIDR
     MapPublicIpOnLaunch: false
     Tags:
       - Key: Name
        Value: !Sub "${AWS::StackName} Private Subnet (AZ2)"
 PrivateSubnet1RouteTableAssociation:
   Type: AWS::EC2::SubnetRouteTableAssociation
    Properties:
      RouteTableId: !Ref RouteTable
      SubnetId: !Ref PrivateSubnet1
  PrivateSubnet2RouteTableAssociation:
   Type: AWS::EC2::SubnetRouteTableAssociation
   Properties:
      RouteTableId: !Ref RouteTable
      SubnetId: !Ref PrivateSubnet2
 S3VpcEndoint:
   Type: AWS::EC2::VPCEndpoint
   Properties:
      ServiceName: !Sub "com.amazonaws.${AWS::Region}.s3"
      VpcEndpointType: Gateway
     VpcId: !Ref VPC
      RouteTableIds:
       - !Ref RouteTable
 SecurityGroup:
   Type: AWS::EC2::SecurityGroup
    Properties:
     VpcId: !Ref VPC
      GroupDescription: Security Group for Amazon MWAA Environments to access VPC
endpoints
      GroupName: !Sub "${AWS::StackName}-mwaa-vpc-endpoints"
```

```
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```

```
SecurityGroupIngress:
  Type: AWS::EC2::SecurityGroupIngress
  Properties:
    GroupId: !Ref SecurityGroup
    IpProtocol: "-1"
    SourceSecurityGroupId: !Ref SecurityGroup
SqsVpcEndoint:
  Type: AWS::EC2::VPCEndpoint
  Properties:
    ServiceName: !Sub "com.amazonaws.${AWS::Region}.sqs"
    VpcEndpointType: Interface
    VpcId: !Ref VPC
    PrivateDnsEnabled: true
    SubnetIds:
     - !Ref PrivateSubnet1
     - !Ref PrivateSubnet2
    SecurityGroupIds:
     - !Ref SecurityGroup
CloudWatchLogsVpcEndoint:
  Type: AWS::EC2::VPCEndpoint
  Properties:
    ServiceName: !Sub "com.amazonaws.${AWS::Region}.logs"
    VpcEndpointType: Interface
   VpcId: !Ref VPC
    PrivateDnsEnabled: true
    SubnetIds:
     - !Ref PrivateSubnet1
     - !Ref PrivateSubnet2
    SecurityGroupIds:
     - !Ref SecurityGroup
CloudWatchMonitoringVpcEndoint:
  Type: AWS::EC2::VPCEndpoint
  Properties:
    ServiceName: !Sub "com.amazonaws.${AWS::Region}.monitoring"
    VpcEndpointType: Interface
    VpcId: !Ref VPC
    PrivateDnsEnabled: true
    SubnetIds:
     - !Ref PrivateSubnet1
     - !Ref PrivateSubnet2
    SecurityGroupIds:
```

```
- !Ref SecurityGroup
   KmsVpcEndoint:
    Type: AWS::EC2::VPCEndpoint
     Properties:
       ServiceName: !Sub "com.amazonaws.${AWS::Region}.kms"
       VpcEndpointType: Interface
       VpcId: !Ref VPC
       PrivateDnsEnabled: true
       SubnetIds:
        - !Ref PrivateSubnet1
        - !Ref PrivateSubnet2
       SecurityGroupIds:
        - !Ref SecurityGroup
Outputs:
  VPC:
     Description: A reference to the created VPC
    Value: !Ref VPC
  MwaaSecurityGroupId:
     Description: Associates the Security Group to the environment to allow access
 to the VPC endpoints
    Value: !Ref SecurityGroup
  PrivateSubnets:
     Description: A list of the private subnets
    Value: !Join [ ",", [ !Ref PrivateSubnet1, !Ref PrivateSubnet2 ]]
  PrivateSubnet1:
     Description: A reference to the private subnet in the 1st Availability Zone
    Value: !Ref PrivateSubnet1
  PrivateSubnet2:
     Description: A reference to the private subnet in the 2nd Availability Zone
    Value: !Ref PrivateSubnet2
```

 In your command prompt, navigate to the directory where cfn-vpc-private.yml is stored. For example:

cd mwaaproject

3. Use the <u>aws cloudformation create-stack</u> command to create the stack using the AWS CLI.

```
aws cloudformation create-stack --stack-name mwaa-private-environment --template-
body file://cfn-vpc-private.yml
```

Note

It takes about 30 minutes to create the Amazon VPC infrastructure.

4. You'll need to create a mechanism to access these VPC endpoints from your computer. To learn more, refer to Managing access to service-specific Amazon VPC endpoints on Amazon MWAA.

Note

You can further restrict outbound access in the CIDR of your Amazon MWAA security group. For example, you can restrict to itself by adding a self-referencing outbound rule, the prefix list for Amazon S3, and the CIDR of your Amazon VPC.

What's next?

- Learn how to create an Amazon MWAA environment in Create an Amazon MWAA environment.
- Learn how to create a VPN tunnel from your computer to your Amazon VPC with private routing in Tutorial: Configuring private network access using an AWS Client VPN.

Create an Amazon MWAA environment

Amazon Managed Workflows for Apache Airflow sets up Apache Airflow on an environment in your chosen version using the same open-source Apache Airflow and user interface available from Apache. This guide describes the steps to create an Amazon MWAA environment.

Contents

- Before you begin
- <u>Apache Airflow versions</u>
- Create an environment

- Step one: Specify details
- Step two: Configure advanced settings
- Step three: Review and create

Before you begin

- The <u>VPC network</u> you specify for your environment cannot be modified after the environment is created.
- You need an Amazon S3 bucket configured to **Block all public access**, with **Bucket Versioning** enabled.
- You need an AWS account with <u>permissions to use Amazon MWAA</u>, and permission in AWS Identity and Access Management (IAM) to create IAM roles. If you choose the **Private network** access mode for the Apache Airflow *web server*, which limits Apache Airflow access within your Amazon VPC, you'll need permission in IAM to create Amazon VPC endpoints.

i Note

Amazon MWAA dynamically determines the network during creation. If you use IPv6 subnets, Amazon MWAA creates IPv6 private link connectivity to the database and webserver. Amazon MWAA does not support transitioning between network types and cannot upgrade existing environments to IPv6.

Apache Airflow versions

The following Apache Airflow versions are supported on Amazon Managed Workflows for Apache Airflow.

🚯 Note

• Effective December 30, 2025, Amazon MWAA will end support for Apache Airflow versions v2.4.3, v2.5.1, and v2.6.3. For more information, refer to <u>Apache Airflow version</u> <u>support and FAQ</u>.

- Beginning with Apache Airflow v2.2.2, Amazon MWAA supports installing Python requirements, provider packages, and custom plugins directly on the Apache Airflow web server.
- Beginning with Apache Airflow v2.7.2, your requirements file must include a -constraint statement. If you do not provide a constraint, Amazon MWAA will specify
 one for you to ensure the packages listed in your requirements are compatible with the
 version of Apache Airflow you are using.

For more information on setting up constraints in your requirements file, refer to Installing Python dependencies.

Apache Airflow version	Apache Airflow release date	Amazon MWAA availability date	Apache Airflow constraints	Python version
<u>v2.10.3</u>	<u>November 4,</u> 2024	December 18, 2024	v2.10.3 constraints file	<u>Python 3.11</u>
<u>v2.10.1</u>	<u>September 5,</u> 2024	September 26, 2024	v2.10.1 constraints file	<u>Python 3.11</u>
<u>v2.9.2</u>	<u>June 10, 2024</u>	July 9, 2024	v2.9.2 constrain ts file	<u>Python 3.11</u>
<u>v2.8.1</u>	<u>January 19,</u> <u>2024</u>	February 23, 2024	v2.8.1 constrain ts file	<u>Python 3.11</u>
<u>v2.7.2</u>	<u>October 12,</u> 2023	November 6, 2023	v2.7.2 constrain ts file	<u>Python 3.11</u>

For more information about migrating your self-managed Apache Airflow deployments, or migrating an existing Amazon MWAA environment, including instructions for backing up your metadata database, refer to the <u>Amazon MWAA Migration Guide</u>.

Create an environment

The following section describes the steps to create an Amazon MWAA environment.

Step one: Specify details

To specify details for the environment

- 1. Open the Amazon MWAA console.
- 2. Use the AWS Region selector to select your region.
- 3. Choose **Create environment**.
- 4. On the **Specify details** page, under **Environment details**:
 - a. Type a unique name for your environment in **Name**.
 - b. Choose the Apache Airflow version in **Airflow version**.

🚯 Note

If no value is specified, defaults to the latest Apache Airflow version. The latest version available is Apache Airflow v2.10.3.

- 5. Under **DAG code in Amazon S3** specify the following:
 - a. **S3 Bucket**. Choose **Browse S3** and select your Amazon S3 bucket, or enter the Amazon S3 URI.
 - b. **DAGs folder**. Choose **Browse S3** and select the dags folder in your Amazon S3 bucket, or enter the Amazon S3 URI.
 - c. **Plugins file** *optional*. Choose **Browse S3** and select the plugins.zip file on your Amazon S3 bucket, or enter the Amazon S3 URI.
 - d. **Requirements file** *optional*. Choose **Browse S3** and select the requirements.txt file on your Amazon S3 bucket, or enter the Amazon S3 URI.
 - e. **Startup script file** *optional*, Choose **Browse S3** and select the script file on your Amazon S3 bucket, or enter the Amazon S3 URI.
- 6. Choose **Next**.

Step two: Configure advanced settings

To configure advanced settings

1. On the **Configure advanced settings** page, under **Networking**:

• Choose your Amazon VPC.

This step populates two of the private subnets in your Amazon VPC.

- 2. Under Web server access, select your preferred Apache Airflow access mode:
 - a. **Private network**. This limits access of the Apache Airflow UI to users *within your Amazon VPC* that have been granted access to the <u>IAM policy for your environment</u>. You need permission to create Amazon VPC endpoints for this step.

(i) Note

Choose the **Private network** option if your Apache Airflow UI is only accessed within a corporate network, and you do not require access to public repositories for web server requirements installation. If you choose this access mode option, you need to create a mechanism to access your Apache Airflow *Web server* in your Amazon VPC. For more information, refer to <u>Accessing the VPC endpoint for your</u> Apache Airflow Web server (private network access).

- b. **Public network**. This allows the Apache Airflow UI to be accessed *over the Internet* by users granted access to the IAM policy for your environment.
- 3. Under **Security group(s)**, choose the security group used to secure your <u>Amazon VPC</u>:
 - a. By default, Amazon MWAA creates a security group in your Amazon VPC with specific inbound and outbound rules in **Create new security group**.
 - b. **Optional**. Deselect the check box in **Create new security group** to select up to 5 security groups.

🚺 Note

An existing Amazon VPC security group must be configured with specific inbound and outbound rules to allow network traffic. To learn more, refer to <u>Security in</u> your VPC on Amazon MWAA.

4. Under Environment class, choose an environment class.

We recommend choosing the smallest size necessary to support your workload. You can change the environment class at any time.

5. For **Maximum worker count**, specify the maximum number of Apache Airflow workers to run in the environment.

For more information, refer to Example high performance use case.

6. Specify the **Maximum web server count** and **Minimum web server count** to configure how Amazon MWAA scales the Apache Airflow web servers in your environment.

For more information about web server automatic scaling, refer to <u>the section called</u> "Configuring web server auto scaling".

- 7. Under **Encryption**, choose a data encryption option:
 - a. By default, Amazon MWAA uses an AWS owned key to encrypt your data.
 - b. Optional. Choose Customize encryption settings (advanced) to choose a different AWS KMS key. If you choose to specify a <u>Customer managed key</u> in this step, you must specify an AWS KMS key ID or ARN. <u>AWS KMS aliases and multi-region keys are not supported</u> by Amazon MWAA. If you specified an Amazon S3 key for server-side encryption on your Amazon S3 bucket, you must specify the same key for your Amazon MWAA environment.

🚯 Note

You must have permissions to the key to select it on the Amazon MWAA console. You must also grant permissions for Amazon MWAA to use the key by attaching the policy described in Attach key policy.

- 8. **Recommended**. Under **Monitoring**, choose one or more log categories for **Airflow logging configuration** to send Apache Airflow logs to CloudWatch Logs:
 - a. **Airflow task logs**. Choose the type of Apache Airflow task logs to send to CloudWatch Logs in **Log level**.
 - b. **Airflow web server logs**. Choose the type of Apache Airflow web server logs to send to CloudWatch Logs in **Log level**.
 - c. Airflow scheduler logs. Choose the type of Apache Airflow scheduler logs to send to CloudWatch Logs in Log level.
 - d. **Airflow worker logs**. Choose the type of Apache Airflow worker logs to send to CloudWatch Logs in **Log level**.
 - e. **Airflow DAG processing logs**. Choose the type of Apache Airflow DAG processing logs to send to CloudWatch Logs in **Log level**.

9. **Optional**. For **Airflow configuration options**, choose **Add custom configuration option**.

You can choose from the suggested dropdown list of <u>Apache Airflow configuration options</u> for your Apache Airflow version, or specify custom configuration options. For example, core.default_task_retries: 3.

- 10. **Optional**. Under **Tags**, choose **Add new tag** to associate tags to your environment. For example, Environment: Staging.
- 11. Under **Permissions**, choose an execution role:
 - a. By default, Amazon MWAA creates an <u>execution role</u> in **Create a new role**. You must have permission to create IAM roles to use this option.
 - b. **Optional**. Choose **Enter role ARN** to enter the Amazon Resource Name (ARN) of an existing execution role.
- 12. Choose Next.

Step three: Review and create

To review an environment summary

Review the environment summary, choose Create environment.

🚯 Note

It takes about twenty to thirty minutes to create an environment.

What's next?

• Learn how to create an Amazon S3 bucket in Create an Amazon S3 bucket for Amazon MWAA.

Managing access to an Amazon MWAA environment

Amazon Managed Workflows for Apache Airflow needs to be permitted to use other AWS services and resources used by an environment. You also need to be granted permission to access an Amazon MWAA environment and your Apache Airflow UI in AWS Identity and Access Management (IAM). This section describes the execution role used to grant access to the AWS resources for your environment and how to add permissions, and the AWS account permissions you need to access your Amazon MWAA environment and Apache Airflow UI.

Topics

- Accessing an Amazon MWAA environment
- Service-linked role for Amazon MWAA
- Amazon MWAA execution role
- <u>Cross-service confused deputy prevention</u>
- Apache Airflow access modes

Accessing an Amazon MWAA environment

To use Amazon Managed Workflows for Apache Airflow, you must use an account, and IAM entities with the necessary permissions. This topic describes the access policies you can attach to your Apache Airflow development team and Apache Airflow users for your Amazon Managed Workflows for Apache Airflow environment.

We recommend using temporary credentials and configuring federated identities with groups and roles, to access your Amazon MWAA resources. As a best practice, avoid attaching policies directly to your IAM users, and instead define groups or roles to provide temporary access to AWS resources.

An IAM role is an IAM identity that you can create in your account that has specific permissions. An IAM role is similar to an IAM user in that it is an AWS identity with permissions policies that determine what the identity can and cannot do in AWS. However, instead of being uniquely associated with one person, a role is intended to be assumable by anyone who needs it. Also, a role does not have standard long-term credentials such as a password or access keys associated with it. Instead, when you assume a role, it provides you with temporary security credentials for your role session. To assign permissions to a federated identity, you create a role and define permissions for the role. When a federated identity authenticates, the identity is associated with the role and is granted the permissions that are defined by the role. For information about roles for federation, see <u>Create a role for a third-party identity provider (federation)</u> in the *IAM User Guide*. If you use IAM Identity Center, you configure a permission set. To control what your identities can access after they authenticate, IAM Identity Center correlates the permission set to a role in IAM. For information about permissions sets, see <u>Permission sets</u> in the *AWS IAM Identity Center User Guide*.

You can use an IAM role in your account to grant another AWS account permissions to access your account's resources. For an example, see <u>Tutorial: Delegate access across AWS accounts using IAM</u> <u>roles</u> in the *IAM User Guide*.

Sections

- How it works
- Full console access policy: AmazonMWAAFullConsoleAccess
- Full API and console access policy: AmazonMWAAFullApiAccess
- <u>Read-only console access policy: AmazonMWAAReadOnlyAccess</u>
- Apache Airflow UI access policy: AmazonMWAAWebServerAccess
- Apache Airflow Rest API access policy: AmazonMWAARestAPIAccess
- Apache Airflow CLI policy: AmazonMWAAAirflowCliAccess
- Creating a JSON policy
- Example use case to attach policies to a developer group
- What's next?

How it works

The resources and services used in an Amazon MWAA environment are not accessible to all AWS Identity and Access Management (IAM) entities. You must create a policy that grants Apache Airflow users permission to access these resources. For example, you need to grant access to your Apache Airflow development team.

Amazon MWAA uses these policies to validate whether a user has the permissions needed to perform an action on the AWS console or via the APIs used by an environment.

You can use the JSON policies in this topic to create a policy for your Apache Airflow users in IAM, and then attach the policy to a user, group, or role in IAM.

- <u>AmazonMWAAFullConsoleAccess</u> Use this policy to grant permission to configure an environment on the Amazon MWAA console.
- <u>AmazonMWAAFullApiAccess</u> Use this policy to grant access to all Amazon MWAA APIs used to manage an environment.
- <u>AmazonMWAAReadOnlyAccess</u> Use this policy to grant access to to view the resources used by an environment on the Amazon MWAA console.
- <u>AmazonMWAAWebServerAccess</u> Use this policy to grant access to the Apache Airflow web server.
- <u>AmazonMWAAAirflowCliAccess</u> Use this policy to grant access to run Apache Airflow CLI commands.

To provide access, add permissions to your users, groups, or roles:

• Users and groups in AWS IAM Identity Center:

Create a permission set. Follow the instructions in <u>Create a permission set</u> in the AWS IAM *Identity Center User Guide*.

• Users managed in IAM through an identity provider:

Create a role for identity federation. Follow the instructions in <u>Create a role for a third-party</u> identity provider (federation) in the *IAM User Guide*.

- IAM users:
 - Create a role that your user can assume. Follow the instructions in Create a role for an IAM user in the IAM User Guide.
 - (Not recommended) Attach a policy directly to a user or add a user to a user group. Follow the instructions in Adding permissions to a user (console) in the *IAM User Guide*.

Full console access policy: AmazonMWAAFullConsoleAccess

A user may need access to the AmazonMWAAFullConsoleAccess permissions policy if they need to configure an environment on the Amazon MWAA console.

🚯 Note

Your full console access policy must include permissions to perform iam: PassRole. This allows the user to pass service-linked roles, and execution roles, to Amazon MWAA. Amazon

MWAA assumes each role in order to call other AWS services on your behalf. The following example uses the iam: PassedToService condition key to specify the Amazon MWAA service principal (airflow.amazonaws.com) as the service to which a role can be passed. For more information about iam: PassRole, refer to <u>Granting a user permissions to pass a</u> role to an AWS service in the *IAM User Guide*.

Use the following policy if you want to create, and manage, your Amazon MWAA environments using an <u>AWS owned key</u> for <u>encryption at-rest</u>.

Using an AWS owned key

JSON

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "airflow:*",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "iam:PassRole"
            ],
            "Resource": "*",
            "Condition": {
                "StringLike": {
                     "iam:PassedToService": "airflow.amazonaws.com"
                }
            }
        },
        {
            "Effect": "Allow",
            "Action": [
                "iam:ListRoles"
            ],
            "Resource": "*"
        },
```

```
{
            "Effect": "Allow",
            "Action": [
                "iam:CreatePolicy"
            ],
            "Resource": "arn:aws:iam::111122223333:policy/service-role/MWAA-
Execution-Policy*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "iam:AttachRolePolicy",
                "iam:CreateRole"
            ],
            "Resource": "arn:aws:iam::111122223333:role/service-role/AmazonMWAA*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "iam:CreateServiceLinkedRole"
            ],
            "Resource": "arn:aws:iam::*:role/aws-service-role/
airflow.amazonaws.com/AWSServiceRoleForAmazonMWAA"
        },
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetBucketLocation",
                "s3:ListAllMyBuckets",
                "s3:ListBucket",
                "s3:ListBucketVersions"
            ],
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "s3:CreateBucket",
                "s3:PutObject",
                "s3:GetEncryptionConfiguration"
            ],
            "Resource": "arn:aws:s3:::*"
        },
        {
```

```
"Effect": "Allow",
    "Action": [
        "ec2:DescribeSecurityGroups",
        "ec2:DescribeSubnets",
        "ec2:DescribeVpcs",
        "ec2:DescribeRouteTables"
    ],
    "Resource": "*"
},
{
    "Effect": "Allow",
    "Action": [
        "ec2:AuthorizeSecurityGroupIngress",
        "ec2:CreateSecurityGroup"
    ],
    "Resource": "arn:aws:ec2:*:*:security-group/airflow-security-group-*"
},
{
    "Effect": "Allow",
    "Action": [
        "kms:ListAliases"
    ],
    "Resource": "*"
},
{
    "Effect": "Allow",
    "Action": "ec2:CreateVpcEndpoint",
    "Resource": [
        "arn:aws:ec2:*:*:vpc-endpoint/*",
        "arn:aws:ec2:*:*:vpc/*",
        "arn:aws:ec2:*:*:subnet/*",
        "arn:aws:ec2:*:*:security-group/*"
    ]
},
{
    "Effect": "Allow",
    "Action": [
        "ec2:CreateNetworkInterface"
    ],
    "Resource": [
        "arn:aws:ec2:*:*:subnet/*",
        "arn:aws:ec2:*:*:network-interface/*"
    1
}
```

}

]

Use the following policy if you want to create, and manage, your Amazon MWAA environments using a <u>customer managed key</u> for encryption at-rest. To use a customer managed key, the IAM principal must have permission to access AWS KMS resources using the key stored in your account.

Using a customer managed key

JSON

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "airflow:*",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "iam:PassRole"
            ],
            "Resource": "*",
            "Condition": {
                "StringLike": {
                     "iam:PassedToService": "airflow.amazonaws.com"
                }
            }
        },
        {
            "Effect": "Allow",
            "Action": [
                "iam:ListRoles"
            ],
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": [
```

```
"iam:CreatePolicy"
            ],
            "Resource": "arn:aws:iam::111122223333:policy/service-role/MWAA-
Execution-Policy*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "iam:AttachRolePolicy",
                "iam:CreateRole"
            ],
            "Resource": "arn:aws:iam::111122223333:role/service-role/AmazonMWAA*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "iam:CreateServiceLinkedRole"
            ],
            "Resource": "arn:aws:iam::*:role/aws-service-role/
airflow.amazonaws.com/AWSServiceRoleForAmazonMWAA"
        },
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetBucketLocation",
                "s3:ListAllMyBuckets",
                "s3:ListBucket",
                "s3:ListBucketVersions"
            ],
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "s3:CreateBucket",
                "s3:PutObject",
                "s3:GetEncryptionConfiguration"
            ],
            "Resource": "arn:aws:s3:::*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "ec2:DescribeSecurityGroups",
```

```
"ec2:DescribeSubnets",
        "ec2:DescribeVpcs",
        "ec2:DescribeRouteTables"
    ],
    "Resource": "*"
},
{
    "Effect": "Allow",
    "Action": [
        "ec2:AuthorizeSecurityGroupIngress",
        "ec2:CreateSecurityGroup"
    ],
    "Resource": "arn:aws:ec2:*:*:security-group/airflow-security-group-*"
},
{
    "Effect": "Allow",
    "Action": [
        "kms:ListAliases"
    ],
    "Resource": "*"
},
{
    "Effect": "Allow",
    "Action": [
        "kms:DescribeKey",
        "kms:ListGrants",
        "kms:CreateGrant",
        "kms:RevokeGrant",
        "kms:Decrypt",
        "kms:Encrypt",
        "kms:GenerateDataKey*",
        "kms:ReEncrypt*"
    ],
    "Resource": "arn:aws:kms:*:111122223333:key/YOUR_KMS_ID"
},
{
    "Effect": "Allow",
    "Action": "ec2:CreateVpcEndpoint",
    "Resource": [
        "arn:aws:ec2:*:*:vpc-endpoint/*",
        "arn:aws:ec2:*:*:vpc/*",
        "arn:aws:ec2:*:*:subnet/*",
        "arn:aws:ec2:*:*:security-group/*"
    1
```

```
},
{
    {
        "Effect": "Allow",
        "Action": [
           "ec2:CreateNetworkInterface"
        ],
        "Resource": [
           "arn:aws:ec2:*:*:subnet/*",
           "arn:aws:ec2:*:*:network-interface/*"
        ]
    }
}
```

Full API and console access policy: AmazonMWAAFullApiAccess

A user may need access to the AmazonMWAAFullApiAccess permissions policy if they need access to all Amazon MWAA APIs used to manage an environment. It does not grant permissions to access the Apache Airflow UI.

i Note

A full API access policy must include permissions to perform iam: PassRole. This allows the user to pass <u>service-linked roles</u>, and <u>execution roles</u>, to Amazon MWAA. Amazon MWAA assumes each role in order to call other AWS services on your behalf. The following example uses the iam: PassedToService condition key to specify the Amazon MWAA service principal (airflow.amazonaws.com) as the service to which a role can be passed. For more information about iam: PassRole, refer to <u>Granting a user permissions to pass a</u> <u>role to an AWS service</u> in the *IAM User Guide*.

Use the following policy if you want to create, and manage, your Amazon MWAA environments using an AWS owned key for encryption at-rest.

Using an AWS owned key

JSON

{

```
"Version":"2012-10-17",
   "Statement":[
      {
         "Effect":"Allow",
         "Action":"airflow:*",
         "Resource":"*"
      },
      {
         "Effect":"Allow",
         "Action":[
            "iam:PassRole"
         ],
         "Resource":"*",
         "Condition":{
            "StringLike":{
               "iam:PassedToService":"airflow.amazonaws.com"
            }
         }
      },
      {
         "Effect":"Allow",
         "Action":[
            "iam:CreateServiceLinkedRole"
         ],
         "Resource":"arn:aws:iam::*:role/aws-service-role/airflow.amazonaws.com/
AWSServiceRoleForAmazonMWAA"
      },
      {
         "Effect":"Allow",
         "Action":[
            "ec2:DescribeSecurityGroups",
            "ec2:DescribeSubnets",
            "ec2:DescribeVpcs",
            "ec2:DescribeRouteTables"
         ],
         "Resource":"*"
      },
      {
         "Effect":"Allow",
         "Action":[
            "s3:GetEncryptionConfiguration"
         ],
         "Resource":"arn:aws:s3:::*"
      },
```

```
{
         "Effect":"Allow",
         "Action":"ec2:CreateVpcEndpoint",
         "Resource":[
            "arn:aws:ec2:*:*:vpc-endpoint/*",
            "arn:aws:ec2:*:*:vpc/*",
            "arn:aws:ec2:*:*:subnet/*",
            "arn:aws:ec2:*:*:security-group/*"
         1
      },
      {
         "Effect":"Allow",
         "Action":[
            "ec2:CreateNetworkInterface"
         ],
         "Resource":[
            "arn:aws:ec2:*:*:subnet/*",
            "arn:aws:ec2:*:*:network-interface/*"
         1
      }
   1
}
```

Use the following policy if you want to create, and manage, your Amazon MWAA environments using a customer managed key for encryption at-rest. To use a customer managed key, the IAM principal must have permission to access AWS KMS resources using the key stored in your account.

Using a customer managed key

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "airflow:*",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Effect": "Allow",
```

User Guide

```
"Action": [
                "iam:PassRole"
            ],
            "Resource": "*",
            "Condition": {
                "StringLike": {
                    "iam:PassedToService": "airflow.amazonaws.com"
                }
            }
        },
        {
            "Effect": "Allow",
            "Action": [
                "iam:CreateServiceLinkedRole"
            ],
            "Resource": "arn:aws:iam::*:role/aws-service-role/
airflow.amazonaws.com/AWSServiceRoleForAmazonMWAA"
        },
        {
            "Effect": "Allow",
            "Action": [
                "ec2:DescribeSecurityGroups",
                "ec2:DescribeSubnets",
                "ec2:DescribeVpcs",
                "ec2:DescribeRouteTables"
            ],
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "kms:DescribeKey",
                "kms:ListGrants",
                "kms:CreateGrant",
                "kms:RevokeGrant",
                "kms:Decrypt",
                "kms:Encrypt",
                "kms:GenerateDataKey*",
                "kms:ReEncrypt*"
            ],
            "Resource": "arn:aws:kms:*:111122223333:key/YOUR_KMS_ID"
        },
        {
            "Effect": "Allow",
```

```
"Action": [
                "s3:GetEncryptionConfiguration"
            ],
            "Resource": "arn:aws:s3:::*"
        },
        {
            "Effect": "Allow",
            "Action": "ec2:CreateVpcEndpoint",
            "Resource": [
                "arn:aws:ec2:*:*:vpc-endpoint/*",
                "arn:aws:ec2:*:*:vpc/*",
                "arn:aws:ec2:*:*:subnet/*",
                "arn:aws:ec2:*:*:security-group/*"
            ]
        },
        {
            "Effect": "Allow",
            "Action": [
                "ec2:CreateNetworkInterface"
            ],
            "Resource": [
                "arn:aws:ec2:*:*:subnet/*",
                "arn:aws:ec2:*:*:network-interface/*"
            1
        }
    ]
}
```

Read-only console access policy: AmazonMWAAReadOnlyAccess

A user may need access to the AmazonMWAAReadOnlyAccess permissions policy if they need to view the resources used by an environment on the Amazon MWAA console environment details page. It doesn't allow a user to create new environments, edit existing environments, or allow a user to view the Apache Airflow UI.

```
{
    "Version": "2012-10-17",
    "Statement": [
    {
```

```
"Effect": "Allow",
"Action": [
    "airflow:ListEnvironments",
    "airflow:GetEnvironment",
    "airflow:ListTagsForResource"
],
"Resource": "*"
}
```

Apache Airflow UI access policy: AmazonMWAAWebServerAccess

A user may need access to the AmazonMWAAWebServerAccess permissions policy if they need to access the Apache Airflow UI. It does not allow the user to view environments on the Amazon MWAA console or use the Amazon MWAA APIs to perform any actions. Specify the Admin, Op, User, Viewer or the Public role in {airflow-role} to customize the level of access for the user of the web token. For more information, refer to <u>Default Roles</u> in the *Apache Airflow reference guide*.

JSON

}

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "airflow:CreateWebLoginToken",
            "Resource": [
            "arn:aws:airflow:us-east-1:111122223333:role/{your-environment-
name}/{airflow-role}"
        ]
        }
    ]
}
```

🚯 Note

- Amazon MWAA provides IAM integration with the five <u>default Apache Airflow role-</u> <u>based access control (RBAC) roles</u>. For more information on working with custom Apache Airflow roles, refer to <u>the section called "Tutorial: Restricting users to a subset of DAGs"</u>.
- The Resource field in this policy could be used to specify the Apache Airflow role-based access control roles for the Amazon MWAA environment. However, it does not support the Amazon MWAA environment ARN (Amazon Resource Name) in the Resource field of the policy.

Apache Airflow Rest API access policy: AmazonMWAARestAPIAccess

To access the Apache Airflow REST API, you must grant the airflow: InvokeRestApi permission in your IAM policy. In the following policy sample, specify the Admin, Op, User, Viewer or the Public role in {airflow-role} to customize the level of user access. For more information, refer to <u>Default Roles</u> in the *Apache Airflow reference guide*.

í) Note

- While configuring a private web server, the InvokeRestApi action cannot be invoked from outside of a Virtual Private Cloud (VPC). You can use the aws:SourceVpc key to apply more granular access control for this operation. For more information, refer to aws:SourceVpc
- The Resource field in this policy could be used to specify the Apache Airflow role-based access control roles for the Amazon MWAA environment. However, it does not support the Amazon MWAA environment ARN (Amazon Resource Name) in the Resource field of the policy.

Apache Airflow CLI policy: AmazonMWAAAirflowCliAccess

A user may need access to the AmazonMWAAAirflowCliAccess permissions policy if they need to run Apache Airflow CLI commands (such as trigger_dag). It does not allow the user to view environments on the Amazon MWAA console or use the Amazon MWAA APIs to perform any actions.

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
               "airflow:CreateCliToken"
        ],
        "Resource": "arn:aws:airflow:us-east-1:11122223333:environment/
${EnvironmentName}"
        }
    ]
}
```

Creating a JSON policy

You can create the JSON policy, and attach the policy to your user, role, or group on the IAM console. The following steps describe how to create a JSON policy in IAM.

To create the JSON policy

- 1. Open the <u>Policies page</u> on the IAM console.
- 2. Choose **Create policy**.
- 3. Choose the **JSON** tab.
- 4. Add your JSON policy.
- 5. Choose **Review policy**.
- 6. Enter a value in the text field for Name and Description (optional).

For example, you could name the policy AmazonMWAAReadOnlyAccess.

7. Choose Create policy.

Example use case to attach policies to a developer group

Let's say you're using a group in IAM named AirflowDevelopmentGroup to apply permissions to all of the developers on your Apache Airflow development team. These users need access to the AmazonMWAAFullConsoleAccess, AmazonMWAAAirflowCliAccess, and AmazonMWAAWebServerAccess permission policies. This section describes how to create a group in IAM, create and attach these policies, and associate the group to an IAM user. The steps assume you're using an <u>AWS owned key</u>.

To create the AmazonMWAAFullConsoleAccess policy

- 1. Download the <u>AmazonMWAAFullConsoleAccess access policy</u>.
- 2. Open the <u>Policies page</u> on the IAM console.
- 3. Choose Create policy.
- 4. Choose the **JSON** tab.
- 5. Paste the JSON policy for AmazonMWAAFullConsoleAccess.
- 6. Substitute the following values:
 - a. 123456789012 Your AWS account ID (such as 0123456789)

- b. *{your-kms-id}* The unique identifer for a customer managed key, applicable only if you use a customer managed key for encryption at-rest.
- 7. Choose the **Review policy**.
- 8. Type AmazonMWAAFullConsoleAccess in Name.
- 9. Choose **Create policy**.

To create the AmazonMWAAWebServerAccess policy

- 1. Download the AmazonMWAAWebServerAccess access policy.
- 2. Open the Policies page on the IAM console.
- 3. Choose **Create policy**.
- 4. Choose the **JSON** tab.
- 5. Paste the JSON policy for AmazonMWAAWebServerAccess.
- 6. Substitute the following values:
 - a. *us-east-1* the region of your Amazon MWAA environment (such as us-east-1)
 - b. 123456789012 your AWS account ID (such as 0123456789)
 - c. {your-environment-name} your Amazon MWAA environment name (such as MyAirflowEnvironment)
 - d. {airflow-role} the Admin Apache Airflow Default Role
- 7. Choose **Review policy**.
- 8. Type AmazonMWAAWebServerAccess in Name.
- 9. Choose Create policy.

To create the AmazonMWAAAirflowCliAccess policy

- 1. Download the <u>AmazonMWAAAirflowCliAccess access</u> policy.
- 2. Open the <u>Policies page</u> on the IAM console.
- 3. Choose **Create policy**.
- 4. Choose the **JSON** tab.
- 5. Paste the JSON policy for AmazonMWAAAirflowCliAccess.
- 6. Choose the **Review policy**.

- 7. Type AmazonMWAAAirflowCliAccess in Name.
- 8. Choose **Create policy**.

To create the group

- 1. Open the Groups page on the IAM console.
- 2. Type a name of AirflowDevelopmentGroup.
- 3. Choose Next Step.
- 4. Type AmazonMWAA to filter results in **Filter**.
- 5. Select the three policies you created.
- 6. Choose Next Step.
- 7. Choose Create Group.

To associate to a user

- 1. Open the Users page on the IAM console.
- 2. Choose a user.
- 3. Choose Groups.
- 4. Choose Add user to groups.
- 5. Select the AirflowDevelopmentGroup.
- 6. Choose Add to Groups.

What's next?

- Learn how to generate a token to access the Apache Airflow UI in Accessing Apache Airflow.
- Learn more about creating IAM policies in <u>Creating IAM policies</u>.

Service-linked role for Amazon MWAA

Amazon Managed Workflows for Apache Airflow uses AWS Identity and Access Management (IAM) <u>service-linked roles</u>. A service-linked role is a unique type of IAM role that is linked directly to Amazon MWAA. Service-linked roles are predefined by Amazon MWAA and include all the permissions that the service requires to call other AWS services on your behalf.

A service-linked role makes setting up Amazon MWAA easier because you don't have to manually add the necessary permissions. Amazon MWAA defines the permissions of its service-linked roles, and unless defined otherwise, only Amazon MWAA can assume its roles. The defined permissions include the trust policy and the permissions policy, and that permissions policy cannot be attached to any other IAM entity.

You can delete a service-linked role only after first deleting their related resources. This protects your Amazon MWAA resources because you can't inadvertently remove permission to access the resources.

For information about other services that support service-linked roles, refer to <u>AWS Services That</u> <u>Work with IAM</u> and look for the services that have **Yes** in the **Service-linked roles** column. Choose a **Yes** with a link to view the service-linked role documentation for that service.

Service-linked role permissions for Amazon MWAA

Amazon MWAA uses the service-linked role named AWSServiceRoleForAmazonMWAA – The service-linked role created in your account grants Amazon MWAA access to the following AWS services:

- Amazon CloudWatch Logs (CloudWatch Logs) To create log groups for Apache Airflow logs.
- Amazon CloudWatch (CloudWatch) To publish metrics related to your environment and its underlying components to your account.
- Amazon Elastic Compute Cloud (Amazon EC2) To create the following resources:
 - An Amazon VPC endpoint in your VPC for an AWS-managed Amazon Aurora PostgreSQL database cluster to be used by the Apache Airflow *Scheduler* and *Worker*.
 - An additional Amazon VPC endpoint to enable network access to the *Web server* if you choose the private network option for your Apache Airflow *Web server*.
 - <u>Elastic Network Interfaces (ENIs)</u> in your Amazon VPC to enable network access to AWS resources hosted in your Amazon VPC.

The following trust policy allows the service principal to assume the service-linked role. The service principal for Amazon MWAA is airflow.amazonaws.com as demonstrated by the policy.



```
"Version": "2012-10-17",
"Statement": [
        {
        "Effect": "Allow",
        "Principal": {
            "Service": "airflow.amazonaws.com"
        },
        "Action": "sts:AssumeRole"
        }
    ]
}
```

The role permissions policy named AmazonMWAAServiceRolePolicy allows Amazon MWAA to complete the following actions on the specified resources:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "logs:CreateLogStream",
                "logs:CreateLogGroup",
                "logs:DescribeLogGroups"
            ],
            "Resource": "arn:aws:logs:*:*:log-group:airflow-*:*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "ec2:AttachNetworkInterface",
                "ec2:CreateNetworkInterface",
                "ec2:CreateNetworkInterfacePermission",
                "ec2:DeleteNetworkInterface",
                "ec2:DeleteNetworkInterfacePermission",
                "ec2:DescribeDhcpOptions",
                "ec2:DescribeNetworkInterfaces",
                "ec2:DescribeSecurityGroups",
                "ec2:DescribeSubnets",
```

```
"ec2:DescribeVpcEndpoints",
        "ec2:DescribeVpcs",
        "ec2:DetachNetworkInterface"
    ],
    "Resource": "*"
},
{
    "Effect": "Allow",
    "Action": "ec2:CreateVpcEndpoint",
    "Resource": "arn:aws:ec2:*:*:vpc-endpoint/*",
    "Condition": {
        "ForAnyValue:StringEquals": {
            "aws:TagKeys": "AmazonMWAAManaged"
        }
    }
},
{
    "Effect": "Allow",
    "Action": [
        "ec2:ModifyVpcEndpoint",
        "ec2:DeleteVpcEndpoints"
    ],
    "Resource": "arn:aws:ec2:*:*:vpc-endpoint/*",
    "Condition": {
        "Null": {
            "aws:ResourceTag/AmazonMWAAManaged": false
        }
    }
},
{
    "Effect": "Allow",
    "Action": [
        "ec2:CreateVpcEndpoint",
        "ec2:ModifyVpcEndpoint"
    ],
    "Resource": [
        "arn:aws:ec2:*:*:vpc/*",
        "arn:aws:ec2:*:*:security-group/*",
        "arn:aws:ec2:*:*:subnet/*"
    ]
},
{
    "Effect": "Allow",
    "Action": "ec2:CreateTags",
```

```
"Resource": "arn:aws:ec2:*:*:vpc-endpoint/*",
            "Condition": {
                "StringEquals": {
                     "ec2:CreateAction": "CreateVpcEndpoint"
                },
                "ForAnyValue:StringEquals": {
                     "aws:TagKeys": "AmazonMWAAManaged"
                }
            }
        },
        {
            "Effect": "Allow",
            "Action": "cloudwatch:PutMetricData",
            "Resource": "*",
            "Condition": {
                "StringEquals": {
                     "cloudwatch:namespace": [
                         "AWS/MWAA"
                    ]
                }
            }
        }
    1
}
```

You must configure permissions to allow an IAM entity (such as a user, group, or role) to create, edit, or delete a service-linked role. For more information, refer to <u>Service-linked role permissions</u> in the *IAM User Guide*.

Creating a service-linked role for Amazon MWAA

You don't need to manually create a service-linked role. When you create a new Amazon MWAA environment using the AWS Management Console, the AWS CLI, or the AWS API, Amazon MWAA creates the service-linked role for you.

If you delete this service-linked role, and then need to create it again, you can use the same process to recreate the role in your account. When you create another environment, Amazon MWAA creates the service-linked role for you again.

Editing a service-linked role for Amazon MWAA

Amazon MWAA does not allow you to edit the AWSServiceRoleForAmazonMWAA service-linked role. After you create a service-linked role, you cannot change the name of the role because various entities might reference the role. However, you can edit the description of the role using IAM. For more information, refer to Editing a service-linked role in the *IAM User Guide*.

Deleting a service-linked role for Amazon MWAA

If you no longer need to use a feature or service that requires a service-linked role, we recommend that you delete that role. That way you don't have an unused entity that is not actively monitored or maintained.

When you delete an Amazon MWAA environment, Amazon MWAA deletes all the associated resources it uses as a part of the service. However, you must wait before Amazon MWAA completes deleting your environment, before attempting to delete the service-linked role. If you delete the service-linked role before Amazon MWAA deletes the environment, Amazon MWAA might be unable to delete all of the environment's associated resources.

To manually delete the service-linked role using IAM

Use the IAM console, the AWS CLI, or the AWS API to delete the AWSServiceRoleForAmazonMWAA service-linked role. For more information, refer to <u>Deleting a service-linked role</u> in the *IAM User Guide*.

Supported regions for Amazon MWAA service-linked roles

Amazon MWAA supports using service-linked roles in all of the regions where the service is available. For more information, refer to <u>Amazon Managed Workflows for Apache Airflow</u> endpoints and quotas.

Policy updates

Change	Description	Date
Amazon MWAA update its service-linked role permission policy	AmazonMWAAServiceR olePolicy – Amazon MWAA updates the permissio	November 18, 2022

Change	Description	Date
	n policy for its service-l inked role to grant Amazon MWAA permission to publish additional metrics related to the service's underlyin g resources to customer accounts. These new metrics are published under the AWS/ MWAA	
Amazon MWAA started tracking changes	Amazon MWAA started tracking changes for its AWS managed service-linked role permission policy.	November 18, 2022

Amazon MWAA execution role

An execution role is an AWS Identity and Access Management (IAM) role with a permissions policy that grants Amazon Managed Workflows for Apache Airflow permission to invoke the resources of other AWS services on your behalf. This can include resources such as your Amazon S3 bucket, <u>AWS owned key</u>, and CloudWatch Logs. Amazon MWAA environments need one execution role per environment. This topic describes how to use and configure the execution role for your environment to allow Amazon MWAA to access other AWS resources used by your environment.

Contents

- Execution role overview
 - Permissions attached by default
 - How to add permission to use other AWS services
 - How to associate a new execution role
- Create a new role
- <u>View and update an execution role policy</u>
 - Attach a JSON policy to use other AWS services
- Grant access to Amazon S3 bucket with account-level public access block

- Use Apache Airflow connections
- Sample JSON policies for an execution role
 - Sample policy for a customer managed key
 - Sample policy for an AWS owned key
- What's next?

Execution role overview

Permission for Amazon MWAA to use other AWS services used by your environment are obtained from the execution role. An Amazon MWAA execution role needs permission to the following AWS services used by an environment:

- Amazon CloudWatch (CloudWatch) to send Apache Airflow metrics and logs.
- Amazon Simple Storage Service (Amazon S3) to parse your environment's DAG code and supporting files (such as a requirements.txt).
- Amazon Simple Queue Service (Amazon SQS) to queue your environment's Apache Airflow tasks in an Amazon SQS queue owned by Amazon MWAA.
- AWS Key Management Service (AWS KMS) for your environment's data encryption (using either an <u>AWS owned key</u> or your <u>Customer managed key</u>).

Note

If you have elected for Amazon MWAA to use an AWS owned KMS key to encrypt your data, then you must define permissions in a policy attached to your Amazon MWAA execution role that grant access to arbitrary KMS keys stored outside of your account via Amazon SQS. The following two conditions are required in order for your environment's execution role to access arbitrary KMS keys:

- A KMS key in a third-party account needs to allow this cross account access via its resource policy.
- Your DAG code needs to access an Amazon SQS queue that starts with airflow-celery- in the third-party account and uses the same KMS key for encryption.
 In order to mitigate the risks associated with cross-account access to resources, we recommend reviewing the code placed in your DAGs to ensure that your workflows are not accessing arbitrary Amazon SQS queues outside your account. Furthermore, you can use a customer managed KMS key stored in your own account to manage encryption on

Amazon MWAA. This limits your environment's execution role to access only the KMS key in your account.

Keep in mind that after you choose an encryption option, you cannot change your selection for an existing environment.

An execution role also needs permission to the following IAM actions:

 airflow:PublishMetrics – to allow Amazon MWAA to monitor the health of an environment.

Permissions attached by default

You can use the default options on the Amazon MWAA console to create an execution role and an AWS owned key, then use the steps on this page to add permission policies to your execution role.

- When you choose the **Create new role** option on the console, Amazon MWAA attaches the minimal permissions needed by an environment to your execution role.
- In some cases, Amazon MWAA attaches the maximum permissions. For example, we recommend choosing the option on the Amazon MWAA console to create an execution role when you create an environment. Amazon MWAA adds the permissions policies for all CloudWatch Logs groups automatically by using the regex pattern in the execution role as "arn:aws:logs:yourregion:your-account-id:log-group:airflow-your-environment-name-*".

How to add permission to use other AWS services

Amazon MWAA can't add or edit permission policies to an existing execution role after an environment is created. You must update your execution role with additional permission policies needed by your environment. For example, if your DAG requires access to AWS Glue, Amazon MWAA can't automatically detect these permissions are required by your environment, or add the permissions to your execution role.

You can add permissions to an execution role in two ways:

 By modifying the JSON policy for your execution role inline. You can use the sample <u>JSON policy</u> <u>documents</u> on this page to either add to or replace the JSON policy of your execution role on the IAM console. By creating a JSON policy for an AWS service and attaching it to your execution role. You can
use the steps on this page to associate a new JSON policy document for an AWS service to your
execution role on the IAM console.

Assuming the execution role is already associated to your environment, Amazon MWAA can start using the added permission policies immediately. This also means if you remove any required permissions from an execution role, your DAGs may fail.

How to associate a new execution role

You can change the execution role for your environment at any time. If a new execution role is not already associated with your environment, use the steps on this page to create a new execution role policy, and associate the role to your environment.

Create a new role

By default, Amazon MWAA creates an <u>AWS owned key</u> for data encryption and an execution role on your behalf. You can choose the default options on the Amazon MWAA console when you create an environment. The following image shows the default option to create an execution role for an environment.

Permissions Info	
Execution role The IAM role used by your environment to acce	ss your DAG code, write logs, and perform other actions.
Create a new role	▼ C
Role name	
AmazonMWAA-MyAirflowEnvironment	:-rdfjhHm

<u> Important</u>

When you create a new execution role, do not reuse the name of a deleted execution role. Unique names can help prevent conflicts and ensure proper resource management. You can view the execution role for your environment on the Amazon MWAA console, and update the JSON policy for the role on the IAM console.

To update an execution role policy

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose the execution role on the **Permissions** pane to open the permissions page in IAM.
- 4. Choose the execution role name to open the permissions policy.
- 5. Choose **Edit policy**.
- 6. Choose the **JSON** tab.
- 7. Update your JSON policy.
- 8. Choose **Review policy**.
- 9. Choose Save changes.

Attach a JSON policy to use other AWS services

You can create a JSON policy for an AWS service and attach it to your execution role. For example, you can attach the following JSON policy to grant read-only access to all resources in AWS Secrets Manager.

```
{
    "Version":"2012-10-17",
    "Statement":[
        {
          "Effect":"Allow",
          "Action":[
            "secretsmanager:GetResourcePolicy",
            "secretsmanager:GetSecretValue",
            "secretsmanager:DescribeSecret",
            "secretsmanager:ListSecretVersionIds"
        ],
        "Resource":[
```

"*"]] }

To attach a policy to your execution role

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose your execution role on the **Permissions** pane.
- 4. Choose Attach policies.
- 5. Choose **Create policy**.
- 6. Choose **JSON**.
- 7. Paste the JSON policy.
- 8. Choose Next: Tags, Next: Review.
- 9. Enter a descriptive name (such as SecretsManagerReadPolicy) and a description for the policy.
- 10. Choose **Create policy**.

Grant access to Amazon S3 bucket with account-level public access block

You might want to block access to all buckets in your account by using the <u>PutPublicAccessBlock</u> Amazon S3 operation. When you block access to all buckets in your account, your environment execution role must include the s3:GetAccountPublicAccessBlock action in a permission policy.

The following example demonstrates the policy you must attach to your execution role when blocking access to all Amazon S3 buckets in your account.

```
{
    "Version": "2012-10-17",
```

```
"Statement": [
    {
        "Effect": "Allow",
        "Action": "s3:GetAccountPublicAccessBlock",
        "Resource": "*"
    }
]
}
```

For more information about restricting access to your Amazon S3 buckets, refer to <u>Blocking public</u> access to your Amazon S3 storage in the Amazon Simple Storage Service User Guide.

Use Apache Airflow connections

You can also create an Apache Airflow connection and specify your execution role and its ARN in your Apache Airflow connection object. To learn more, refer to <u>Managing connections to Apache</u> <u>Airflow</u>.

Sample JSON policies for an execution role

The sample permission policies in this section show two policies you can use to replace the permissions policy used for your existing execution role, or to create a new execution role and use for your environment. These policies contain <u>Resource ARN</u> placeholders for Apache Airflow log groups, an Amazon S3 bucket, and an Amazon MWAA environment.

We recommend copying the example policy, replacing the sample ARNs or placeholders, then using the JSON policy to create or update an execution role. For example, replacing {your-region} with us-east-1.

Sample policy for a customer managed key

The following example shows an execution role policy you can use for an Customer managed key.

Next, you need to allow Amazon MWAA to assume this role in order to perform actions on your behalf. This can be done by adding "airflow.amazonaws.com" and "airflow-env.amazonaws.com" service principals to the list of trusted entities for this execution role using the IAM console, or by placing these service principals in the assume role policy document for this execution role via the IAM create-role command using the AWS CLI. A sample assume role policy document can be found below:

JSON

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": {
               "Service": ["airflow.amazonaws.com","airflow-env.amazonaws.com"]
        },
        "Action": "sts:AssumeRole"
        }
   ]
}
```

Then attach the following JSON policy to your <u>Customer managed key</u>. This policy uses the <u>kms:EncryptionContext</u> condition key prefix to permit access to your Apache Airflow logs group in CloudWatch Logs.

```
{
    "Sid": "Allow logs access",
    "Effect": "Allow",
    "Principal": {
        "Service": "logs.{your-region}.amazonaws.com"
    },
    "Action": [
        "kms:Encrypt*",
        "kms:Decrypt*",
        "kms:ReEncrypt*",
        "kms:GenerateDataKey*",
        "kms:Describe*"
    ],
    "Resource": "*",
    "Condition": {
        "ArnLike": {
            "kms:EncryptionContext:aws:logs:arn": "arn:aws:logs:{your-region}:{your-
account-id}:*"
        }
    }
}
```

Sample policy for an AWS owned key

The following example shows an execution role policy you can use for an AWS owned key.

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "airflow:PublishMetrics",
            "Resource": "arn:aws:airflow:us-east-1:111122223333:environment/
{your-environment-name}"
        },
        {
            "Effect": "Deny",
            "Action": "s3:ListAllMyBuckets",
            "Resource": [
        "arn:aws:s3:::amzn-s3-demo-bucket",
        "arn:aws:s3:::amzn-s3-demo-bucket/*"
            1
        },
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetObject*",
                "s3:GetBucket*",
                "s3:List*"
            ],
            "Resource": [
        "arn:aws:s3:::amzn-s3-demo-bucket",
        "arn:aws:s3:::amzn-s3-demo-bucket/*"
            ]
        },
        {
            "Effect": "Allow",
            "Action": [
                "logs:CreateLogStream",
                "logs:CreateLogGroup",
                "logs:PutLogEvents",
                "logs:GetLogEvents",
                "logs:GetLogRecord",
```

```
"logs:GetLogGroupFields",
                "logs:GetQueryResults"
            ],
            "Resource": [
            "arn:aws:logs:us-east-1:111122223333:log-group:airflow-{your-
environment-name}-*"
            ]
        },
        {
            "Effect": "Allow",
            "Action": [
                "logs:DescribeLogGroups"
            ],
            "Resource": [
                "*"
            ]
        },
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetAccountPublicAccessBlock"
            ],
            "Resource": [
                "*"
            1
        },
        {
            "Effect": "Allow",
            "Action": "cloudwatch:PutMetricData",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "sqs:ChangeMessageVisibility",
                "sqs:DeleteMessage",
                "sqs:GetQueueAttributes",
                "sqs:GetQueueUrl",
                "sqs:ReceiveMessage",
                "sqs:SendMessage"
            ],
            "Resource": "arn:aws:sqs:us-east-1:*:airflow-celery-*"
        },
        {
```

```
"Effect": "Allow",
            "Action": [
                 "kms:Decrypt",
                 "kms:DescribeKey",
                 "kms:GenerateDataKey*",
                 "kms:Encrypt"
            ],
            "NotResource": "arn:aws:kms:*:111122223333:key/*",
            "Condition": {
                 "StringLike": {
                     "kms:ViaService": [
                     "sqs.us-east-1.amazonaws.com"
                     1
                }
            }
        }
    1
}
```

What's next?

- Learn about the required permissions you and your Apache Airflow users need to access your environment in Accessing an Amazon MWAA environment.
- Learn about Using customer managed keys for encryption.
- Explore more Customer managed policy examples.

Cross-service confused deputy prevention

The confused deputy problem is a security issue where an entity that doesn't have permission to perform an action can coerce a more-privileged entity to perform the action. In AWS, cross-service impersonation can result in the confused deputy problem. Cross-service impersonation can occur when one service (the *calling service*) calls another service (the *called service*). The calling service can be manipulated to use its permissions to act on another customer's resources in a way it should not otherwise have permission to access. To prevent this, AWS provides tools that help you protect your data for all services with service principals that have been given access to resources in your account.

We recommend using the <u>aws:SourceArn</u> and <u>aws:SourceAccount</u> global condition context keys in your environment' execution role to limit the permissions that Amazon MWAA gives another service to access the resource. Use aws:SourceArn if you want only one resource to be associated with the cross-service access. Use aws:SourceAccount if you want to allow any resource in that account to be associated with the cross-service use.

The most effective way to protect against the confused deputy problem is to use the aws:SourceArn global condition context key with the full ARN of the resource. If you don't know the full ARN of the resource or if you are specifying multiple resources, use the aws:SourceArn global context condition key with wildcard characters (*) for the unknown portions of the ARN. For example, arn:aws:airflow:*:123456789012:environment/*.

The value of aws:SourceArn must be your Amazon MWAA environment ARN, for which you are creating an execution role.

The following example shows how you can use the aws:SourceArn and aws:SourceAccount global condition context keys in your environment's execution role trust policy to prevent the confused deputy problem. You can use the following trust policy when you create a new execution role.

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": {
                "Service": [
                    "airflow.amazonaws.com",
                    "airflow-env.amazonaws.com"
                1
            },
            "Action": "sts:AssumeRole",
            "Condition": {
                "ArnLike": {
                    "aws:SourceArn": "arn:aws:airflow:us-
east-1:123456789012:environment/your-environment-name"
                },
                "StringEquals": {
                    "aws:SourceAccount": "123456789012"
```

Apache Airflow access modes

}

}

The Amazon Managed Workflows for Apache Airflow console contains built-in options to configure private or public routing to the Apache Airflow *web server* on your environment. This guide describes the access modes available for the Apache Airflow *Web server* on your Amazon Managed Workflows for Apache Airflow environment, and the additional resources you'll need to configure in your Amazon VPC if you choose the private network option.

Contents

- Apache Airflow access modes
 - Public network
 - Private network
- <u>Access modes overview</u>
 - Public network access mode
 - Private network access mode
- Setup for private and public access modes
 - Setup for public network
 - Setup for private network
- Accessing the VPC endpoint for your Apache Airflow Web server (private network access)

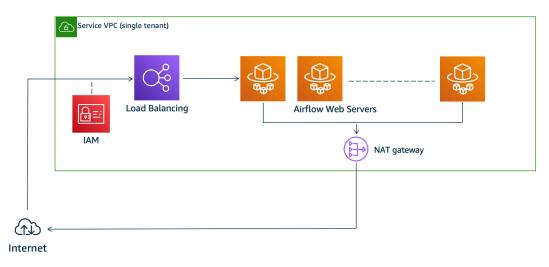
Apache Airflow access modes

You can choose private or public routing for your Apache Airflow *Web server*. To enable private routing, choose **Private network**. This limits user access to an Apache Airflow *Web server* to within an Amazon VPC. To enable public routing, choose **Public network**. This allows users to access the Apache Airflow *Web server* over the Internet.

Public network

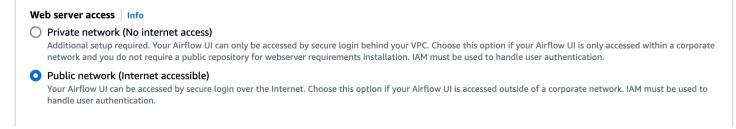
The following architectural diagram shows an Amazon MWAA environment with a public web server.

Public Web Server Option



The public network access mode allows the Apache Airflow UI to be accessed *over the internet* by users granted access to the IAM policy for your environment.

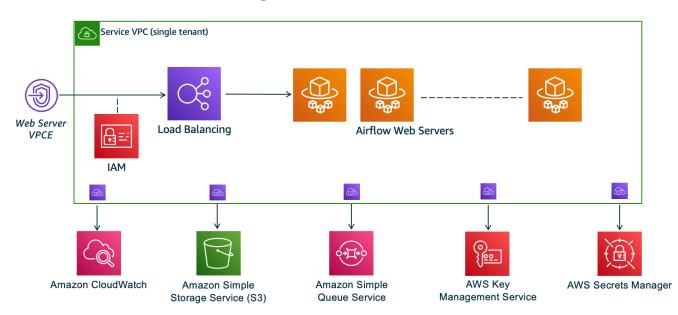
The following image shows where to find the **Public network** option on the Amazon MWAA console.



Private network

The following architectural diagram shows an Amazon MWAA environment with a private web server.

Private Web Server Option



The private network access mode limits access to the Apache Airflow UI to users *within your Amazon VPC* that have been granted access to the <u>IAM policy for your environment</u>.

When you create an environment with private web server access, you must package all of your dependencies in a Python wheel archive (.whl), then reference the .whl in your requirements.txt. For instructions on packaging and installing your dependencies using wheel, refer to Managing dependencies using Python wheel.

The following image shows where to find the **Private network** option on the Amazon MWAA console.

Web server access Info

Private network (No internet access)

Additional setup required. Your Airflow UI can only be accessed by secure login behind your VPC. Choose this option if your Airflow UI is only accessed within a corporate network and you do not require a public repository for webserver requirements installation. IAM must be used to handle user authentication.

Public network (Internet accessible)

Your Airflow UI can be accessed by secure login over the Internet. Choose this option if your Airflow UI is accessed outside of a corporate network. IAM must be used to handle user authentication.

Access modes overview

This section describes the VPC endpoints (AWS PrivateLink) created in your Amazon VPC when you choose the **Public network** or **Private network** access mode.

Public network access mode

If you chose the **Public network** access mode for your Apache Airflow *Web server*, network traffic is publicly routed *over the Internet*.

- Amazon MWAA creates a VPC interface endpoint for your Amazon Aurora PostgreSQL metadata database. The endpoint is created in the Availability Zones mapped to your private subnets and is independent from other AWS accounts.
- Amazon MWAA then binds an IP address from your private subnets to the interface endpoints. This is designed to support the best practice of binding a single IP from each Availability Zone of the Amazon VPC.

Private network access mode

If you chose the **Private network** access mode for your Apache Airflow *Web server*, network traffic is privately routed *within your Amazon VPC*.

- Amazon MWAA creates a VPC interface endpoint for your Apache Airflow Web server, and an interface endpoint for your Amazon Aurora PostgreSQL metadata database. The endpoints are created in the Availability Zones mapped to your private subnets and is independent from other AWS accounts.
- Amazon MWAA then binds an IP address from your private subnets to the interface endpoints. This is designed to support the best practice of binding a single IP from each Availability Zone of the Amazon VPC.

To learn more, refer to the section called "Example use cases for an Amazon VPC and Apache Airflow access mode".

Setup for private and public access modes

The following section describes the additional setup and configurations you'll need based on the Apache Airflow access mode you've chosen for your environment.

Setup for public network

If you choose the **Public network** option for your Apache Airflow *Web server*, you can begin using the Apache Airflow UI after you create your environment.

You'll need to take the following steps to configure access for your users, and permission for your environment to use other AWS services.

 Add permissions. Amazon MWAA needs permission to use other AWS services. When you create an environment, Amazon MWAA creates a <u>service-linked role</u> that allows it to use certain IAM actions for Amazon Elastic Container Registry (Amazon ECR), CloudWatch Logs, and Amazon EC2.

You can add permission to use additional actions for these services, or to use other AWS services by adding permissions to your execution role. To learn more, refer to <u>Amazon MWAA</u> execution role.

 Create user policies. You may need to create multiple IAM policies for your users to configure access to your environment and Apache Airflow UI. To learn more, refer to <u>Accessing an</u> <u>Amazon MWAA environment</u>.

Setup for private network

If you choose the **Private network** option for your Apache Airflow *Web server*, you'll need to configure access for your users, permission for your environment to use other AWS services, and create a mechanism to access the resources in your Amazon VPC from your computer.

1. **Add permissions**. Amazon MWAA needs permission to use other AWS services. When you create an environment, Amazon MWAA creates a <u>service-linked role</u> that allows it to use certain IAM actions for Amazon Elastic Container Registry (Amazon ECR), CloudWatch Logs, and Amazon EC2.

You can add permission to use additional actions for these services, or to use other AWS services by adding permissions to your execution role. To learn more, refer to <u>Amazon MWAA</u> execution role.

- Create user policies. You may need to create multiple IAM policies for your users to configure access to your environment and Apache Airflow UI. To learn more, refer to <u>Accessing an</u> Amazon MWAA environment.
- 3. **Enable network access**. You'll need to create a mechanism in your Amazon VPC to connect to the VPC endpoint (AWS PrivateLink) for your Apache Airflow *Web server*. For example, by creating a VPN tunnel from your computer using an AWS Client VPN.

Accessing the VPC endpoint for your Apache Airflow Web server (private network access)

If you've chosen the **Private network** option, you'll need to create a mechanism in your Amazon VPC to access the VPC endpoint (AWS PrivateLink) for your Apache Airflow *Web server*. We recommend using the same Amazon VPC, VPC security group, and private subnets as your Amazon MWAA environment for these resources.

To learn more, refer to Managing access for VPC endpoints.

Accessing Apache Airflow

Amazon MWAA let's you access your Apache Airflow environment using multiple methods: the Apache Airflow user interface (UI) console, the Apache Airflow CLI, and the Apache Airflow REST API. You can use the Amazon MWAA console to view and invoke a DAG in your Apache Airflow UI, or use Amazon MWAA APIs to get a token and invoke a DAG. This section describes the permissions needed to access the Apache Airflow UI, how to generate a token to make Amazon MWAA API calls directly in your command shell, and the supported commands in the Apache Airflow CLI.

Topics

- Prerequisites
- Open the Apache Airflow UI
- Logging into Apache Airflow
- <u>Create a Apache Airflow web server access token</u>
- Setting up a custom domain for the Apache Airflow web server
- <u>Creating an Apache Airflow CLI token</u>
- Using the Apache Airflow REST API
- <u>Apache Airflow CLI command reference</u>

Prerequisites

The following section describes the preliminary steps required to use the commands and scripts in this section.

Access

- AWS account access in AWS Identity and Access Management (IAM) to the Amazon MWAA permissions policy in Apache Airflow UI access policy: AmazonMWAAWebServerAccess.
- AWS account access in AWS Identity and Access Management (IAM) to the Amazon MWAA permissions policy Full API and console access policy: AmazonMWAAFullApiAccess.

AWS CLI

The AWS Command Line Interface (AWS CLI) is an open source tool that enables you to interact with AWS services using commands in your command-line shell. To complete the steps on this page, you need the following:

- AWS CLI Install version 2.
- AWS CLI Quick configuration with aws configure.

Open the Apache Airflow UI

The following image shows the link to your Apache Airflow UI on the Amazon MWAA console.

Environments (2)		C Edit De	lete Actions v Create environme	nt
Q Find environments			< 1 >	۲
Name V Status	▽ Created date	▼ Airflow version		▽
O MyAirflowEnvironment O Available	Jan 28, 2021 09:49:06 (UT	TC-07:00) 1.10.12	Open Airflow UI 🔀	

Logging into Apache Airflow

You need <u>Apache Airflow UI access policy: AmazonMWAAWebServerAccess</u> permissions for your AWS account in AWS Identity and Access Management (IAM) to view your Apache Airflow UI.

To access your Apache Airflow UI

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose Open Airflow UI.

Create a Apache Airflow web server access token

You can use the commands on this page to create a web server access token. An access token allows you access to your Amazon MWAA environment. For example, you can get a token, then deploy DAGs programmatically using Amazon MWAA APIs. The following section includes the steps to create an Apache Airflow web login token using the AWS CLI, a bash script, a POST API request, or a Python script. The token returned in the response is valid for 60 seconds.

Effective August 19, 2025, Amazon MWAA added support for IPv6 endpoints, and now supports IPv4 and IPv6 endpoints. As of this date, all newly created environments will use .on.aws domains for the Airflow user interface (UI). Customers must migrate their Airflow UI from .amazonaws.com to .on.aws domains for these newly created environments. Virtual Private Cloud (VPC) endpoint services for webserver and database will maintain their current .amazonaws.com domains with no required changes.

Contents

- Prerequisites
 - <u>Access</u>
 - AWS CLI
- Using the AWS CLI
- Using a bash script
- Using a Python script
- What's next?

Prerequisites

The following section describes the preliminary steps required to use the commands and scripts on this page.

Access

- AWS account access in AWS Identity and Access Management (IAM) to the Amazon MWAA permissions policy in <u>Apache Airflow UI access policy: AmazonMWAAWebServerAccess</u>.
- AWS account access in AWS Identity and Access Management (IAM) to the Amazon MWAA permissions policy <u>Full API and console access policy: AmazonMWAAFullApiAccess</u>.

AWS CLI

The AWS Command Line Interface (AWS CLI) is an open source tool that enables you to interact with AWS services using commands in your command-line shell. To complete the steps on this page, you need the following:

- AWS CLI Install version 2.
- AWS CLI Quick configuration with aws configure.

Using the AWS CLI

The following example uses the <u>create-web-login-token</u> command in the AWS CLI to create an Apache Airflow web login token.

```
aws mwaa create-web-login-token --name YOUR_ENVIRONMENT_NAME
```

Using a bash script

The following example uses a bash script to call the <u>create-web-login-token</u> command in the AWS CLI to create an Apache Airflow web login token.

1. Copy the contents of the following code sample and save locally as get-web-token.sh.

```
#!/bin/bash
HOST=YOUR_HOST_NAME
YOUR_URL=https://$HOST/aws_mwaa/aws-console-sso?login=true#
WEB_TOKEN=$(aws mwaa create-web-login-token --name YOUR_ENVIRONMENT_NAME --query
WebToken --output text)
echo $YOUR_URL$WEB_TOKEN
```

 Substitute the placeholders in *red* for YOUR_HOST_NAME and YOUR_ENVIRONMENT_NAME. For example, a host name for a public network may look like this (without the *https://)*:

```
123456a0-0101-2020-9e11-1b159eec9000.c2.us-east-1.airflow.amazonaws.com
```

3. (optional) macOS and Linux users may need to run the following command to ensure the script is executable.

```
chmod +x get-web-token.sh
```

4. Run the following script to get a web login token.

```
./get-web-token.sh
```

5. You should see the following in your command prompt:

```
https://123456a0-0101-2020-9e11-1b159eec9000.c2.us-east-1.airflow.amazonaws.com/
aws_mwaa/aws-console-sso?login=true#{your-web-login-token}
```

Using a Python script

The following example uses the <u>boto3 create_web_login_token</u> method in a Python script to create an Apache Airflow web login token. You can run this script outside of Amazon MWAA. The only thing you need to do is install the boto3 library. You may want to create a virtual environment to install the library. It assumes you have configured AWS authentication credentials for your account.

 Copy the contents of the following code sample and save locally as create-web-logintoken.py.

```
import boto3
mwaa = boto3.client('mwaa')
response = mwaa.create_web_login_token(
    Name="YOUR_ENVIRONMENT_NAME"
)
webServerHostName = response["WebServerHostname"]
webToken = response["WebToken"]
airflowUIUrl = 'https://{0}/aws_mwaa/aws-console-sso?
login=true#{1}'.format(webServerHostName, webToken)
print("Here is your Airflow UI URL: ")
print(airflowUIUrl)
```

- 2. Substitute the placeholder in *red* for YOUR_ENVIRONMENT_NAME.
- 3. Run the following script to get a web login token.

python3 create-web-login-token.py

What's next?

• Explore the Amazon MWAA API operation used to create a web login token at CreateWebLoginToken.

Setting up a custom domain for the Apache Airflow web server

Amazon Managed Workflows for Apache Airflow (Amazon MWAA) lets you to set up a custom domain for the managed Apache Airflow web server. Using a custom domain, you can access your environment's Amazon MWAA managed Apache Airflow web server using the Apache Airflow UI, the Apache Airflow CLI, or the Apache Airflow web server.

i Note

You can only use custom domain with a private web server without internet access.

Use cases for a custom domain on Amazon MWAA

- 1. Share the web server domain across your cloud application on AWS Using a custom domain lets you define a user-friendly URL for accessing the web server, instead of the generated service domain name. You can store this custom domain and share it as an environment variable in your applications.
- 2. Access a private web server If you want to configure access for a web server in a VPC with no internet access, using a custom domain simplifies the URL redirection work flow.

Topics

- Configure the custom domain
- Set up the networking infrastructure

Configure the custom domain

To configure the custom domain feature, you need to provide the custom domain value via the webserver.base_url Apache Airflow configuration when creating or updating your Amazon MWAA environment. The following constraints apply to your custom domain name:

- The value should be a fully qualified domain name (FQDN) without any protocol or path. For example, your-custom-domain.com.
- Amazon MWAA does not allow a path in the URL. For example, your-custom-domain.com/ dags/ is not a valid custom domain name.
- The URL length is limited to 255 ASCII characters.
- If you provide an empty string, by default, the environment will be created with a web server URL generated by Amazon MWAA.

The following example shows using the AWS CLI to create an environment with a custom web server domain name.

```
$ aws mwaa create-environment \
    --name my-mwaa-env \
    --source-bucket-arn arn:aws:s3:::amzn-s3-demo-bucket \
    --airflow-configuration-options '{"webserver.base_url":"my-custom-domain.com"}' \
    --network-configuration '{"SubnetIds":["subnet-0123456789abcdef","subnet-
fedcba9876543210"]}' \
    --execution-role-arn arn:aws:iam::123456789012:role/my-execution-role
```

After the environment is created or updated, you need to set up the networking infrastructure in your AWS account to access the private web server via the custom domain.

To revert back to the default service-generated URL, update your private environment and remove the webserver.base_url configuration option.

Set up the networking infrastructure

Use the following steps to set up the required networking infrastructure to use with your custom domain in your AWS account.

1. Get the IP addresses for the Amazon VPC Endpoint Network Interfaces (ENI). To do this, first, use <u>get-environment</u> to find the WebserverVpcEndpointService for your environment.

```
$ aws mwaa get-environment --name your-environment-name
```

If successful, you'll see output similar to the following.

```
"Environment": {
    "AirflowConfigurationOptions": {},
    "AirflowVersion": "latest-version",
    "Arn": "environment-arn",
    "CreatedAt": "2024-06-01T01:00:00-00:00",
    "DagS3Path": "dags",
    .
    .
    "WebserverVpcEndpointService": "web-server-vpc-endpoint-service",
    "WeeklyMaintenanceWindowStart": "TUE:21:30"
}
```

Note the WebserverVpcEndpointService value and use it for web-server-vpcendpoint-service in the following Amazon EC2 describe-vpc-endpoints command. -filters Name=service-name, Values=web-server-vpc-endpoint-service-id in the following command.

2. Retrieve the Amazon VPC endpoint details. This command fetches details about Amazon VPC endpoints that match a specific service name, returning the endpoint ID and associated network interface IDs in a text format.

```
$ aws ec2 describe-vpc-endpoints \
    --filters Name=service-name,Values=web-server-vpc-endpoint-service \
    --query 'VpcEndpoints[*].
{EndpointId:VpcEndpointId,NetworkInterfaceIds:NetworkInterfaceIds}' \
    --output text
```

3. Get the network interface details. This command retrieves private IP addresses for each network interface associated with the Amazon VPC endpoints identified in the previous step.

```
$ for eni_id in $(
    aws ec2 describe-vpc-endpoints \
    --filters Name=service-name,Values=service-id \
    --query 'VpcEndpoints[*].NetworkInterfaceIds' \
    --output text
); do
    aws ec2 describe-network-interfaces \
    --network-interface-ids $eni_id \
    --query 'NetworkInterfaces[*].PrivateIpAddresses[*].PrivateIpAddress' \
    --output text
```

done

4. Use create-target-group to create a new target group. You will use this target group to register the IP addresses for your web server Amazon VPC endpoints.

```
$ aws elbv2 create-target-group \
    --name new-target-group-namne \
    --protocol HTTPS \
    --port 443 \
    --vpc-id web-server-vpc-id \
    --target-type ip \
    --health-check-protocol HTTPS \
    --health-check-port 443 \
    --health-check-path / \
    --health-check-enabled \
    --matcher 'HttpCode="200,302"'
```

Register the IP addresses using the register-targets command.

```
$ aws elbv2 register-targets \
    --target-group-arn target-group-arn \
    --targets Id=ip-address-1 Id=ip-address-2
```

5. Request an ACM certificate. Skip this step if you are using an existing certificate.

```
$ aws acm request-certificate \
    --domain-name my-custom-domain.com \
    --validation-method DNS
```

6. Configure an Application Load Balancer. First, create the load balancer, then create a listener for the load balancer. Specify the ACM certificate you created in the previous step.

```
$ aws elbv2 create-load-balancer \
    --name my-mwaa-lb \
    --type application \
    --subnets subnet-id-1 subnet-id-2
```

```
$ aws elbv2 create-listener \
    --load-balancer-arn load-balancer-arn \
    --protocol HTTPS \
    --port 443 \
```

--ssl-policy ELBSecurityPolicy-2016-08 \

```
--certificates CertificateArn=acm-certificate-arn \
```

```
--default-actions Type=forward, TargetGroupArn=target-group-arn
```

If you use a Network Load Balancer in a private subnet, set up a <u>bastion host</u> or <u>AWS VPN tunnel</u> to access the web server.

7. Create a hosted zone using Route 53 for the domain.

```
$ aws route53 create-hosted-zone --name my-custom-domain.com \
     --caller-reference 1
```

Create an A record for the domain. To do this using the AWS CLI, get the hosted zone ID using list-hosted-zones-by-name then apply the record with change-resource-record-sets.

```
$ HOSTED_ZONE_ID=$(aws route53 list-hosted-zones-by-name \
         --dns-name my-custom-domain.com \
         --query 'HostedZones[0].Id' --output text)
```

```
$ aws route53 change-resource-record-sets \
    --hosted-zone-id $HOSTED_ZONE_ID \
    --change-batch '{
        "Changes": [
            {
                "Action": "CREATE",
                "ResourceRecordSet": {
                    "Name": "my-custom-domain.com",
                    "Type": "A",
                    "AliasTarget": {
                        "HostedZoneId": "load-balancer-hosted-zone-id>",
                        "DNSName": "load-balancer-dns-name",
                        "EvaluateTargetHealth": true
                    }
                }
            }
        ]
    }'
```

8. Update the security group rules for the web server Amazon VPC endpoint to follow the principle of least privilege by allowing HTTPS traffic only from the public subnets where the Application

User Guide

Load Balancer is located. Save the following JSON locally. For example, as sg-ingress-ip-permissions.json.

```
Ε
{
  "IpProtocol": "tcp",
  "FromPort": 443,
  "ToPort": 443,
  "UserIdGroupPairs": [
    {
      "GroupId": "load-balancer-security-group-id"
    }
  ],
  "IpRanges": [
    {
      "CidrIp": "public-subnet-1-cidr"
    },
    {
      "CidrIp": "public-subnet-2-cidr"
    }
  ]
}
]
```

Run the following Amazon EC2 command to update your ingress security group rules. Specify the JSON file for --ip-permissions.

```
$ aws ec2 authorize-security-group-ingress \
    --group-id <security-group-id> \
    --ip-permissions file://sg-ingress-ip-permissions.json
```

Run the following Amazon EC2 command to update your egress rules.

```
$ aws ec2 authorize-security-group-egress \
    --group-id webserver-vpc-endpoint-security-group-id \
    --protocol tcp \
    --port 443 \
    --source-group load-balancer-security-group-id
```

Open the Amazon MWAA console and navigate to the Apache Airflow UI. If you are setting up an Network Load Balancer in a private subnet instead of the Application Load Balancer used here, you must access the web server with one of the following options.

- the section called "Tutorial: Linux Bastion Host"
- the section called "Tutorial: AWS Client VPN"

Creating an Apache Airflow CLI token

🚯 Tip

REST API is more modern than the CLI and is designed for programmatic integration with external systems. REST is the preferred way of interacting with Apache Airflow.

You can use the commands on this page to generate a CLI token, and then make Amazon Managed Workflows for Apache Airflow API calls directly in your command shell. For example, you can get a token, then deploy DAGs programmatically using Amazon MWAA APIs. The following section includes the steps to create an Apache Airflow CLI token using the AWS CLI, a curl script, a Python script, or a bash script. The token returned in the response is valid for 60 seconds.

The AWS CLI token is intended as a replacement for synchronous shell actions, not asynchronous API commands. As such, available concurrency is limited. To ensure that the web server remains responsive for users, it is recommended not to open a new AWS CLI request until the previous one completes successfully.

Contents

- Prerequisites
 - <u>Access</u>
 - AWS CLI
- Using the AWS CLI
- Using a curl script
- Using a bash script
- Using a Python script
- What's next?

The following section describes the preliminary steps required to use the commands and scripts on this page.

Access

- AWS account access in AWS Identity and Access Management (IAM) to the Amazon MWAA permissions policy in <u>Apache Airflow UI access policy: AmazonMWAAWebServerAccess</u>.
- AWS account access in AWS Identity and Access Management (IAM) to the Amazon MWAA permissions policy <u>Full API and console access policy: AmazonMWAAFullApiAccess</u>.

AWS CLI

The AWS Command Line Interface (AWS CLI) is an open source tool that enables you to interact with AWS services using commands in your command-line shell. To complete the steps on this page, you need the following:

- AWS CLI Install version 2.
- AWS CLI Quick configuration with aws configure.

Using the AWS CLI

The following example uses the <u>create-cli-token</u> command in the AWS CLI to create an Apache Airflow CLI token.

```
aws mwaa create-cli-token --name YOUR_ENVIRONMENT_NAME
```

Using a curl script

The following example uses a curl script to call the <u>create-web-login-token</u> command in the AWS CLI to invoke the Apache Airflow CLI via an endpoint on the Apache Airflow web server.

Apache Airflow v2

1. Copy the curl statement from your text file and paste it in your command shell.

🚯 Note

After copying it to your clipboard, you may need to use **Edit > Paste** from your shell menu.

```
CLI_JSON=$(aws mwaa --region us-east-1 create-cli-token --
name YOUR_ENVIRONMENT_NAME) \
  && CLI_TOKEN=$(echo $CLI_JSON | jq -r '.CliToken') \
  && WEB_SERVER_HOSTNAME=$(echo $CLI_JSON | jq -r '.WebServerHostname') \
  && CLI_RESULTS=$(curl --request POST "https://$WEB_SERVER_HOSTNAME/aws_mwaa/
  cli" \
    --header "Authorization: Bearer $CLI_TOKEN" \
    --header "Content-Type: text/plain" \
    --data-raw "dags trigger YOUR_DAG_NAME") \
  && echo "Output:" \
  && echo $CLI_RESULTS | jq -r '.stdout' | base64 --decode \
  && echo $CLI_RESULTS | jq -r '.stderr' | base64 --decode
```

 Substitute the placeholders for YOUR_REGION with the AWS region for your environment, YOUR_DAG_NAME, and YOUR_ENVIRONMENT_NAME. For example, a host name for a public network may look like this (without the *https://*):

123456a0-0101-2020-9e11-1b159eec9000.c2.us-east-1.airflow.amazonaws.com (or 123456a0-0101-2020-9e11-1b159eec9000.c2.us-east-1.airflow.on.aws)

3. You should see the following in your command prompt:

```
{
  "stderr":"<STDERR of the CLI execution (if any), base64 encoded>",
  "stdout":"<STDOUT of the CLI execution, base64 encoded>"
}
```

Apache Airflow v1

1. Copy the cURL statement from your text file and paste it in your command shell.

🚯 Note

After copying it to your clipboard, you may need to use **Edit > Paste** from your shell menu.

```
CLI_JSON=$(aws mwaa --region us-east-1 create-cli-token --
name YOUR_ENVIRONMENT_NAME) \
  && CLI_TOKEN=$(echo $CLI_JSON | jq -r '.CliToken') \
  && WEB_SERVER_HOSTNAME=$(echo $CLI_JSON | jq -r '.WebServerHostname') \
  && CLI_RESULTS=$(curl --request POST "https://$WEB_SERVER_HOSTNAME/aws_mwaa/
  cli" \
    --header "Authorization: Bearer $CLI_TOKEN" \
    --header "Content-Type: text/plain" \
    --data-raw "trigger_dag YOUR_DAG_NAME") \
  && echo *CLI_RESULTS | jq -r '.stdout' | base64 --decode \
  && echo *CLI_RESULTS | jq -r '.stderr' | base64 --decode
```

 Substitute the placeholders for YOUR_REGION with the AWS region for your environment, YOUR_DAG_NAME, and YOUR_HOST_NAME. For example, a host name for a public network may look like this (without the *https://*):

123456a0-0101-2020-9e11-1b159eec9000.c2.us-east-1.airflow.amazonaws.com
 (or 123456a0-0101-2020-9e11-1b159eec9000.c2.us-east-1.airflow.on.aws)

3. You should see the following in your command prompt:

```
{
  "stderr":"<STDERR of the CLI execution (if any), base64 encoded>",
  "stdout":"<STDOUT of the CLI execution, base64 encoded>"
}
```

4. Substitute the placeholders for YOUR_ENVIRONMENT_NAME and YOUR_DAG_NAME.

Using a bash script

The following example uses a bash script to call the <u>create-cli-token</u> command in the AWS CLI to create an Apache Airflow CLI token.

Apache Airflow v2

1. Copy the contents of the following code sample and save locally as get-cli-token.sh.

```
# brew install jq
aws mwaa create-cli-token --name YOUR_ENVIRONMENT_NAME | export CLI_TOKEN=$(jq
-r .CliToken) && curl --request POST "https://YOUR_HOST_NAME/aws_mwaa/cli" \
--header "Authorization: Bearer $CLI_TOKEN" \
--header "Content-Type: text/plain" \
--data-raw "dags trigger YOUR_DAG_NAME"
```

 Substitute the placeholders for YOUR_ENVIRONMENT_NAME, YOUR_HOST_NAME, and YOUR_DAG_NAME. For example, a host name for a public network may look like this (without the *https://*):

```
123456a0-0101-2020-9e11-1b159eec9000.c2.us-east-1.airflow.amazonaws.com
(or 123456a0-0101-2020-9e11-1b159eec9000.c2.us-east-1.airflow.on.aws)
```

3. (optional) macOS and Linux users may need to run the following command to ensure the script is executable.

chmod +x get-cli-token.sh

4. Run the following script to create an Apache Airflow CLI token.

./get-cli-token.sh

Apache Airflow v1

1. Copy the contents of the following code sample and save locally as get-cli-token.sh.

```
# brew install jq
aws mwaa create-cli-token --name YOUR_ENVIRONMENT_NAME | export CLI_TOKEN=$(jq
-r .CliToken) && curl --request POST "https://YOUR_HOST_NAME/aws_mwaa/cli" \
--header "Authorization: Bearer $CLI_TOKEN" \
```

```
--header "Content-Type: text/plain" \
--data-raw "trigger_dag YOUR_DAG_NAME"
```

 Substitute the placeholders in *red* for YOUR_ENVIRONMENT_NAME, YOUR_HOST_NAME, and YOUR_DAG_NAME. For example, a host name for a public network may look like this (without the *https://*):

```
123456a0-0101-2020-9e11-1b159eec9000.c2.us-east-1.airflow.amazonaws.com
(or 123456a0-0101-2020-9e11-1b159eec9000.c2.us-east-1.airflow.on.aws)
```

3. (optional) macOS and Linux users may need to run the following command to ensure the script is executable.

chmod +x get-cli-token.sh

4. Run the following script to create an Apache Airflow CLI token.

./get-cli-token.sh

Using a Python script

The following example uses the <u>boto3 create_cli_token</u> method in a Python script to create an Apache Airflow CLI token and trigger a DAG. You can run this script outside of Amazon MWAA. The only thing you need to do is install the boto3 library. You may want to create a virtual environment to install the library. It assumes you have <u>configured AWS authentication credentials</u> for your account.

Apache Airflow v2

 Copy the contents of the following code sample and save locally as create-clitoken.py.

```
"""
Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
Permission is hereby granted, free of charge, to any person obtaining a copy of
this software and associated documentation files (the "Software"), to deal in
the Software without restriction, including without limitation the rights to
use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of
the Software, and to permit persons to whom the Software is furnished to do so.
```

```
THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR
IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS
FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR
COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER
IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
.....
import boto3
import json
import requests
import base64
mwaa_env_name = 'YOUR_ENVIRONMENT_NAME'
dag_name = 'YOUR_DAG_NAME'
mwaa_cli_command = 'dags trigger'
client = boto3.client('mwaa')
mwaa_cli_token = client.create_cli_token(
    Name=mwaa_env_name
)
mwaa_auth_token = 'Bearer ' + mwaa_cli_token['CliToken']
mwaa_webserver_hostname = 'https://{0}/aws_mwaa/
cli'.format(mwaa_cli_token['WebServerHostname'])
raw_data = '{0} {1}'.format(mwaa_cli_command, dag_name)
mwaa_response = requests.post(
        mwaa_webserver_hostname,
        headers={
            'Authorization': mwaa_auth_token,
            'Content-Type': 'text/plain'
            },
        data=raw_data
        )
mwaa_std_err_message = base64.b64decode(mwaa_response.json()
['stderr']).decode('utf8')
mwaa_std_out_message = base64.b64decode(mwaa_response.json()
['stdout']).decode('utf8')
print(mwaa_response.status_code)
print(mwaa_std_err_message)
```

print(mwaa_std_out_message)

- 2. Substitute the placeholders for YOUR_ENVIRONMENT_NAME and YOUR_DAG_NAME.
- 3. Run the following script to create an Apache Airflow CLI token.

```
python3 create-cli-token.py
```

Apache Airflow v1

 Copy the contents of the following code sample and save locally as create-clitoken.py.

```
import boto3
import json
import requests
import base64
mwaa_env_name = 'YOUR_ENVIRONMENT_NAME'
dag_name = 'YOUR_DAG_NAME'
mwaa_cli_command = 'trigger_dag'
client = boto3.client('mwaa')
mwaa_cli_token = client.create_cli_token(
    Name=mwaa_env_name
)
mwaa_auth_token = 'Bearer ' + mwaa_cli_token['CliToken']
mwaa_webserver_hostname = 'https://{0}/aws_mwaa/
cli'.format(mwaa_cli_token['WebServerHostname'])
raw_data = '{0} {1}'.format(mwaa_cli_command, dag_name)
mwaa_response = requests.post(
        mwaa_webserver_hostname,
        headers={
            'Authorization': mwaa_auth_token,
            'Content-Type': 'text/plain'
            },
        data=raw_data
        )
```

```
mwaa_std_err_message = base64.b64decode(mwaa_response.json()
['stderr']).decode('utf8')
mwaa_std_out_message = base64.b64decode(mwaa_response.json()
['stdout']).decode('utf8')
print(mwaa_response.status_code)
print(mwaa_std_err_message)
print(mwaa_std_out_message)
```

- 2. Substitute the placeholders for YOUR_ENVIRONMENT_NAME and YOUR_DAG_NAME.
- 3. Run the following script to create an Apache Airflow CLI token.

python3 create-cli-token.py

What's next?

Explore the Amazon MWAA API operation used to create a CLI token at CreateCliToken.

Using the Apache Airflow REST API

Amazon Managed Workflows for Apache Airflow (Amazon MWAA) supports interacting with your Apache Airflow environments directly using the Apache Airflow REST API for environments running Apache Airflow v2.4.3 and above. This lets you access and manage your Amazon MWAA environments programmatically, providing a standardized way to invoke data orchestration workflows, manage your DAGs, and monitor the status of various Apache Airflow components such as the metadata database, triggerer, and scheduler.

In order to support scalability while using the Apache Airflow REST API, Amazon MWAA provides you with the option to horizontally scale web server capacity to handle increased demand, whether from REST API requests, command line interface (CLI) usage, or more concurrent Apache Airflow user interface (UI) users. For more information on how Amazon MWAA scales web servers, refer to the section called "Configuring web server auto scaling".

You can use the Apache Airflow REST API to implement the following use-cases for your environments:

- **Programmatic access** You can now start Apache Airflow DAG runs, manage datasets, and retrieve the status of various components such as the metadata database, triggerers, and schedulers without relying on the Apache Airflow UI or CLI.
- Integrate with external applications and microservices REST API support allows you to build custom solutions that integrate your Amazon MWAA environments with other systems. For example, you can start workflows in response to events from external systems, such as completed database jobs or new user sign-ups.
- Centralized monitoring You can build monitoring dashboards that aggregate the status of your DAGs across multiple Amazon MWAA environments, enabling centralized monitoring and management.

For more information about the Apache Airflow REST API, refer to <u>The Apache Airflow REST API</u> <u>Reference</u>.

By using InvokeRestApi, you can access the Apache Airflow REST API using AWS credentials. Alternatively, you can also access it by obtaining a web server access token and then using the token to call it.

- If you encounter an error with the message "Update your environment to use InvokeRestApi" while using the InvokeRestApi operation, it indicates that you need to update your Amazon MWAA environment. This error occurs when your Amazon MWAA environment is not compatible with the latest changes related to the InvokeRestApi feature. To resolve this issue, update your Amazon MWAA environment to incorporate the necessary changes for the InvokeRestApi feature.
- The InvokeRestApi operation has a default timeout duration of 10 seconds. If the operation does not complete within this 10-second timeframe, it will be automatically terminated, and an error will be raised. Ensure that your REST API calls are designed to complete within this timeout period to avoid encountering errors.

<u> Important</u>

The response payload size cannot exceed 6 MB. Your RestApi fails if this limit is exceeded.

The following examples show how you to make API calls to the Apache Airflow REST API and start a new DAG run:

Topics

- Granting access to the Apache Airflow REST API: airflow:InvokeRestApi
- Calling the Apache Airflow REST API
- Creating a web server session token and calling the Apache Airflow REST API

Granting access to the Apache Airflow REST API: airflow:InvokeRestApi

To access the Apache Airflow REST API using AWS credential, you must grant the airflow:InvokeRestApi permission in your IAM policy. In the following policy sample, specify the Admin, Op, User, Viewer or the Public role in {airflow-role} to customize the level of user access. For more information, refer to <u>Default Roles</u> in the *Apache Airflow reference guide*.

JSON

🚯 Note

While configuring a private web server, the InvokeRestApi action cannot be invoked from outside of a Virtual Private Cloud (VPC). You can use the aws:SourceVpc key to apply more granular access control for this operation. For more information, refer to <u>aws:SourceVpc</u>.

Calling the Apache Airflow REST API

The following sample script covers how to use the Apache Airflow REST API to list the available DAGs in your environment and how to create an Apache Airflow variable:

```
import boto3
env_name = "MyAirflowEnvironment"
def list_dags(client):
    request_params = {
        "Name": env_name,
        "Path": "/dags",
        "Method": "GET",
        "QueryParameters": {
            "paused": False
        }
    }
    response = client.invoke_rest_api(
        **request_params
    )
    print("Airflow REST API response: ", response['RestApiResponse'])
def create_variable(client):
    request_params = {
        "Name": env_name,
        "Path": "/variables",
        "Method": "POST",
        "Body": {
            "key": "test-restapi-key",
            "value": "test-restapi-value",
            "description": "Test variable created by MWAA InvokeRestApi API",
        }
    }
    response = client.invoke_rest_api(
        **request_params
    )
    print("Airflow REST API response: ", response['RestApiResponse'])
if __name__ == "__main__":
```

```
client = boto3.client("mwaa")
list_dags(client)
create_variable(client)
```

Creating a web server session token and calling the Apache Airflow REST API

To create a web server access token, use the following Python function. This function first calls the Amazon MWAA API to obtain a web login token. The web login token, which expires after 60 seconds, is then exchanged for a web *session* token, which lets you access the web server and use the Apache Airflow REST API. If you require more than 10 transactions per second (TPS) of throttling capacity, you can use this method to access the Apache Airflow REST API.

🚺 Note

The session token expires after 12 hours.

```
def get_session_info(region, env_name):
    logging.basicConfig(level=logging.INF0)
   try:
        # Initialize MWAA client and request a web login token
       mwaa = boto3.client('mwaa', region_name=region)
        response = mwaa.create_web_login_token(Name=env_name)
        # Extract the web server hostname and login token
       web_server_host_name = response["WebServerHostname"]
       web_token = response["WebToken"]
        # Construct the URL needed for authentication
        login_url = f"https://{web_server_host_name}/aws_mwaa/login"
        login_payload = {"token": web_token}
        # Make a POST request to the MWAA login url using the login payload
        response = requests.post(
            login_url,
            data=login_payload,
            timeout=10
        )
```

```
# Check if login was succesfull
    if response.status_code == 200:
        # Return the hostname and the session cookie
        return (
            web_server_host_name,
            response.cookies["session"]
        )
    else:
        # Log an error
        logging.error("Failed to log in: HTTP %d", response.status_code)
        return None
except requests.RequestException as e:
     # Log any exceptions raised during the request to the MWAA login endpoint
    logging.error("Request failed: %s", str(e))
    return None
except Exception as e:
    # Log any other unexpected exceptions
   logging.error("An unexpected error occurred: %s", str(e))
    return None
```

Once authentication is complete, you have the credentials to start sending requests to the API endpoints. In the example below, use the endpoint dags/{dag_id}/dagRuns.

```
def trigger_dag(region, env_name, dag_name):
    """
    Triggers a DAG in a specified MWAA environment using the Airflow REST API.
    Args:
    region (str): AWS region where the MWAA environment is hosted.
    env_name (str): Name of the MWAA environment.
    dag_name (str): Name of the DAG to trigger.
    """
    logging.info(f"Attempting to trigger DAG {dag_name} in environment {env_name} at
    region {region}")
    # Retrieve the web server hostname and session cookie for authentication
    try:
        web_server_host_name, session_cookie = get_session_info(region, env_name)
        if not session_cookie:
            logging.error("Authentication failed, no session cookie retrieved.")
```

```
return
    except Exception as e:
        logging.error(f"Error retrieving session info: {str(e)}")
        return
    # Prepare headers and payload for the request
    cookies = {"session": session_cookie}
    json_body = {"conf": {}}
    # Construct the URL for triggering the DAG
    url = f"https://{web_server_host_name}/api/v1/dags/{dag_id}/dagRuns"
    # Send the POST request to trigger the DAG
   try:
        response = requests.post(url, cookies=cookies, json=json_body)
        # Check the response status code to determine if the DAG was triggered
 successfully
        if response.status_code == 200:
            logging.info("DAG triggered successfully.")
        else:
            logging.error(f"Failed to trigger DAG: HTTP {response.status_code} -
 {response.text}")
    except requests.RequestException as e:
        logging.error(f"Request to trigger DAG failed: {str(e)}")
if __name__ == "__main__":
    logging.basicConfig(level=logging.INF0)
    # Check if the correct number of arguments is provided
    if len(sys.argv) != 4:
        logging.error("Incorrect usage. Proper format: python script_name.py {region}
 {env_name} {dag_name}")
        sys.exit(1)
    region = sys.argv[1]
    env_name = sys.argv[2]
    dag_name = sys.argv[3]
    # Trigger the DAG with the provided arguments
    trigger_dag(region, env_name, dag_name)
```

Apache Airflow CLI command reference

This topic describes the supported and unsupported Apache Airflow CLI commands on Amazon Managed Workflows for Apache Airflow.

🚺 Tip

REST API is more modern than the CLI and is designed for programmatic integration with external systems. REST is the preferred way of interacting with Apache Airflow.

Contents

- Prerequisites
 - <u>Access</u>
 - AWS CLI
- What changed in v2
- Supported CLI commands
 - Supported commands
 - Using commands that parse DAGs
- Sample code
 - Set, get or delete an Apache Airflow v2 variable
 - Add a configuration when triggering a DAG
 - Run CLI commands on an SSH tunnel to a bastion host
 - Samples in GitHub and AWS tutorials

Prerequisites

The following section describes the preliminary steps required to use the commands and scripts on this page.

Access

• AWS account access in AWS Identity and Access Management (IAM) to the Amazon MWAA permissions policy in <u>Apache Airflow UI access policy: AmazonMWAAWebServerAccess</u>.

• AWS account access in AWS Identity and Access Management (IAM) to the Amazon MWAA permissions policy Full API and console access policy: AmazonMWAAFullApiAccess.

AWS CLI

The AWS Command Line Interface (AWS CLI) is an open source tool that enables you to interact with AWS services using commands in your command-line shell. To complete the steps on this page, you need the following:

- AWS CLI Install version 2.
- AWS CLI Quick configuration with aws configure.

What changed in v2

New: Airflow CLI command structure. The Apache Airflow v2 CLI is organized so that related commands are grouped together as subcommands, which means you need to update Apache Airflow v1 scripts if you want to upgrade to Apache Airflow v2. For example, unpause in Apache Airflow v1 is now dags unpause in Apache Airflow v2. To learn more, refer to <u>Airflow CLI changes in 2</u> in the *Apache Airflow reference guide*.

Supported CLI commands

The following section lists the Apache Airflow CLI commands available on Amazon MWAA.

Supported commands

Apache Airflow v2

Minor versions	Command
v2.0+	cheat-sheet
v2.0+	connections add
v2.0+	connections delete
v2.2+ (<u>note</u>)	dags backfill

Minor versions	Command
v2.0+	dags delete
v2.2+ (<u>note</u>)	dags list
v2.0+	dags list-jobs
v2.6+	dags list-import-errors
v2.2+ (<u>note</u>)	dags list-runs
v2.2+ (<u>note</u>)	dags next-execution
v2.0+	dags pause
v2.0+	dags report
v2.4+	dags reserialize
v2.0+	dags show
v2.0+	dags state
v2.0+	dags test
v2.0+	dags trigger
v2.0+	dags unpause
v2.4+	db clean
v2.0+	providers behaviours
v2.0+	providers get
v2.0+	providers hooks
v2.0+	providers links
v2.0+	providers list

Minor versions	Command
v2.8+	providers notifications
v2.6+	providers secrets
v2.7+	providers triggerer
v2.0+	providers widgets
v2.6+	roles add-perms
v2.6+	roles del-perms
v2.6+	roles create
v2.0+	roles list
v2.0+	tasks clear
v2.0+	tasks failed-deps
v2.0+	tasks list
v2.0+	tasks render
v2.0+	tasks state
v2.0+	tasks states-for-dag-run
v2.0+	tasks test
v2.0+	variables delete
v2.0+	variables get
v2.0+	variables set
v2.0+	variables list
v2.0+	version

Using commands that parse DAGs

If your environment is running Apache Airflow v1.10.12 or v2.0.2, CLI commands that parse DAGs will fail if the DAG uses plugins that depend on packages installed through a requirements.txt:

Apache Airflow v2.0.2

- dags backfill
- dags list
- dags list-runs
- dags next-execution

You can use these CLI commands if your DAGs do not use plugins that depend on packages installed through a requirements.txt.

Sample code

The following section contains examples of different ways to use the Apache Airflow CLI.

Set, get or delete an Apache Airflow v2 variable

You can use the following sample code to set, get or delete a variable in the format of <script> <mwaa env name> get | set | delete <variable> <variable value> </variable> </variable>.

```
[ $# -eq 0 ] && echo "Usage: $0 MWAA environment name " && exit
if [[ $2 == "" ]]; then
   dag="variables list"
elif [ $2 == "get" ] || [ $2 == "delete" ] || [ $2 == "set" ]; then
   dag="variables $2 $3 $4 $5"
else
   echo "Not a valid command"
   exit 1
fi
CLI_JSON=$(aws mwaa --region $AWS_REGION create-cli-token --name $1) \
   && CLI_TOKEN=$(echo $CLI_JSON | jq -r '.CliToken') \
```

```
&& WEB_SERVER_HOSTNAME=$(echo $CLI_JSON | jq -r '.WebServerHostname') \
&& CLI_RESULTS=$(curl --request POST "https://$WEB_SERVER_HOSTNAME/aws_mwaa/cli" \
--header "Authorization: Bearer $CLI_TOKEN" \
--header "Content-Type: text/plain" \
--data-raw "$dag" ) \
&& echo "Output:" \
&& echo $CLI_RESULTS | jq -r '.stdout' | base64 --decode \
&& echo $CLI_RESULTS | jq -r '.stderr' | base64 --decode
```

Add a configuration when triggering a DAG

You can use the following sample code with Apache Airflow v1 and Apache Airflow v2 to add a configuration when triggering a DAG, such as airflow trigger_dag 'dag_name' -conf '{"key":"value"}'.

```
import boto3
import json
import requests
import base64
mwaa_env_name = 'YOUR_ENVIRONMENT_NAME'
dag_name = 'YOUR_DAG_NAME'
key = "YOUR_KEY"
value = "YOUR_VALUE"
conf = "{\"" + key + "\":\"" + value + "\"}"
client = boto3.client('mwaa')
mwaa_cli_token = client.create_cli_token(
  Name=mwaa_env_name
)
mwaa_auth_token = 'Bearer ' + mwaa_cli_token['CliToken']
mwaa_webserver_hostname = 'https://{0}/aws_mwaa/
cli'.format(mwaa_cli_token['WebServerHostname'])
raw_data = "trigger_dag {0} -c '{1}'".format(dag_name, conf)
mwaa_response = requests.post(
      mwaa_webserver_hostname,
      headers={
          'Authorization': mwaa_auth_token,
          'Content-Type': 'text/plain'
```

```
},
data=raw_data
)

mwaa_std_err_message = base64.b64decode(mwaa_response.json()['stderr']).decode('utf8')
mwaa_std_out_message = base64.b64decode(mwaa_response.json()['stdout']).decode('utf8')

print(mwaa_response.status_code)
print(mwaa_std_err_message)
print(mwaa_std_out_message)
```

Run CLI commands on an SSH tunnel to a bastion host

The following example shows how to run Airflow CLI commands using an SSH tunnel proxy to a Linux Bastion Host.

Using curl

2.

```
1. ssh -D 8080 -f -C -q -N YOUR_USER@YOUR_BASTION_HOST
```

curl -x socks5h://0:8080 --request POST https://YOUR_HOST_NAME/aws_mwaa/cli -header YOUR_HEADERS --data-raw YOUR_CLI_COMMAND

Samples in GitHub and AWS tutorials

- Working with Apache Airflow v2.0.2 parameters and variables in Amazon Managed Workflows
 for Apache Airflow
- Interacting with Apache Airflow v1.10.12 on Amazon MWAA via the command line
- Interactive Commands with Apache Airflow v1.10.12 on Amazon MWAA and Bash Operator on *GitHub*

Managing connections to Apache Airflow

This chapter describes how to configure an Apache Airflow connection for an Amazon Managed Workflows for Apache Airflow environment.

Topics

- Overview of Apache Airflow variables and connections
- Apache Airflow provider packages installed on Amazon MWAA environments
- Overview of connection types
- Configuring an Apache Airflow connection using a AWS Secrets Manager secret

Overview of Apache Airflow variables and connections

In some cases, you may want to specify additional connections or variables for an environment, such as an AWS profile, or to add your execution role in a connection object in the Apache Airflow metastore, then refer to the connection from within a DAG.

• Self-managed Apache Airflow. On a self-managed Apache Airflow installation, you set <u>Apache</u> Airflow configuration options in airflow.cfg.

```
[secrets]
backend = airflow.providers.amazon.aws.secrets.secrets_manager.SecretsManagerBackend
backend_kwargs = {"connections_prefix" : "airflow/connections", "variables_prefix" :
   "airflow/variables"}
```

 Apache Airflow on Amazon MWAA. On Amazon MWAA, you need to add these configuration settings as <u>Apache Airflow configuration options</u> on the Amazon MWAA console. Apache Airflow configuration options are written as environment variables to your environment and override all other existing configurations for the same setting.

Apache Airflow provider packages installed on Amazon MWAA environments

Amazon MWAA installs <u>provider extras</u> for Apache Airflow v2 and above connection types when you create a new environment. Installing provider packages allows you to view a connection type

in the Apache Airflow UI. It also means you don't need to specify these packages as a Python dependency in your requirements.txt file. This page lists the Apache Airflow provider packages installed by Amazon MWAA for all Apache Airflow v2 environments.

🚺 Note

For Apache Airflow v2 and above, Amazon MWAA installs <u>Watchtower version 2.0.1</u> after perfming pip3 install -r requirements.txt, to ensure compatibility with CloudWatch logging is not overridden by other Python library installations.

Contents

- Provider packages for Apache Airflow v2.10.1 connections
- Provider packages for Apache Airflow v2.9.2 connections
- Provider packages for Apache Airflow v2.8.1 connections
- Provider packages for Apache Airflow v2.7.2 connections
- Provider packages for Apache Airflow v2.6.3 connections
- Provider packages for Apache Airflow v2.5.1 connections
- Provider packages for Apache Airflow v2.4.3 connections
- Provider packages for Apache Airflow v2.2.2 connections
- Provider packages for Apache Airflow v2.0.2 connections
- Specifying newer provider packages

Provider packages for Apache Airflow v2.10.1 connections

When you create an Amazon MWAA environment in Apache Airflow v2.10.1, Amazon MWAA installs the following provider packages used for Apache Airflow connections.

🚯 Note

Connection type	Package
AWS Connection	apache-airflow-providers-amazon[aiob otocore]==8.28.0
Postgres Connection	apache-airflow-providers-postgres==5.12.0
FTP Connection	apache-airflow-providers-ftp==3.11.0
Fab Connection	apache-airflow-providers-fab==1.3.0
Celery Connection	apache-airflow-providers-celery==3.8.1
HTTP Connection	apache-airflow-providers-http==4.13.0
IMAP Connection	apache-airflow-providers-imap==3.7.0
Common SQL	apache-airflow-providers-common-sql= =1.16.0
SQLite Connection	apache-airflow-providers-sqlite==3.9.0
SMTP Connection	apache-airflow-providers-smtp==1.8.0

Provider packages for Apache Airflow v2.9.2 connections

When you create an Amazon MWAA environment in Apache Airflow v2.9.2, Amazon MWAA installs the following provider packages used for Apache Airflow connections.

🚯 Note

Connection type	Package
AWS Connection	apache-airflow-providers-amazon[aiob otocore]==8.24.0
Postgres Connection	apache-airflow-providers-postgres==5.11.1
FTP Connection	apache-airflow-providers-ftp==3.9.1
Fab Connection	apache-airflow-providers-fab==1.1.1
Celery Connection	apache-airflow-providers-celery==3.7.2
HTTP Connection	apache-airflow-providers-http==4.11.1
IMAP Connection	apache-airflow-providers-imap==3.6.1
Common SQL	apache-airflow-providers-common-sql= =1.14.0
SQLite Connection	apache-airflow-providers-sqlite==3.8.1
SMTP Connection	apache-airflow-providers-smtp==1.7.1

Provider packages for Apache Airflow v2.8.1 connections

When you create an Amazon MWAA environment in Apache Airflow v2.8.1, Amazon MWAA installs the following provider packages used for Apache Airflow connections.

🚯 Note

Connection type	Package
AWS Connection	apache-airflow-providers-amazon[aiob otocore]==8.16.0
Postgres Connection	apache-airflow-providers-postgres==5.10.0
FTP Connection	apache-airflow-providers-ftp==3.7.0
Celery Connection	apache-airflow-providers-celery==3.5.1
HTTP Connection	apache-airflow-providers-http==4.8.0
IMAP Connection	apache-airflow-providers-imap==3.5.0
Common SQL	apache-airflow-providers-common-sql= =1.10.0
SQLite Connection	apache-airflow-providers-sqlite==3.7.0

Provider packages for Apache Airflow v2.7.2 connections

When you create an Amazon MWAA environment in Apache Airflow v2.7.2, Amazon MWAA installs the following provider packages used for Apache Airflow connections.

Note

Connection type	Package
AWS Connection	apache-airflow-providers-amazon[aiob otocore]==8.7.1
Postgres Connection	apache-airflow-providers-postgres==5.6.1

Connection type	Package
FTP Connection	apache-airflow-providers-ftp==3.5.2
Celery Connection	apache-airflow-providers-celery==3.3.4
HTTP Connection	apache-airflow-providers-http==4.5.2
IMAP Connection	apache-airflow-providers-imap==3.3.2
Common SQL	apache-airflow-providers-common-sql==1.7.2
SQLite Connection	apache-airflow-providers-sqlite==3.4.3

Provider packages for Apache Airflow v2.6.3 connections

When you create an Amazon MWAA environment in Apache Airflow v2.6.3, Amazon MWAA installs the following provider packages used for Apache Airflow connections.

🚯 Note

Connection type	Package
AWS Connection	apache-airflow-providers-amazon[aiob otocore]==8.2.0
Postgres Connection	apache-airflow-providers-postgres==5.5.1
FTP Connection	apache-airflow-providers-ftp==3.4.2
Celery Connection	apache-airflow-providers-celery==3.2.1
HTTP Connection	apache-airflow-providers-http==4.4.2

Connection type	Package
IMAP Connection	apache-airflow-providers-imap==3.2.2
Common SQL	apache-airflow-providers-common-sql==1.5.2
SQLite Connection	apache-airflow-providers-sqlite==3.4.2

Provider packages for Apache Airflow v2.5.1 connections

When you create an Amazon MWAA environment in Apache Airflow v2.5.1, Amazon MWAA installs the following provider packages used for Apache Airflow connections.

(i) Note

Connection type	Package
AWS Connection	apache-airflow-providers-amazon==7.1.0
Postgres Connection	apache-airflow-providers-postgres==5.4.0
FTP Connection	apache-airflow-providers-ftp==3.3.0
Celery Connection	apache-airflow-providers-celery==3.1.0
HTTP Connection	apache-airflow-providers-http==4.1.1
IMAP Connection	apache-airflow-providers-imap==3.1.1
Common SQL	apache-airflow-providers-common-sql==1.3.3
SQLite Connection	apache-airflow-providers-sqlite==3.3.1

Provider packages for Apache Airflow v2.4.3 connections

When you create an Amazon MWAA environment in Apache Airflow v2.4.3, Amazon MWAA installs the following provider packages used for Apache Airflow connections.

Connection type	Package
AWS Connection	apache-airflow-providers-amazon==6.0.0
Postgres Connection	apache-airflow-providers-postgres==5.2.2
FTP Connection	apache-airflow-providers-ftp==3.1.0
Celery Connection	apache-airflow-providers-celery==3.0.0
HTTP Connection	apache-airflow-providers-http==4.0.0
IMAP Connection	apache-airflow-providers-imap==3.0.0
Common SQL	apache-airflow-providers-common-sql==1.2.0
SQLite Connection	apache-airflow-providers-sqlite==3.2.1

Provider packages for Apache Airflow v2.2.2 connections

When you create an Amazon MWAA environment in Apache Airflow v2.2.2, Amazon MWAA installs the following provider packages used for Apache Airflow connections.

Connection type	Package
AWS Connection	apache-airflow-providers-amazon==2.4.0
Postgres Connection	apache-airflow-providers-postgres==2.3.0
FTP Connection	apache-airflow-providers-ftp==2.0.1
Celery Connection	apache-airflow-providers-celery==2.1.0
HTTP Connection	apache-airflow-providers-http==2.0.1

Connection type	Package
IMAP Connection	apache-airflow-providers-imap==2.0.1
SQLite Connection	apache-airflow-providers-sqlite==2.0.1

Provider packages for Apache Airflow v2.0.2 connections

When you create an Amazon MWAA environment in Apache Airflow v2.0.2, Amazon MWAA installs the following provider packages used for Apache Airflow connections.

Connection type	Package
Tableau Connection	apache-airflow-providers-tableau==1.0.0
Databricks Connection	apache-airflow-providers-databricks==1.0.1
SSH Connection	apache-airflow-providers-ssh==1.3.0
Postgres Connection	apache-airflow-providers-postgres==1.0.2
Docker Connection	apache-airflow-providers-docker==1.2.0
Oracle Connection	apache-airflow-providers-oracle==1.1.0
Presto Connection	apache-airflow-providers-presto==1.0.2
SFTP Connection	apache-airflow-providers-sftp==1.2.0

Specifying newer provider packages

Beginning with Apache Airflow v2.7.2, your requirements file must include a --constraint statement. If you do not provide a constraint, Amazon MWAA will specify one for you to ensure the packages listed in your requirements are compatible with the version of Apache Airflow you are using.

Apache Airflow constraints files specify the provider versions available at the time of a Apache Airflow release. In many cases, however, newer providers are compatible with that version of

Apache Airflow. Because you must use constraints, to specify a newer version of a provider package, you can modify the constraints file for a specific provider version:

- 1. Download the version-specific constraints file from https://raw.githubusercontent.com/ apache/airflow/constraints-2.7.2/constraints-3.11.txt"
- 2. Modify the apache-airflow-providers-amazon version in the constraints file to the version you want to use.
- 3. Save the modified constraints file to the Amazon S3 dags folder of your Amazon MWAA environment, for example, as constraints-3.11-updated.txt
- 4. Specify your requirements as shown in the following.

--constraint "/usr/local/airflow/dags/constraints-3.11-updated.txt"

apache-airflow-providers-amazon==version-number

Note

If you are using a private web server, we recommend you <u>package the required libraries</u> as WHL files by using the Amazon MWAA local-runner.

Overview of connection types

Apache Airflow stores connections as a connection URI string. It provides a connections template in the Apache Airflow UI to generate the connection URI string, regardless of the connection type. If a connection template is not available in the Apache Airflow UI, an alternate connection template can be used to generate this connection URI string, such as using the HTTP connection template. The primary difference is the URI prefix, such as my-conn-type://, which Apache Airflow providers typically ignore for a connection. This page describes how to use connection templates in the Apache Airflow UI interchangeably for different connection types.

🔥 Warning

Do not overwrite the <u>aws_default</u> connection in Amazon MWAA. Amazon MWAA uses this connection to perform a variety of critical tasks, such as collecting task logs.

Overwriting this connection might result in data loss and disruptions to your environment availability.

Topics

- Example connection URI string
- Example connection template
- Example using an HTTP connection template for a Jdbc connection

Example connection URI string

The following example shows a connection URI string for the MySQL connection type.

```
'mysql://288888a0-50a0-888-9a88-1a111aaa0000.a1.us-east-1.airflow.amazonaws.com
%2Fhome?role_arn=arn%3Aaws%3Aiam%3A%3A001122332255%3Arole%2Fservice-role%2FAmazonMWAA-
MyAirflowEnvironment-iAaaaA&region_name=us-east-1'
```

Example connection template

The following example shows the HTTP connection template in the Apache Airflow UI.

Apache Airflow v2

The following example shows the HTTP connection template for Apache Airflow v2 in the Apache Airflow UI.

Add Connection	
Conn Id *	
Conn Type *	HTTP
Description	
Host	
Schema	
Login	
Password	
Port	
Extra	

Apache Airflow v1

The following example shows the HTTP connection template for Apache Airflow v1 in the Apache Airflow UI.

Add Connection	
Conn Id *	
Conn Type	HTTP T
Host	
Schema	
Login	
Password	
Port	
Extra	
Save 🗈 🗲	

Example using an HTTP connection template for a Jdbc connection

The following example shows how to use the **HTTP** connection template for a *Jdbc* connection type in Apache Airflow v2.0.2, and the same values in the **Jdbc** connection template for Apache Airflow v1.10.12 in the Apache Airflow UI.

Apache Airflow v2

The following example shows the connection URI string generated by Apache Airflow for the example in this section.

```
http://myconnectionurl/some/path&login=mylogin&extra_jdbc_dry_path=usr/local/
airflow/dags/classpath/redshif-
jdbc42-2.0.0.1.jar&extra_jdbc_dry_clsname=redshift-jdbc42-2.0.0.1
```

The following example shows how to use the HTTP connection template for a *Jdbc* connection for Apache Airflow v2 in the Apache Airflow UI.

Add Connection	
Conn Id *	my_jdbc_conn
Conn Type *	HTTP Conn Type missing? Make sure you've installed the corresponding Airflow Provider Package.
Description	
Host	myconnectionrurl/some/path
Schema	
Login	mylogin
Password	
Port	
Extra	{ "extra <u>idbc_dry</u> path":"/usr/local/airflow/dags/ <u>classpath</u> /redshift-jdbc42-2.0.0.1.jar", "extra <u>idbc_dry_clsname</u> ":"redshift-jdbc42-2.0.0.1" }
Save 🗈	

Apache Airflow v1

The following example shows the connection URI string generated by Apache Airflow for the example in this section.

```
jdbc://myconnectionurl/some/path&login=mylogin&extra_jdbc_dry_path=usr/local/
airflow/dags/classpath/redshif-
jdbc42-2.0.0.1.jar&extra_jdbc_dry_clsname=redshift-jdbc42-2.0.0.1
```

The following example shows the *Jdbc* connection template for Apache Airflow v1.10.12 in the Apache Airflow UI.

Add Connection	
Conn Id *	my_jdbc_conn
Conn Type	Jdbc Connection *
Connection URL	myconnectionrurl/some/path
Login	mylogin
Password	
Driver Path	/usr/local/airflow/dags/classpath/redshift-jdbc42-2.0.0.1.jar
Driver Class	redshift-jdbc42-2.0.0.1
Save 🖺 🗲	

Configuring an Apache Airflow connection using a AWS Secrets Manager secret

AWS Secrets Manager is a supported alternative Apache Airflow backend on an Amazon Managed Workflows for Apache Airflow environment. This topic shows how to use AWS Secrets Manager to securely store secrets for Apache Airflow variables and an Apache Airflow connection on Amazon Managed Workflows for Apache Airflow.

1 Note

- You will be charged for the secrets you create. For more information on Secrets Manager pricing, refer to AWS Pricing.
- <u>AWS Systems Manager Parameter Store</u> is also supported as a secrets backend in Amazon MWAA. For more information, refer to Amazon Provider Package documentation.

Contents

- Step one: Provide Amazon MWAA with permission to access Secrets Manager secret keys
- Step two: Create the Secrets Manager backend as an Apache Airflow configuration option
- Step three: Generate an Apache Airflow AWS connection URI string
- Step four: Add the variables in Secrets Manager
- <u>Step five: Add the connection in Secrets Manager</u>
- Sample code
- <u>Resources</u>
- What's next?

Step one: Provide Amazon MWAA with permission to access Secrets Manager secret keys

The <u>execution role</u> for your Amazon MWAA environment needs read access to the secret key in AWS Secrets Manager. The following IAM policy allows read-write access using the AWS managed <u>SecretsManagerReadWrite</u> policy.

To attach the policy to your execution role

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose your execution role on the **Permissions** pane.
- 4. Choose Attach policies.
- 5. Type SecretsManagerReadWrite in the Filter policies text field.
- 6. Choose **Attach policy**.

{

If you do not want to use an AWS managed permission policy, you can directly update your environment's execution role to allow any level of access to your Secrets Manager resources. For example, the following policy statement grants read access to all secrets you create in a specific AWS Region in Secrets Manager.

```
"Version": "2012-10-17",
"Statement": [
```

```
{
            "Effect": "Allow",
            "Action": [
                "secretsmanager:GetResourcePolicy",
                "secretsmanager:GetSecretValue",
                "secretsmanager:DescribeSecret",
                "secretsmanager:ListSecretVersionIds"
            ],
            "Resource": "arn:aws:secretsmanager:us-west-2:012345678910:secret:*"
        },
        {
            "Effect": "Allow",
            "Action": "secretsmanager:ListSecrets",
            "Resource": "*"
        }
    ]
}
```

Step two: Create the Secrets Manager backend as an Apache Airflow configuration option

The following section describes how to create an Apache Airflow configuration option on the Amazon MWAA console for the AWS Secrets Manager backend. If you're using a configuration setting of the same name in airflow.cfg, the configuration you create in the following steps will take precedence and override the configuration settings.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose Edit.
- 4. Choose Next.
- 5. Choose **Add custom configuration** in the **Airflow configuration options** pane. Add the following key-value pairs:
 - a. secrets.backend: airflow.providers.amazon.aws.secrets.secrets_manager.SecretsManagerBackend
 - b. secrets.backend_kwargs: {"connections_prefix" : "airflow/ connections", "variables_prefix" : "airflow/variables"} This configures Apache Airflow to look for connection strings and variables at airflow/connections/* and airflow/variables/* paths.

You can use a <u>lookup pattern</u> to reduces the number of API calls Amazon MWAA makes to Secrets Manager on your behalf. If you do not specify a lookup pattern, Apache Airflow searches for all connections and variables in the configured backend. By specifying a pattern, you narrow the possible paths that Apache Airflow looks. This lowers your costs when using Secrets Manager with Amazon MWAA.

To specify a lookup pattern, specify the connections_lookup_pattern and variables_lookup_pattern parameters. These parameters accept a RegEx string as input. For example, to look for secrets that start with test, enter the following for secrets.backend_kwargs:

```
{
   "connections_prefix": "airflow/connections",
   "connections_lookup_pattern": "^test",
   "variables_prefix" : "airflow/variables",
   "variables_lookup_pattern": "^test"
}
```

🚯 Note

To use connections_lookup_pattern and variables_lookup_pattern, you must install apache-airflow-providers-amazon version 7.3.0 or higher. For more information on updating provder pacakges for to newer versions, refer to the section called "Specifying newer provider packages".

6. Choose Save.

Step three: Generate an Apache Airflow AWS connection URI string

To create a connection string, use the "tab" key on your keyboard to indent the key-value pairs in the <u>Connection</u> object. We also recommend creating a variable for the extra object in your shell session. The following section walks you through the steps to <u>generate an Apache Airflow</u> <u>connection URI</u> string for an Amazon MWAA environment using Apache Airflow or a Python script.

Apache Airflow CLI

The following shell session uses your local Airflow CLI to generate a connection string. If you don't have the CLI installed, we recommend using the Python script.

python3

2. Enter the following command:

```
>>> import json
```

3. Enter the following command:

```
>>> from airflow.models.connection import Connection
```

 Create a variable in your shell session for the extra object. Substitute the sample values in YOUR_EXECUTION_ROLE_ARN with the execution role ARN, and the region in us-east-1 (such as us-east-1).

```
>>> extra=json.dumps({'role_arn': 'YOUR_EXECUTION_ROLE_ARN', 'region_name': 'us-
east-1'})
```

5. Create the connection object. Substitute the sample value in myconn with the name of the Apache Airflow connection.

```
>>> myconn = Connection(
```

- 6. Use the "tab" key on your keyboard to indent each of the following key-value pairs in your connection object. Substitute the sample values in *red*.
 - a. Specify the AWS connection type:

```
... conn_id='aws',
```

b. Specify the Apache Airflow database option:

```
... conn_type='mysql',
```

c. Specify the Apache Airflow UI URL on Amazon MWAA:

```
... host='288888a0-50a0-888-9a88-1a111aaa0000.a1.us-
```

```
east-1.airflow.amazonaws.com/home',
```

d. Specify the AWS access key ID (username) to login to Amazon MWAA:

```
... login='YOUR_AWS_ACCESS_KEY_ID',
```

e. Specify the AWS secret access key (password) to login to Amazon MWAA:

... password='YOUR_AWS_SECRET_ACCESS_KEY',

f. Specify the extra shell session variable:

```
... extra=extra
```

- g. Close the connection object.
 - ...)
- 7. Print the connection URI string:

>>> myconn.get_uri()

You should see the connection URI string in the response:

```
'mysql://288888a0-50a0-888-9a88-1a111aaa0000.a1.us-east-1.airflow.amazonaws.com
%2Fhome?role_arn=arn%3Aaws%3Aiam%3A%3A001122332255%3Arole%2Fservice-role
%2FAmazonMWAA-MyAirflowEnvironment-iAaaaA&region_name=us-east-1'
```

Python script

The following Python script does not require the Apache Airflow CLI.

 Copy the contents of the following code sample and save locally as mwaa_connection.py.

```
import urllib.parse
conn_type = 'YOUR_DB_OPTION'
host = 'YOUR_MWAA_AIRFLOW_UI_URL'
port = 'YOUR_PORT'
login = 'YOUR_AWS_ACCESS_KEY_ID'
password = 'YOUR_AWS_SECRET_ACCESS_KEY'
```

```
role_arn = urllib.parse.quote_plus('YOUR_EXECUTION_ROLE_ARN')
region_name = 'us-east-1'
conn_string = '{0}://{1}:{2}@{3}:{4}?
role_arn={5}&region_name={6}'.format(conn_type, login, password, host, port,
role_arn, region_name)
print(conn_string)
```

- 2. Substitute the placeholders in *red*.
- 3. Run the following script to generate a connection string.

python3 mwaa_connection.py

Step four: Add the variables in Secrets Manager

The following section describes how to create the secret for a variable in Secrets Manager.

To create the secret

- 1. Open the AWS Secrets Manager console.
- 2. Choose Store a new secret.
- 3. Choose **Other type of secret**.
- 4. On the **Specify the key/value pairs to be stored in this secret** pane, choose **Plaintext**.
- 5. Add the variable value as **Plaintext** in the following format.

"YOUR_VARIABLE_VALUE"

For example, to specify an integer:

14

For example, to specify a string:

"mystring"

- 6. For **Encryption key**, choose an AWS KMS key option from the dropdown list.
- 7. Enter a name in the text field for **Secret name** in the following format.

airflow/variables/YOUR_VARIABLE_NAME

For example:

airflow/variables/test-variable

- 8. Choose Next.
- 9. On the **Configure secret** page, on the **Secret name and description** pane, do the following.
 - a. For **Secret name**, provide a name for your secret.
 - b. (Optional) For **Description**, provide a description for your secret.

Choose Next.

- 10. On the **Configure rotation optional** leave the default options and choose **Next**.
- 11. Repeat these steps in Secrets Manager for any additional variables you want to add.
- 12. On the **Review** page, review your secret, then choose **Store**.

Step five: Add the connection in Secrets Manager

The following section describes how to create the secret for your connection string URI in Secrets Manager.

To create the secret

- 1. Open the AWS Secrets Manager console.
- 2. Choose **Store a new secret**.
- 3. Choose Other type of secret.
- 4. On the **Specify the key/value pairs to be stored in this secret** pane, choose **Plaintext**.
- 5. Add the connection URI string as **Plaintext** in the following format.

YOUR_CONNECTION_URI_STRING

For example:

mysql://288888a0-50a0-888-9a88-1a111aaa0000.a1.us-east-1.airflow.amazonaws.com
%2Fhome?role_arn=arn%3Aaws%3Aiam%3A%3A001122332255%3Arole%2Fservice-role
%2FAmazonMWAA-MyAirflowEnvironment-iAaaaA®ion_name=us-east-1

🔥 Warning

Apache Airflow parses each of the values in the connection string. You must **not** use single nor double quotes, or it will parse the connection as a single string.

- 6. For **Encryption key**, choose an AWS KMS key option from the dropdown list.
- 7. Enter a name in the text field for **Secret name** in the following format.

airflow/connections/YOUR_CONNECTION_NAME

For example:

airflow/connections/myconn

- 8. Choose Next.
- 9. On the **Configure secret** page, on the **Secret name and description** pane, do the following.
 - a. For **Secret name**, provide a name for your secret.
 - b. (Optional) For **Description**, provide a description for your secret.

Choose Next.

- 10. On the **Configure rotation optional** leave the default options and choose **Next**.
- 11. Repeat these steps in Secrets Manager for any additional variables you want to add.
- 12. On the **Review** page, review your secret, then choose **Store**.

Sample code

• Learn how to use the secret key for the Apache Airflow connection (myconn) on this page using the sample code at Using a secret key in AWS Secrets Manager for an Apache Airflow connection.

• Learn how to use the secret key for the Apache Airflow variable (test-variable) on this page using the sample code at <u>Using a secret key in AWS Secrets Manager for an Apache Airflow</u> variable.

Resources

- For more information about configuring Secrets Manager secrets using the console and the AWS CLI, refer to Create a secret in the AWS Secrets Manager User Guide.
- Use a Python script to migrate a large volume of Apache Airflow variables and connections to Secrets Manager in <u>Move your Apache Airflow connections and variables to AWS Secrets</u> <u>Manager</u>.

What's next?

• Learn how to generate a token to access the Apache Airflow UI in Accessing Apache Airflow.

Managing Amazon MWAA environments

The Amazon Managed Workflows for Apache Airflow console contains built-in options to configure private or public access to the Apache Airflow UI. It also contains built-in options to configure the environment size, when to scale workers, and Apache Airflow configuration options that allow you to override Apache Airflow configurations that are normally only accessible in airflow.cfg. This chapter describes how to use these configurations on the Amazon MWAA console.

Topics

- <u>Configuring the Amazon MWAA environment class</u>
- <u>Configuring Amazon MWAA worker automatic scaling</u>
- Configuring Amazon MWAA web server automatic scaling
- Using Apache Airflow configuration options on Amazon MWAA
- Update an Amazon MWAA environment
- <u>Changing the Apache Airflow version</u>
- Using a startup script with Amazon MWAA

Configuring the Amazon MWAA environment class

The environment class you choose for your Amazon MWAA environment determines the size of the AWS-managed AWS Fargate containers where the <u>Celery Executor</u> runs, and the AWS-managed Amazon Aurora PostgreSQL metadata database where the Apache Airflow schedulers creates task instances. This topic describes each Amazon MWAA environment class, and how to update the environment class on the Amazon MWAA console.

Sections

- Environment capabilities
- Apache Airflow Schedulers

Environment capabilities

The following section contains the default concurrent Apache Airflow tasks, Random Access Memory (RAM), and the virtual centralized processing units (vCPUs) for each environment class.

The concurrent tasks listed assume that task concurrency does not exceed the Apache Airflow *Worker* capacity in the environment.

In the following table, DAG capacity refers to DAG definitions, not executions, and assumes that your DAGs are <u>dynamic</u> in a single Python file and written with <u>Apache Airflow best practices</u>.

Task executions depend by how many are scheduled simultaneously, and assumes that the number of DAG runs set to start at the same time does not exceed the default max_dagruns_per_loop_to_schedule, as well as the size and number of workers as detailed in this topic.

mw1.micro

- Up to 25 DAG capacity
- 3 concurrent tasks (by default)
- Components:
 - Web server: 1 vCPU, 3GB RAM
 - Worker and scheduler: 1 vCPU, 3GB RAM
 - Database: 2 vCPU, 4GB RAM

í) Note

mw1.micro does not support auto-scaling.

mw1.small

- Up to 50 DAG capacity
- 5 concurrent tasks (by default)
- Components:
 - Web servers: 1 vCPU, 2GB RAM each
 - Workers: 1 vCPU, 2GB RAM each
 - Schedulers: 1 vCPU, 2GB RAM each
 - Database: 2 vCPU, 4GB RAM

mw1.medium

- Up to 250 DAG capacity
- 10 concurrent tasks (by default)
- Components:
 - Web servers: 1 vCPU 2GB RAM each
 - Workers: 2 vCPU 4GB RAM each
 - Schedulers: 2 vCPU 4GB RAM each
 - Database: 2 vCPU 8GB RAM

mw1.large

- Up to 1000 DAG capacity
- 20 concurrent tasks (by default)
- Components:
 - Web servers: 2 vCPU 4GB RAM each
 - Workers: 4 vCPU 8GB RAM each
 - Schedulers: 4 vCPU 8GB RAM each
 - Database: 2 vCPU 8GB RAM

mw1.xlarge

- Up to 2000 DAG capacity
- 40 concurrent tasks (by default)
- Components:
 - Web servers: 4 vCPU 12GB RAM each
 - Workers: 8 vCPU 24GB RAM each
 - Schedulers: 8 vCPU 24GB RAM each
 - Database: 4 vCPU 32GB RAM

mw1.2xlarge

- 80 concurrent tasks (by default)
- Componenets:
 - Web servers: 8 vCPU 24GB RAM each
 - Workers: 16 vCPU 48GB RAM each
 - Schedulers: 16 vCPU 48GB RAM each
 - Database: 8 vCPU 64GB RAM

You can use celery.worker_autoscale to increase tasks per worker. For more information, refer to the the section called "Example high performance use case".

Apache Airflow Schedulers

The following section contains the Apache Airflow *scheduler* options available on the Amazon MWAA, and how the number of schedulers affects the number of *triggerers*.

In Apache Airflow, a <u>triggerer</u> manages tasks which it defers until certain conditions specified using a *trigger* have been met. In Amazon MWAA the triggerer runs alongside the scheduler on the same Fargate task. Increasing the scheduler count correspondingly increases the number of available triggerers, optimizing how the environment manages deferred tasks. This ensures efficient handling of tasks, promptly scheduling them to run when conditions are satisfied.

Apache Airflow v2

• **v2** - For environments larger than mw1.micro, accepts values from 2 to 5. Defaults to 2 for all environment sizes except mw1.micro, which defaults to 1.

Configuring Amazon MWAA worker automatic scaling

The auto scaling mechanism automatically increases the number of Apache Airflow workers in response to running and queued tasks on your Amazon Managed Workflows for Apache Airflow environment and disposes of extra workers when there are no more tasks queued or executing. This topic describes how you can configure auto scaling by specifying the maximum number of Apache Airflow workers that run on your environment using the Amazon MWAA console.

🚯 Note

Amazon MWAA uses Apache Airflow metrics to determine when additional <u>Celery Executor</u> workers are needed, and as required increases the number of Fargate workers up to the value specified by max-workers. As the additional workers complete work and work load decreases, Amazon MWAA removes them, thus downscaling back to the value set by min-workers.

If workers pick up new tasks while downscaling, Amazon MWAA keeps the Fargate resource and does not remove the worker. For more information, see <u>How Amazon MWAA auto</u> <u>scaling works</u>.

Sections

- How worker scaling works
- Using the Amazon MWAA console
- Example high performance use case
- Troubleshooting tasks stuck in the running state
- What's next?

How worker scaling works

Amazon MWAA uses RunningTasks and QueuedTasks <u>metrics</u>, where (*tasks running + tasks queued*) / (*tasks per worker*) = (*required workers*). If the required number of workers is greater than the current number of workers, Amazon MWAA will add Fargate worker containers to that value, up to the maximum value specified by max-workers.

As the workload decreases and the RunningTasks and QueuedTasks metric sum reduces, Amazon MWAA requests Fargate to scale down the workers for the environment. Any workers which still completing work remain protected during downscaling until they complete their work. Depending on the workload, tasks may be queued while workers downscale.

Using the Amazon MWAA console

You can choose the maximum number of workers that can run on your environment concurrently on the Amazon MWAA console. By default, you can specify a maximum value up to 25.

To configure the number of workers

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose Edit.
- 4. Choose Next.
- 5. On the Environment class pane, enter a value in Maximum worker count.
- 6. Choose Save.

🚯 Note

It can take a few minutes before changes take effect on your environment.

Example high performance use case

The following section describes the type of configurations you can use to enable high performance and parallelism on an environment.

On-premise Apache Airflow

Typically, in an on-premise Apache Airflow platform, you would configure task parallelism, auto scaling, and concurrency settings in your airflow.cfg file:

- core.parallelism The maximum number of task instances that can run simultaneously per scheduler.
- core.dag_concurrency The maximum concurrency for DAGs (not workers).
- celery.worker_autoscale The maximum and minimum number of tasks that can run concurrently on any worker.

For example, if core.parallelism was set to 100 and core.dag_concurrency was set to 7, you would still only be able to run a total of 14 tasks concurrently if you had 2 DAGs. Given, each DAG is set to run only seven tasks concurrently (in core.dag_concurrency), even though overall parallelism is set to 100 (in core.parallelism).

On an Amazon MWAA environment

On an Amazon MWAA environment, you can configure these settings directly on the Amazon MWAA console using <u>Using Apache Airflow configuration options on Amazon MWAA</u>, <u>Configuring the Amazon MWAA environment class</u>, and the **Maximum worker count** auto scaling mechanism. While core.dag_concurrency is not available in the drop down list as an **Apache Airflow configuration option** on the Amazon MWAA console, you can add it as a custom <u>Apache Airflow configuration option</u>.

Let's say, when you created your environment, you chose the following settings:

- 1. The **mw1.small** <u>environment class</u> which controls the maximum number of concurrent tasks each worker can run by default and the vCPU of containers.
- 2. The default setting of 10 Workers in Maximum worker count.
- 3. An <u>Apache Airflow configuration option</u> for celery.worker_autoscale of 5, 5 tasks per worker.

This means you can run 50 concurrent tasks in your environment. Any tasks beyond 50 will be queued, and wait for the running tasks to complete.

Run more concurrent tasks. You can modify your environment to run more tasks concurrently using the following configurations:

- Increase the maximum number of concurrent tasks each worker can run by default and the vCPU of containers by choosing the mw1.medium (10 concurrent tasks by default) environment class.
- 2. Add celery.worker_autoscale as an Apache Airflow configuration option.
- 3. Increase the **Maximum worker count**. In this example, increasing maximum workers from 10 to 20 would double the number of concurrent tasks the environment can run.

Specify Minimum workers. You can also specify the minimum and maximum number of Apache Airflow *Workers* that run in your environment using the AWS Command Line Interface (AWS CLI). For example:

```
aws mwaa update-environment --max-workers 10 --min-workers 10 --
name YOUR_ENVIRONMENT_NAME
```

To learn more, refer to the update-environment command in the AWS CLI.

Troubleshooting tasks stuck in the running state

In rare cases, Apache Airflow may think there are tasks still running. To resolve this issue, you need to clear the stranded task in your Apache Airflow UI. For more information, refer to the <u>I see my</u> tasks stuck or not completing troubleshooting topic.

What's next?

• Learn more about the best practices we recommend to tune the performance of your environment in Performance tuning for Apache Airflow on Amazon MWAA.

Configuring Amazon MWAA web server automatic scaling

For environments running Apache Airflow v2.2.2 and above, Amazon MWAA dynamically scales your web servers to handle fluctuating workloads, which in turn prevents performance issues during peak loads. By automatically scaling the number of web servers based on CPU utilization and active connection count, Amazon MWAA ensures that your Apache Airflow environment can seamlessly accommodate increased demand, whether from REST API requests, CLI usage, or more concurrent Apache Airflow user interface users.

Sections

- How web server scaling works
- Using the Amazon MWAA console

How web server scaling works

Amazon MWAA uses the container metric, <u>CPUUtilization</u>, and the load balancer metric, <u>ActiveConnectionCount</u>, to determine if scaling the web servers is required based on the amount of traffic. If CPUUtilization is higher than 70 or ActiveConnectionCount is higher than 15, Amazon MWAA will add additional Fargate web server containers up to the maximum value specified by MaxWebservers.

As traffic decreases and the CPUUtilization and ActiveConnectionCount values reduce, Amazon MWAA requests Fargate to scale down the web server containers for the environment to the minimum value set by MinimumWebservers.

Using the Amazon MWAA console

You can choose the number of web servers that can run on your environment concurrently on the Amazon MWAA console. By default, the minimum number of web servers is two, and the maximum number of web servers is five.

To configure the number of web servers

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose **Edit**.
- 4. Choose Next.
- 5. On the Environment class pane, enter a value in Maximum web server count.
- 6. Next, enter a value in Minimum web server count.
- 7. Choose Save.

í) Note

It can take a few minutes before changes take effect on your environment.

Using Apache Airflow configuration options on Amazon MWAA

Apache Airflow configuration options can be attached to your Amazon Managed Workflows for Apache Airflow environment as environment variables. You can choose from the suggested dropdown list, or specify custom configuration options for your Apache Airflow version on the Amazon MWAA console. This topic describes the Apache Airflow configuration options available, and how to use these options to override Apache Airflow configuration settings on your environment.

Contents

- Prerequisites
- How it works
- Using configuration options to load plugins in Apache Airflow v2
- Configuration options overview

- Apache Airflow configuration options
- Apache Airflow reference
- Using the Amazon MWAA console
- <u>Configuration reference</u>
 - Email configurations
 - Task configurations
 - Scheduler configurations
 - Worker configurations
 - Web server configurations
 - Triggerer configurations
- Examples and sample code
 - Example DAG
 - Example email notification settings
- What's next?

Prerequisites

You'll need the following before you can complete the steps on this page.

- Permissions Your AWS account must have been granted access by your administrator to the <u>AmazonMWAAFullConsoleAccess</u> access control policy for your environment. In addition, your Amazon MWAA environment must be permitted by your <u>execution role</u> to access the AWS resources used by your environment.
- Access If you require access to public repositories to install dependencies directly on the web server, your environment must be configured with **public network** web server access. For more information, refer to the section called "Apache Airflow access modes".
- Amazon S3 configuration The <u>Amazon S3 bucket</u> used to store your DAGs, custom plugins in plugins.zip, and Python dependencies in requirements.txt must be configured with *Public Access Blocked* and *Versioning Enabled*.

How it works

When you create an environment, Amazon MWAA attaches the configuration settings you specify on the Amazon MWAA console in **Airflow configuration options** as environment variables to the AWS Fargate container for your environment. If you're using a setting of the same name in airflow.cfg, the options you specify on the Amazon MWAA console override the values in airflow.cfg.

While we don't expose the airflow.cfg in the Apache Airflow UI of an Amazon MWAA environment by default, you can change the Apache Airflow configuration options directly on the Amazon MWAA console, including setting webserver.expose_config to expose the configurations.

Using configuration options to load plugins in Apache Airflow v2

By default in Apache Airflow v2, plugins are configured to be "lazily" loaded using the core.lazy_load_plugins : True setting. If you're using custom plugins in Apache Airflow v2, you must add core.lazy_load_plugins : False as an Apache Airflow configuration option to load plugins at the start of each Airflow process to override the default setting.

Configuration options overview

When you add a configuration on the Amazon MWAA console, Amazon MWAA writes the configuration as an environment variable.

- Listed options. You can choose from one of the configuration settings available for your Apache Airflow version in the dropdown list. For example, dag_concurrency : 16. The configuration setting is translated to your environment's Fargate container as AIRFLOW_CORE_DAG_CONCURRENCY : 16
- Custom options. You can also specify Airflow configuration options that are not listed for your Apache Airflow version in the dropdown list. For example, foo.user: YOUR_USER_NAME. The configuration setting is translated to your environment's Fargate container as AIRFLOW__FO0__USER : YOUR_USER_NAME

Apache Airflow configuration options

The following image shows where you can customize the **Apache Airflow configuration options** on the Amazon MWAA console.

Airflow configuration options - optional Info

Modify the default settings for Airflow configuration options. You can select an option from the suggestion list or type one manually.

All Airflow configuration options are using default values.

Add custom configuration value

Apache Airflow reference

For a list of configuration options supported by Apache Airflow, refer to <u>Configuration Reference</u> in the *Apache Airflow reference guide*. To view the options for the version of Apache Airflow you are running on Amazon MWAA, select the version from the drop down list.

Using the Amazon MWAA console

The following procedure walks you through the steps of adding an Airflow configuration option to your environment.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose Edit.
- 4. Choose Next.
- 5. Choose Add custom configuration in the Airflow configuration options pane.
- 6. Choose a configuration from the dropdown list and enter a value, or type a custom configuration and enter a value.
- 7. Choose Add custom configuration for each configuration you want to add.
- 8. Choose Save.

Configuration reference

The following section contains the list of available Apache Airflow configurations in the dropdown list on the Amazon MWAA console.

Email configurations

The following list shows the Airflow email notification configuration options available on Amazon MWAA.

We recommend using port 587 for SMTP traffic. By default, AWS blocks outbound SMTP traffic on port 25 of all Amazon EC2 instances. If you want to send outbound traffic on port 25, you can request for this restriction to be removed.

Airflow version	Airflow configura tion option	Description	Example value
v2	email.email_backend	The Apache Airflow utility used for email notifications in <u>email_backend</u> .	airflow.utils.emai l.send_email_smtp
ν2	smtp.smtp_host	The name of the outbound server used for the email address in <u>smtp_host</u> .	localhost
v2	smtp.smtp_starttls	Transport Layer Security (TLS) is used to encrypt the email over the Internet in <u>smtp_star</u> <u>ttls</u> .	False
v2	smtp.smtp_ssl	Secure Sockets Layer (SSL) is used to connect the server and email client in <u>smtp_ssl</u> .	True

Airflow version	Airflow configura tion option	Description	Example value
v2	smtp.smtp_port	The Transmission Control Protocol (TCP) port designate d to the server in <u>smtp_port</u> .	587
v2	smtp.smtp_mail_fro m	The outbound email address in smtp_mail_from.	myemail@d omain.com

Task configurations

The following list shows the configurations available in the dropdown list for Airflow tasks on Amazon MWAA.

Airflow version	Airflow configura tion option	Description	Example value
v2	core.default_task_ retries	The number of times to retry an Apache Airflow task in <u>default_task_retri</u> <u>es</u> .	3
v2	core.parallelism	The maximum number of task instances that can run simultaneously across the entire environment in parallel (<u>parallelism</u>).	40

Scheduler configurations

The following list shows the Apache Airflow scheduler configurations available in the dropdown list on Amazon MWAA.

Apache Airflow v2

Airflow version	Airflow configura tion option	Description	Example value
ν2	scheduler.catchup_ by_default	Tells the scheduler to create a DAG run to "catch up" to the specific time interval in <u>catchup_b</u> y_default.	False
v2	scheduler.schedule r_zombie_task_thre shold	Tells the scheduler whether to mark the task instance as failed and reschedule the task in <u>scheduler</u> <u>_zombie_task_thres</u> <u>hold</u> .	300

Worker configurations

The following list shows the Airflow worker configurations available in the dropdown list on Amazon MWAA.

Airflow version	Airflow configura tion option	Description	Example value
v2	celery.worker_auto scale	The maximum and minimum number	16,12

Airflow version	Airflow configura tion option	Description	Example value
		of tasks that can run concurrently on any worker using the <u>Celery Executor</u> in <u>worker_autoscale</u> . Value must be comma-separated in the following order: max_concu rrency, mi n_concurrency .	

Web server configurations

The following list shows the Airflow web server configurations available in the dropdown list on Amazon MWAA.

Airflow version	Airflow configura tion option	Description	Example value
v2	webserver.default_ ui_timezone	The default Apache Airflow UI datetime setting in <u>default_u</u> i_timezone. (i) Note Setting the default_u i_timezon e option does not	America/New_York

Airflow version	Airflow configura tion option	Description	Example value
		change the time zone in which your DAGs are scheduled to run. To change the time zone for your DAGs, you can use a custom plugin. For more informati on, refer to <u>the section</u> <u>called</u> "Changing <u>a DAG's</u> <u>timezone"</u> .	

Triggerer configurations

The following list shows the Apache Airflow triggerer configurations available on Amazon MWAA.

Airflow version	Airflow configura tion option	Description	Example value
v2.7	mwaa.triggerer_ena bled	Used for activatin g and deactivating the triggerer on	True

Airflow version	Airflow configura tion option	Description	Example value
		Amazon MWAA. By default, this value is set to True. If set to False, Amazon MWAA will not start any triggerer processes on schedulers.	
v2.7	triggerer.default_ capacity	Defines the number triggers each triggerer can run in parallel. On Amazon MWAA, this capacity is set per each triggerer and per each scheduler as both components run alongside each other. The default per scheduler is set to 60, 125, 250, 500, and 1000 for small, medium and large, xlarge, and 2xlarge instances, respectively.	125

Examples and sample code

Example DAG

You can use the following DAG to print your email_backend Apache Airflow configuration options. To run in response to Amazon MWAA events, copy the code to your environment's DAGs folder on your Amazon S3 storage bucket.

```
from airflow.decorators import dag
from datetime import datetime
def print_var(**kwargs):
  email_backend = kwargs['conf'].get(section='email', key='email_backend')
  print("email_backend")
  return email_backend
@dag(
  dag_id="print_env_variable_example",
  schedule_interval=None,
  start_date=datetime(yyyy, m, d),
  catchup=False,
)
def print_variable_dag():
  email_backend_test = PythonOperator(
  task_id="email_backend_test",
  python_callable=print_var,
  provide_context=True
)
print_variable_test = print_variable_dag()
```

Example email notification settings

The following Apache Airflow configuration options can be used for a Gmail.com email account using an app password. For more information, refer to <u>Sign in using app passwords</u> in the *Gmail Help reference guide*.

Airflow configuration options - optional Info Modify the default settings for Airflow configuration options. You can select an option from the suggestion list or type one manually. **Configuration option** Custom value X Q smtp.smtp_host smtp.gmail.com Remove X Q smtp.smtp_mail_from <your email>@gmail.com Remove X Q smtp.smtp_password <your 16 digit app password> Remove Q smtp.smtp_port X 587 Remove X Q smtp.smtp_ssl False Remove X True Q smtp.smtp_starttls Remove Q smtp.smtp_user X <your email>@gmail.com Remove Add custom configuration value

What's next?

• Learn how to upload your DAG folder to your Amazon S3 bucket in Adding or updating DAGs.

Update an Amazon MWAA environment

1 Note

Amazon MWAA graceful updates are not yet supported in the Canada West (Calgary) and Asia Pacific (Malaysia) regions.

Amazon MWAA environment updates apply the latest changes and security patches. You can also edit existing configurations and upgrade the Apache Airflow version. This guide describes the steps to update an Amazon MWAA environment.

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Before you begin

- The <u>VPC network</u> you specified for your environment cannot be modified after the environment is created.
- You need an Amazon S3 bucket configured to **Block all public access**, with **Bucket Versioning** enabled.
- You need an AWS account with <u>permissions to use Amazon MWAA</u>, and permission in AWS Identity and Access Management (IAM) to create IAM roles. If you choose the **Private network** access mode for the Apache Airflow *web server*, which limits Apache Airflow access within your Amazon VPC, you'll need permission in IAM to create Amazon VPC endpoints.
- To enable Graceful environment updates, you need to upgrade to Apache Airflow version 2.4.3 or higher. To upgrade the Airflow version, refer to <u>Changing the Apache Airflow version</u>.

Worker replacement strategy

You can choose a worker replacement strategy to control how Amazon MWAA handles active workers during an environment update. You can select one of the following strategies:

Forced updates

Forced update is the default worker replacement strategy. Forced updates immediately stop all active workers, causing running tasks to fail during the update.

Graceful updates

Graceful updates allow workers to continue running tasks for up to 12 hours before shutting down. It prevents tasks failing due to update interruptions, as long as they finish under 12 hours. New tasks are routed to updated workers.

To enable Graceful updates on an existing environment, you must complete one **Forced update** and ensure the environment is on Apache Airflow version 2.4.3 or higher.

i Note

If you perform an update while your environment is in MAINTENANCE status, the worker replacement strategy for any ongoing environment update switches from GRACEFUL to FORCED. Your update is performed after maintenance is complete.

Update environment resources

Amazon MWAA environment updates use the existing environment configuration by default. To update the environment without changing your current configuration:

- 1. Open the Environments page on the Amazon MWAA console.
- 2. From the **Environments** list, choose the environment that you want to update.
- 3. On the environment page, choose **Edit** to edit the environment.
- 4. Choose Next until you are on the Review and save page.
- 5. On the **Review and save** page, review your changes, then choose **Save**.

Update an environment

The following section describes the steps to update an Amazon MWAA environment.

Step one: Specify details

To specify details for the environment

- 1. Open the Environments page on the Amazon MWAA console.
- 2. From the **Environments** list, choose the environment that you want to update.

- 3. On the environment page, choose **Edit** to edit the environment.
- 4. In the Environment details section, for Airflow version, choose the new Apache Airflow version number that you want to upgrade the environment to from the dropdown list.

🚯 Note

Before you upgrade, make sure that your DAGs and other workflow resources are compatible with the new Apache Airflow version. For more information, refer to Changing the Apache Airflow version.

- 5. Under **DAG code in Amazon S3** specify the following:
 - a. **S3 Bucket**. Choose **Browse S3** and select your Amazon S3 bucket, or enter the Amazon S3 URI.
 - b. **DAGs folder**. Choose **Browse S3** and select the dags folder in your Amazon S3 bucket, or enter the Amazon S3 URI.
 - c. **Plugins file** *optional*. Choose **Browse S3** and select the plugins.zip file on your Amazon S3 bucket, or enter the Amazon S3 URI.
 - d. **Requirements file** *optional*. Choose **Browse S3** and select the requirements.txt file on your Amazon S3 bucket, or enter the Amazon S3 URI.
 - e. **Startup script file** *optional*, Choose **Browse S3** and select the script file on your Amazon S3 bucket, or enter the Amazon S3 URI.
- 6. Choose Next.

Step two: Configure advanced settings

To configure advanced settings

- 1. Under **Web server access**, select your preferred <u>Apache Airflow access mode</u>:
 - a. **Private network**. This limits access of the Apache Airflow UI to users *within your Amazon VPC* that have been granted access to the <u>IAM policy for your environment</u>. You need permission to create Amazon VPC endpoints for this step.

🚺 Note

Choose the **Private network** option if your Apache Airflow UI is only accessed within a corporate network, and you do not require access to public repositories for web server requirements installation. If you choose this access mode option, you need to create a mechanism to access your Apache Airflow *Web server* in your Amazon VPC. For more information, refer to <u>Accessing the VPC endpoint for your</u> Apache Airflow Web server (private network access).

- b. **Public network**. This allows the Apache Airflow UI to be accessed *over the Internet* by users granted access to the IAM policy for your environment.
- 2. Under **Security group(s)**, choose the security group used to secure your <u>Amazon VPC</u>:
 - a. By default, Amazon MWAA creates a security group in your Amazon VPC with specific inbound and outbound rules in **Create new security group**.
 - b. **Optional**. Deselect the check box in **Create new security group** to select up to 5 security groups.

🚺 Note

An existing Amazon VPC security group must be configured with specific inbound and outbound rules to allow network traffic. To learn more, refer to <u>Security in</u> your VPC on Amazon MWAA.

3. Under **Environment class**, choose an <u>environment class</u>.

We recommend choosing the smallest size necessary to support your workload. You can change the environment class at any time.

4. For **Maximum worker count**, specify the maximum number of Apache Airflow workers to run in the environment.

For more information, refer to Example high performance use case.

5. Specify the **Maximum web server count** and **Minimum web server count** to configure how Amazon MWAA scales the Apache Airflow web servers in your environment.

For more information about web server automatic scaling, refer to <u>the section called</u> "Configuring web server auto scaling".

- 6. Under **Encryption**, choose a data encryption option:
 - a. By default, Amazon MWAA uses an AWS owned key to encrypt your data.
 - b. Optional. Choose Customize encryption settings (advanced) to choose a different AWS KMS key. If you choose to specify a <u>Customer managed key</u> in this step, you must specify an AWS KMS key ID or ARN. <u>AWS KMS aliases and multi-region keys are not supported</u> by <u>Amazon MWAA</u>. If you specified an Amazon S3 key for server-side encryption on your Amazon S3 bucket, you must specify the same key for your Amazon MWAA environment.

🚯 Note

You must have permissions to the key to select it on the Amazon MWAA console. You must also grant permissions for Amazon MWAA to use the key by attaching the policy described in <u>Attach key policy</u>.

- 7. **Recommended**. Under **Monitoring**, choose one or more log categories for **Airflow logging configuration** to send Apache Airflow logs to CloudWatch Logs:
 - a. **Airflow task logs**. Choose the type of Apache Airflow task logs to send to CloudWatch Logs in **Log level**.
 - b. **Airflow web server logs**. Choose the type of Apache Airflow web server logs to send to CloudWatch Logs in **Log level**.
 - c. **Airflow scheduler logs**. Choose the type of Apache Airflow scheduler logs to send to CloudWatch Logs in **Log level**.
 - d. **Airflow worker logs**. Choose the type of Apache Airflow worker logs to send to CloudWatch Logs in **Log level**.
 - e. **Airflow DAG processing logs**. Choose the type of Apache Airflow DAG processing logs to send to CloudWatch Logs in **Log level**.
- 8. **Optional**. For **Airflow configuration options**, choose **Add custom configuration option**.

You can choose from the suggested dropdown list of <u>Apache Airflow configuration options</u> for your Apache Airflow version, or specify custom configuration options. For example, core.default_task_retries: 3.

- 9. Under **Permissions**, choose an execution role:
 - a. By default, Amazon MWAA creates an <u>execution role</u> in **Create a new role**. You must have permission to create IAM roles to use this option.

- b. **Optional**. Choose **Enter role ARN** to enter the Amazon Resource Name (ARN) of an existing execution role.
- Under Update specifications, choose a <u>Worker replacement strategy</u> to control how active workers are handled during an update.
- 11. Choose Next.

Step three: Review and update

To review an environment summary

• Review the environment summary, choose Save.

🚯 Note

It takes about twenty to thirty minutes to update an environment using forced updates. Graceful environment updates may take up to twelve hours to complete, as it waits for your ongoing tasks to finish.

Changing the Apache Airflow version

Amazon MWAA supports minor version upgrades and downgrades. This means you can update your environment from version x.4.z to x.5.z or from x.5.z to x.4.z. To perform a major version upgrade, for example from version 1.y.z to 2.y.z, you must create a new environment and migrate your resources. For more information on upgrading to a new major version of Apache Airflow, refer to <u>Migrating to a new Amazon MWAA environment</u> in the *Amazon MWAA Migration Guide*.

During the upgrade or downgrade process, Amazon MWAA captures a snapshot of your environment metadata, upgrades or downgrades the workers, schedulers, the web server to the new Apache Airflow version, and finally restores the metadata database using the snapshot.

Before you upgrade or downgrade, make sure that your DAGs and other workflow resources are compatible with the new Apache Airflow version you are upgrading to. If you use a requirements.txt to manage dependencies, you must also ensure that the dependencies you specify in your requirements are compatible with the new version.

Topics

• Specify the new version

Upgrade or downgrade your workflow resources

Whenever you're changing Apache Airflow versions, ensure that you <u>reference the correct --</u> constraint URL in your requirements.txt.

🔥 Warning

Specifying requirements that are incompatible with your target Apache Airflow version during an upgrade or downgrade might result in a lengthy rollback process to the previous version of Apache Airflow with the previous requirements version.

Migrate your workflow resources

- 1. Create a fork of the <u>aws-mwaa-local-runner</u> repository, and clone a copy of the Amazon MWAA local runner.
- 2. Checkout to the branch of the aws-mwaa-local-runner repository that matches the version you are upgrading or downgrading to.
- 3. Use the Amazon MWAA local runner CLI tool to build the Docker image and run Apache Airflow locally. For more information, see the local runner README in the GitHub repository.
- 4. To update your requirements.txt, follow the best practices we recommend in <u>Managing</u> <u>Python dependencies</u>, in the *Amazon MWAA User Guide*.
- (Optional) To speed up the upgrade or downgrade process, <u>clean up the environment's</u> <u>metadata database</u>. Environments with a large amount of metadata can take significantly longer to upgrade.
- 6. After you have successfully tested your workflow resources, copy your DAGs, requirements.txt, and plugins to your environment's Amazon S3 bucket.

You are now ready to edit the environment, specify a new Apache Airflow version, and start the update procedure.

Upgrade or downgrade your workflow resources

Specify the new version

After you have completed updating your workflow resources to ensure compatibility with the new Apache Airflow version, do the following to edit environment details and specify the version of Apache Airflow that you want to upgrade to.

🚺 Note

When you perform an upgrade or downgrade, all tasks currently running on the environment are terminated during the procedure. The update procedure can take up to two hours, during which time your environment will be unavailable.

Specify a new version using the console

- 1. Open the Environments page on the Amazon MWAA console.
- 2. From the **Environments** list, choose the environment that you want to upgrade or downgrade.
- 3. On the environment page, choose **Edit** to edit the environment.
- 4. In the **Environment details** section, for **Airflow version**, choose the Apache Airflow version number that you want to upgrade or downgrade the environment to from the dropdown list.
- 5. Choose **Next** until you are on the **Review and save** page.
- 6. On the **Review and save** page, review your changes, then choose **Save**.

When you apply changes, your environment begins the upgrade or downgrade procedure. During this period, the <u>status</u> of your environment indicates what actions Amazon MWAA is taking, and whether the procedure is successful.

In a successful upgrade or downgrade scenario, the status will show UPDATING, then CREATING_SNAPSHOT as Amazon MWAA captures a backup of your metadata. Finally, the status will return first to UPDATING, then to AVAILABLE when the procedure is done.

If the environment fails to updrade or downgrade, your environment status will show ROLLING_BACK. If the rollback is successful, the status will first show UPDATE_FAILED, indicating that the update failed but the environment is available. If the rollback fails, the status will show UNAVAILABLE, indicating that you cannot access the environment.

Using a startup script with Amazon MWAA

A startup script is a shell (.sh) script that you host in your environment's Amazon S3 bucket similar to your DAGs, requirements, and plugins. Amazon MWAA runs this script during startup on every individual Apache Airflow component (worker, scheduler, and web server) before installing requirements and initializing the Apache Airflow process. Use a startup script to do the following:

- Install runtimes Install Linux runtimes required by your workflows and connections.
- **Configure environment variables** Set environment variables for each Apache Airflow component. Overwrite common variables such as PATH, PYTHONPATH, and LD_LIBRARY_PATH.
- Manage keys and tokens Pass access tokens for custom repositories to requirements.txt and configure security keys.

The following topics describe how to configure a startup script to install Linux runtimes, set environment variables, and troubleshoot related issues using CloudWatch Logs.

Topics

- Configure a startup script
- Install Linux runtimes using a startup script
- <u>Set environment variables using a startup script</u>

Configure a startup script

To use a startup script with your existing Amazon MWAA environment, upload a . sh file to your environment's Amazon S3 bucket. Then, to associate the script with the environment, specify the following in your environment details:

- The Amazon S3 URL path to the script The relative path to the script hosted in your bucket, for example, s3://mwaa-environment/startup.sh
- The Amazon S3 version ID of the script The version of the startup shell script in your Amazon S3 bucket. You must specify the version ID that Amazon S3 assigns to the file every time you update the script. Version IDs are Unicode, UTF-8 encoded, URL-ready, opaque strings that are no more than 1,024 bytes long, for example, 3sL4kqtJlcpXroDTDmJ+rmSpXd3dIbrHY +MTRCxf3vjVBH40Nr8X8gdRQBpUMLUo.

To complete the steps in this section, use the following sample script. The script outputs the value assigned to MWAA_AIRFLOW_COMPONENT. This environment variable identifies each Apache Airflow component that the script runs on.

Copy the code and save it locally as startup.sh.

```
#!/bin/sh
echo "Printing Apache Airflow component"
echo $MWAA_AIRFLOW_COMPONENT
```

Next, upload the script to your Amazon S3 bucket.

AWS Management Console

To upload a shell script (console)

- 1. Sign in to the AWS Management Console and open the Amazon S3 console at https://console.aws.amazon.com/s3/.
- 2. From the **Buckets** list, choose the name of the bucket associated with your environment.
- 3. On the **Objects** tab, choose **Upload**.
- 4. On the **Upload** page, drag and drop the shell script you created.
- 5. Choose **Upload**.

The script appears in the list of **Objects**. Amazon S3 creates a new version ID for the file. If you update the script and upload it again using the same file name, a new version ID is assigned to the file.

AWS CLI

To create and upload a shell script (CLI)

1. Open a new command prompt, and run the Amazon S3 1s command to list and identify the bucket associated with your environment.

\$ aws s3 ls

2. Navigate to the folder where you saved the shell script. Use cp in a new prompt window to upload the script to your bucket. Replace *amzn-s3-demo-bucket* with your information.

\$ aws s3 cp startup.sh s3://amzn-s3-demo-bucket/startup.sh

If successful, Amazon S3 outputs the URL path to the object:

upload: ./startup.sh to s3://amzn-s3-demo-bucket/startup.sh

3. Use the following command to retrieve the latest version ID for the script.

```
$ aws s3api list-object-versions --bucket amzn-s3-demo-bucket --prefix startup
--query 'Versions[?IsLatest].[VersionId]' --output text
```

BbdVMmBRjtestta1EsVnbybZp1Wqh1J4

You specify this version ID when you associate the script with an environment.

Now, associate the script with your environment.

AWS Management Console

To associate the script with an environment (console)

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Select the row for the environment you want to update, then choose Edit.
- 3. On the **Specify details** page, for **Startup script file** *optional*, enter the Amazon S3 URL for the script, for example: s3://amzn-s3-demo-bucket/startup-sh..
- 4. Choose the latest version from the drop down list, or **Browse S3** to find the script.
- 5. Choose **Next**, then proceed to the **Review and save** page.
- 6. Review changes, then choose **Save**.

Environment updates can take between 10 to 30 minutes. Amazon MWAA runs the startup script as each component in your environment restarts.

AWS CLI

To associate the script with an environment (CLI)

 Open a command prompt and use update-environment to specify the Amazon S3 URL and version ID for the script.

```
$ aws mwaa update-environment \
    --name your-mwaa-environment \
    --startup-script-s3-path startup.sh \
    --startup-script-s3-object-version BbdVMmBRjtestta1EsVnbybZp1Wqh1J4
```

If successful, Amazon MWAA returns the Amazon Resource Name (ARN) for the environment:

arn:aws::airflow:us-west-2:123456789012:environment/your-mwaa-environment

Environment update can take between 10 to 30 minutes. Amazon MWAA runs the startup script as each component in your environment restarts.

Finally, retrieve log events to verify that the script is working as expected. When you activate logging for an each Apache Airflow component, Amazon MWAA creates a new log group and log stream. For more information, refer to Apache Airflow log types.

AWS Management Console

To check the Apache Airflow log stream (console)

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose your environment.
- 3. In the **Monitoring** pane, choose the log group for which you want to view logs, for example, **Airflow scheduler log group** .
- 4. In the CloudWatch console, from the Log streams list, choose a stream with the following prefix: startup_script_exection_ip.
- 5. On the **Log events** pane, you will see the output of the command printing the value for MWAA_AIRFLOW_COMPONENT. For example, for scheduler logs, you will the following:

```
Printing Apache Airflow component

scheduler

Finished running startup script. Execution time: 0.004s.

Running verification

Verification completed
```

You can repeat the previous steps to view worker and web server logs.

Install Linux runtimes using a startup script

Use a startup script to update the operating system of an Apache Airflow component, and install additional runtime libraries to use with your workflows. For example, the following script runs yum update to update the operating system.

When running yum update in a startup script, you must exclude Python using -exclude=python* as shown in the example. For your environment to run, Amazon MWAA installs a specific version of Python compatible with your environment. Therefore, you can't update the environment's Python version using a startup script.

```
#!/bin/sh
echo "Updating operating system"
sudo yum update -y --exclude=python*
```

To install runtimes on specific Apache Airflow component, use MWAA_AIRFLOW_COMPONENT and if and fi conditional statements. This example runs a single command to install the libaio library on the scheduler and worker, but not on the web server.

🔥 Important

- If you have configured a <u>private web server</u>, you must either use the following condition or provide all installation files locally in order to avoid installation timeouts.
- Use sudo to run operations that require administrative privileges.

#!/bin/sh

```
if [[ "${MWAA_AIRFLOW_COMPONENT}" != "webserver" ]]
  then
   sudo yum -y install libaio
  fi
```

You can use a startup script to check the Python version.

```
#!/bin/sh
export PYTHON_VERSION_CHECK=`python -c 'import sys; version=sys.version_info[:3];
print("{0}.{1}.{2}".format(*version))'`
echo "Python version is $PYTHON_VERSION_CHECK"
```

Amazon MWAA does not support overriding the default Python version, as this may lead to incompatibilities with the installed Apache Airflow libraries.

Set environment variables using a startup script

Use startup scripts to set environment variables and modify Apache Airflow configurations. The following defines a new variable, ENVIRONMENT_STAGE. You can reference this variable in a DAG or in your custom modules.

```
#!/bin/sh
export ENVIRONMENT_STAGE="development"
echo "$ENVIRONMENT_STAGE"
```

Use startup scripts to overwrite common Apache Airflow or system variables. For example, you set LD_LIBRARY_PATH to instruct Python to look for binaries in the path you specify. This lets you provide custom binaries for your workflows using plugins:

```
#!/bin/sh
export LD_LIBRARY_PATH=/usr/local/airflow/plugins/your-custom-binary
```

Reserved environment variables

Amazon MWAA reserves a set of critical environment variables. If you overwrite a *reserved* variable, Amazon MWAA restores it to its default. The following lists the reserved variables:

- MWAA__AIRFLOW__COMPONENT Used to identify the Apache Airflow component with one of the following values: scheduler, worker, or webserver.
- AIRFLOW_WEBSERVER_SECRET_KEY The secret key used for securely signing session cookies in the Apache Airflow web server.
- AIRFLOW__CORE__FERNET_KEY The key used for encryption and decryption of sensitive data stored in the metadata database, for example, connection passwords.
- AIRFLOW_HOME The path to the Apache Airflow home directory where configuration files and DAG files are stored locally.
- AIRFLOW__CELERY__BROKER_URL The URL of the message broker used for communication between the Apache Airflow scheduler and the Celery worker nodes.
- AIRFLOW CELERY RESULT BACKEND The URL of the database used to store the results of Celery tasks.
- AIRFLOW_CORE_EXECUTOR The executor class that Apache Airflow should use. In Amazon MWAA this is a CeleryExecutor
- AIRFLOW__CORE__LOAD_EXAMPLES Used to activate, or deactivate, the loading of example DAGs.
- AIRFLOW__METRICS__METRICS_BLOCK_LIST Used to manage which Apache Airflow metrics are emitted and captured by Amazon MWAA in CloudWatch.
- SQL_ALCHEMY_CONN The connection string for the RDS for PostgreSQL database used to store Apache Airflow metadata in Amazon MWAA.
- AIRFLOW__CORE__SQL_ALCHEMY_CONN Used for the same purpose as SQL_ALCHEMY_CONN, but following the new Apache Airflow naming convention.
- AIRFLOW__CELERY__DEFAULT_QUEUE The default queue for Celery tasks in Apache Airflow.
- AIRFLOW_OPERATORS_DEFAULT_QUEUE The default queue for tasks using specific Apache Airflow operators.
- AIRFLOW_VERSION The Apache Airflow version installed in the Amazon MWAA environment.
- AIRFLOW_CONN_AWS_DEFAULT The default AWS credentials used to integrate with other AWS services in.
- AWS_DEFAULT_REGION Sets the default AWS Region used with default credentials to integrate with other AWS services.
- AWS_REGION If defined, this environment variable overrides the values in the environment variable AWS_DEFAULT_REGION and the profile setting region.
- PYTHONUNBUFFERED Used to send stdout and stderr streams to container logs.

- AIRFLOW_METRICS_STATSD_ALLOW_LIST Used to configure an allow list of commaseparated prefixes to send the metrics that start with the elements of the list.
- AIRFLOW__METRICS__STATSD_ON Activates sending metrics to StatsD.
- AIRFLOW__METRICS__STATSD_HOST Used to connect to the StatSD daemon.
- AIRFLOW__METRICS__STATSD_PORT Used to connect to the StatSD daemon.
- AIRFLOW__METRICS__STATSD_PREFIX Used to connect to the StatSD daemon.
- AIRFLOW__CELERY__WORKER_AUTOSCALE Sets the maximum and minimum concurrency.
- AIRFLOW CORE DAG CONCURRENCY Sets the number of task instances that can run concurrently by the scheduler in one DAG.
- AIRFLOW CORE MAX_ACTIVE TASKS_PER_DAG Sets the maximum number of active tasks per DAG.
- AIRFLOW__CORE__PARALLELISM Defines the maximum number of task instances that can simultaneously.
- AIRFLOW_SCHEDULER_PARSING_PROCESSES Sets the maximum number of processes parsed by the scheduler to schedule DAGs.
- AIRFLOW__CELERY_BROKER_TRANSPORT_OPTIONS__VISIBILITY_TIMEOUT Defines the number of seconds a worker waits to acknowledge the task before the message is redelivered to another worker.
- AIRFLOW__CELERY_BROKER_TRANSPORT_OPTIONS__REGION Sets the AWS Region for the underlying Celery transport.
- AIRFLOW__CELERY_BROKER_TRANSPORT_OPTIONS__PREDEFINED_QUEUES Sets the queue for the underlying Celery transport.
- AIRFLOW_SCHEDULER_ALLOWED_RUN_ID_PATTERN Used to verify the validity of your input for the run_id parameter when triggering a DAG.
- AIRFLOW_WEBSERVER_BASE_URL The URL of the web server used to host the Apache Airflow UI.
- PYTHONPATH (only for Apache Airflow v2.9 and later) Reserved by Amazon MWAA to ensure that all basic environment functionalities operate correctly.

Note

For Apache Airflow versions earlier than v2.9, PYTHONPATH is an *unreserved* environment variable.

Unreserved environment variables

You can use a startup script to overwrite *unreserved* environment variables. The following lists some of these common variables:

- PATH Specifies a list of directories where the operating system searches for executable files and scripts. When a command runs in the command line, the system checks the directories in PATH in order to find and execute the command. When you create custom operators or tasks in Apache Airflow, you might need to rely on external scripts or executables. If the directories containing these files are not in the specified in the PATH variable, the tasks fail to run when the system is unable to locate them. By adding the appropriate directories to PATH, Apache Airflow tasks can find and run the required executables.
- PYTHONPATH Used by the Python interpreter to determine which directories to search for imported modules and packages. It is a list of directories that you can add to the default search path. This lets the interpreter find and load Python libraries not included in the standard library, or installed in system directories. Use this variable to add your modules and custom Python packages and use them with your DAGs.

🚯 Note

For Apache Airflow v2.9 and later, PYTHONPATH is a *reserved* environment variable.

- LD_LIBRARY_PATH An environment variable used by the dynamic linker and loader in Linux to find and load shared libraries. It specifies a list of directories containing shared libraries, which are searched before the default system library directories. Use this variable to specify your custom binaries.
- CLASSPATH Used by the Java Runtime Environment (JRE) and Java Development Kit (JDK) to locate and load Java classes, libraries, and resources at runtime. It is a list of directories, JAR files, and ZIP archives that contain compiled Java code.

Working with DAGs on Amazon MWAA

To run Directed Acyclic Graphs (DAGs) on an Amazon Managed Workflows for Apache Airflow environment, you copy your files to the Amazon S3 storage bucket attached to your environment, then let Amazon MWAA know where your DAGs and supporting files are located on the Amazon MWAA console. Amazon MWAA takes care of synchronizing the DAGs among workers, schedulers, and the web server. This guide describes how to add or update your DAGs, and install custom plugins and Python dependencies on an Amazon MWAA environment.

Topics

- Amazon S3 bucket overview
- Adding or updating DAGs
- Installing custom plugins
- Installing Python dependencies
- Deleting files on Amazon S3

Amazon S3 bucket overview

An Amazon S3 bucket for an Amazon MWAA environment must have *Public Access Blocked*. By default, all Amazon S3 resources—buckets, objects, and related sub-resources (for example, lifecycle configuration)—are private.

- Only the resource owner, the AWS account that created the bucket, can access the resource. The resource owner (for example, your administrator) can grant access permissions to others by writing an access control policy.
- The access policy you set up must have permission to add DAGs, custom plugins in plugins.zip, and Python dependencies in requirements.txt to your Amazon S3 bucket. For an example policy that contains the required permissions, refer to AmazonMWAAFullConsoleAccess.

An Amazon S3 bucket for an Amazon MWAA environment must have *Versioning Enabled*. When Amazon S3 bucket versioning is enabled, anytime a new version is created, a new copy is created.

• Versioning is enabled for the custom plugins in a plugins.zip, and Python dependencies in a requirements.txt on your Amazon S3 bucket.

• You must specify the version of a plugins.zip, and requirements.txt on the Amazon MWAA console each time these files are updated on your Amazon S3 bucket.

Adding or updating DAGs

Directed Acyclic Graphs (DAGs) are defined within a Python file that defines the DAG's structure as code. You can use the AWS CLI, or the Amazon S3 console to upload DAGs to your environment. This topic describes the steps to add or update Apache Airflow DAGs on your Amazon Managed Workflows for Apache Airflow environment using the dags folder in your Amazon S3 bucket.

Sections

- Prerequisites
- How it works
- What's changed in v2
- Testing DAGs using the Amazon MWAA CLI utility
- Uploading DAG code to Amazon S3
- Specifying the path to your DAGs folder on the Amazon MWAA console (the first time)
- Viewing changes on your Apache Airflow UI
- What's next?

Prerequisites

You'll need the following before you can complete the steps on this page.

- Permissions Your AWS account must have been granted access by your administrator to the <u>AmazonMWAAFullConsoleAccess</u> access control policy for your environment. In addition, your Amazon MWAA environment must be permitted by your <u>execution role</u> to access the AWS resources used by your environment.
- Access If you require access to public repositories to install dependencies directly on the web server, your environment must be configured with **public network** web server access. For more information, refer to the section called "Apache Airflow access modes".
- Amazon S3 configuration The <u>Amazon S3 bucket</u> used to store your DAGs, custom plugins in plugins.zip, and Python dependencies in requirements.txt must be configured with *Public Access Blocked* and *Versioning Enabled*.

How it works

A Directed Acyclic Graph (DAG) is defined within a single Python file that defines the DAG's structure as code. It consists of the following:

- A DAG definition.
- Operators that describe how to run the DAG and the tasks to run.
- Operator relationships that describe the order in which to run the tasks.

To run an Apache Airflow platform on an Amazon MWAA environment, you need to copy your DAG definition to the dags folder in your storage bucket. For example, the DAG folder in your storage bucket may look like this:

Example DAG folder

dags/
dag_def.py

Amazon MWAA automatically syncs new and changed objects from your Amazon S3 bucket to Amazon MWAA scheduler and worker containers' /usr/local/airflow/dags folder every 30 seconds, preserving the Amazon S3 source's file hierarchy, regardless of file type. The time that new DAGs take to appear in your Apache Airflow UI is controlled by <u>scheduler.dag_dir_list_interval</u>. Changes to existing DAGs will be picked up on the next DAG processing loop.

🚺 Note

You do not need to include the airflow.cfg configuration file in your DAG folder. You can override the default Apache Airflow configurations from the Amazon MWAA console. For more information, refer to Using Apache Airflow configuration options on Amazon MWAA.

What's changed in v2

• New: Operators, Hooks, and Executors. The import statements in your DAGs, and the custom plugins you specify in a plugins.zip on Amazon MWAA have changed between Apache Airflow v1 and Apache Airflow v2. For example, from

airflow.contrib.hooks.aws_hook import AwsHook in Apache Airflow v1 has changed to from airflow.providers.amazon.aws.hooks.base_aws import AwsBaseHook in Apache Airflow v2. To learn more, refer to <u>Python API Reference</u> in the *Apache Airflow reference guide*.

Testing DAGs using the Amazon MWAA CLI utility

- The command line interface (CLI) utility replicates an Amazon Managed Workflows for Apache Airflow environment locally.
- The CLI builds a Docker container image locally that's similar to an Amazon MWAA production image. This allows you to run a local Apache Airflow environment to develop and test DAGs, custom plugins, and dependencies before deploying to Amazon MWAA.
- To run the CLI, refer to the aws-mwaa-local-runner on GitHub.

Uploading DAG code to Amazon S3

You can use the Amazon S3 console or the AWS Command Line Interface (AWS CLI) to upload DAG code to your Amazon S3 bucket. The following steps assume you are uploading code (.py) to a folder named dags in your Amazon S3 bucket.

Using the AWS CLI

The AWS Command Line Interface (AWS CLI) is an open source tool that enables you to interact with AWS services using commands in your command-line shell. To complete the steps on this page, you need the following:

- AWS CLI Install version 2.
- <u>AWS CLI Quick configuration with aws configure</u>.

To upload using the AWS CLI

1. Use the following command to list all of your Amazon S3 buckets.

aws s3 ls

2. Use the following command to list the files and folders in the Amazon S3 bucket for your environment.

aws s3 ls s3://YOUR_S3_BUCKET_NAME

3. The following command uploads a dag_def.py file to a dags folder.

aws s3 cp dag_def.py s3://amzn-s3-demo-bucket/dags/

If a folder named dags does not already exist on your Amazon S3 bucket, this command creates the dags folder and uploads the file named dag_def.py to the new folder.

Using the Amazon S3 console

The Amazon S3 console is a web-based user interface that allows you to create and manage the resources in your Amazon S3 bucket. The following steps assume you have a DAGs folder named dags.

To upload using the Amazon S3 console

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Select the **S3 bucket** link in the **DAG code in S3** pane to open your storage bucket on the Amazon S3 console.
- 4. Choose the dags folder.
- 5. Choose Upload.
- 6. Choose Add file.
- 7. Select the local copy of your dag_def.py, choose **Upload**.

Specifying the path to your DAGs folder on the Amazon MWAA console (the first time)

The following steps assume you are specifying the path to a folder on your Amazon S3 bucket named dags.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose the environment where you want to run DAGs.
- 3. Choose Edit.

- 4. On the DAG code in Amazon S3 pane, choose Browse S3 next to the DAG folder field.
- 5. Select your dags folder.
- 6. Choose Choose.
- 7. Choose Next, Update environment.

Viewing changes on your Apache Airflow UI

Logging into Apache Airflow

You need <u>Apache Airflow UI access policy: AmazonMWAAWebServerAccess</u> permissions for your AWS account in AWS Identity and Access Management (IAM) to view your Apache Airflow UI.

To access your Apache Airflow UI

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose **Open Airflow UI**.

What's next?

• Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> runner on GitHub.

Installing custom plugins

Amazon Managed Workflows for Apache Airflow supports Apache Airflow's built-in plugin manager, allowing you to use custom Apache Airflow operators, hooks, sensors, or interfaces. This page describes the steps to install <u>Apache Airflow custom plugins</u> on your Amazon MWAA environment using a plugins.zip file.

Contents

- Prerequisites
- How it works
- When to use the plugins
- <u>Custom plugins overview</u>

- Custom plugins directory and size limits
- Examples of custom plugins
 - Example using a flat directory structure in plugins.zip
 - Example using a nested directory structure in plugins.zip
- Creating a plugins.zip file
 - Step one: Test custom plugins using the Amazon MWAA CLI utility
 - Step two: Create the plugins.zip file
- Uploading plugins.zip to Amazon S3
 - Using the AWS CLI
 - Using the Amazon S3 console
- Installing custom plugins on your environment
 - Specifying the path to plugins.zip on the Amazon MWAA console (the first time)
 - Specifying the plugins.zip version on the Amazon MWAA console
- Example use cases for plugins.zip
- What's next?

Prerequisites

You'll need the following before you can complete the steps on this page.

- Permissions Your AWS account must have been granted access by your administrator to the <u>AmazonMWAAFullConsoleAccess</u> access control policy for your environment. In addition, your Amazon MWAA environment must be permitted by your <u>execution role</u> to access the AWS resources used by your environment.
- Access If you require access to public repositories to install dependencies directly on the web server, your environment must be configured with **public network** web server access. For more information, refer to the section called "Apache Airflow access modes".
- Amazon S3 configuration The <u>Amazon S3 bucket</u> used to store your DAGs, custom plugins in plugins.zip, and Python dependencies in requirements.txt must be configured with *Public Access Blocked* and *Versioning Enabled*.

How it works

To run custom plugins on your environment, you must do three things:

- 1. Create a plugins.zip file locally.
- 2. Upload the local plugins.zip file to your Amazon S3 bucket.
- 3. Specify the version of this file in the **Plugins file** field on the Amazon MWAA console.

i Note

If this is the first time you're uploading a plugins.zip to your Amazon S3 bucket, you also need to specify the path to the file on the Amazon MWAA console. You only need to complete this step once.

When to use the plugins

Plugins are required only for extending the Apache Airflow user interface, as outlined in the <u>Apache Airflow documentation</u>. Custom operators can be placed directly in the /dags folder alongside your DAG code.

If you need to create your own integrations with external systems, place them in the /dags folder or a subfolder within it, but not in the plugins.zip folder. In Apache Airflow 2.x, plugins are primarily used for extending the UI.

Similarly, other dependencies should not be placed in plugins.zip. Instead, they can be stored in a location under the Amazon S3 /dags folder, where they will be synchronized to each Amazon MWAA container before Apache Airflow starts.

🚺 Note

Any file in the /dags folder or in plugins.zip that does not explicitly define an Apache Airflow DAG object must be listed in an .airflowignore file.

Custom plugins overview

Apache Airflow's built-in plugin manager can integrate external features to its core by simply dropping files in an \$AIRFLOW_HOME/plugins folder. It allows you to use custom Apache Airflow operators, hooks, sensors, or interfaces. The following section provides an example of flat and nested directory structures in a local development environment and the resulting import statements, which determines the directory structure within a plugins.zip.

Custom plugins directory and size limits

The Apache Airflow *Scheduler* and the *Workers* look for custom plugins during startup on the AWS-managed Fargate container for your environment at /usr/local/airflow/plugins/*.

- **Directory structure**. The directory structure (at /*) is based on the contents of your plugins.zip file. For example, if your plugins.zip contains the operators directory as a top-level directory, then the directory will be extracted to /usr/local/airflow/ plugins/operators on your environment.
- Size limit. We recommend a plugins.zip file less than than 1 GB. The larger the size of a plugins.zip file, the longer the startup time on an environment. Although Amazon MWAA doesn't limit the size of a plugins.zip file explicitly, if dependencies can't be installed within ten minutes, the Fargate service will time-out and attempt to rollback the environment to a stable state.

i Note

For environments using Apache Airflow v1.10.12 or Apache Airflow v2.0.2, Amazon MWAA limits outbound traffic on the Apache Airflow web server, and does not allow you to install plugins nor Python dependencies directly on the web server. Starting with Apache Airflow v2.2.2, Amazon MWAA can install plugins and dependencies directly on the web server.

Examples of custom plugins

The following section uses sample code in the *Apache Airflow reference guide* to show how to structure your local development environment.

Example using a flat directory structure in plugins.zip

Apache Airflow v2

The following example shows a plugins.zip file with a flat directory structure for Apache Airflow v2.

Example flat directory with PythonVirtualenvOperator plugins.zip

The following example shows the top-level tree of a plugins.zip file for the PythonVirtualenvOperator custom plugin in <u>Creating a custom plugin for Apache Airflow</u> <u>PythonVirtualenvOperator</u>.

virtual_python_plugin.py

Example plugins/virtual_python_plugin.py

The following example shows the PythonVirtualenvOperator custom plugin.

```
.....
```

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```
THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR
IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS
FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR
COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER
IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
"""
from airflow.plugins_manager import AirflowPlugin
```

```
import airflow.utils.python_virtualenv
from typing import List
```

```
def _generate_virtualenv_cmd(tmp_dir: str, python_bin: str, system_site_packages:
    bool) -> List[str]:
        cmd = ['python3','/usr/local/airflow/.local/lib/python3.7/site-packages/
    virtualenv', tmp_dir]
```

```
if system_site_packages:
    cmd.append('--system-site-packages')
    if python_bin is not None:
        cmd.append(f'--python={python_bin}')
    return cmd
airflow.utils.python_virtualenv._generate_virtualenv_cmd=generate_virtualenv_cmd
class VirtualPythonPlugin(AirflowPlugin):
    name = 'virtual_python_plugin'
```

Apache Airflow v1

The following example shows a plugins.zip file with a flat directory structure for Apache Airflow v1.

Example flat directory with PythonVirtualenvOperator plugins.zip

The following example shows the top-level tree of a plugins.zip file for the PythonVirtualenvOperator custom plugin in <u>Creating a custom plugin for Apache Airflow</u> PythonVirtualenvOperator.

virtual_python_plugin.py

Example plugins/virtual_python_plugin.py

The following example shows the PythonVirtualenvOperator custom plugin.

```
from airflow.plugins_manager import AirflowPlugin
from airflow.operators.python_operator import PythonVirtualenvOperator

def _generate_virtualenv_cmd(self, tmp_dir):
    cmd = ['python3','/usr/local/airflow/.local/lib/python3.7/site-packages/
virtualenv', tmp_dir]
    if self.system_site_packages:
        cmd.append('--system-site-packages')
    if self.python_version is not None:
        cmd.append('--python=python{}'.format(self.python_version))
    return cmd
PythonVirtualenvOperator._generate_virtualenv_cmd=generate_virtualenv_cmd

class EnvVarPlugin(AirflowPlugin):
```

name = 'virtual_python_plugin'

Example using a nested directory structure in plugins.zip

Apache Airflow v2

The following example shows a plugins.zip file with separate directories for hooks, operators, and a sensors directory for Apache Airflow v2.

Example plugins.zip

```
__init__.py
my_airflow_plugin.py
hooks/
|-- __init__.py
|-- my_airflow_hook.py
operators/
|-- __init__.py
|-- my_airflow_operator.py
sensors/
|-- __init__.py
|-- my_airflow_sensor.py
```

The following example shows the import statements in the DAG (<u>DAGs folder</u>) that uses the custom plugins.

Example dags/your_dag.py

```
from airflow import DAG
from datetime import datetime, timedelta
from operators.my_airflow_operator import MyOperator
from sensors.my_airflow_sensor import MySensor
from operators.hello_operator import HelloOperator
default_args = {
    'owner': 'airflow',
    'depends_on_past': False,
    'start_date': datetime(2018, 1, 1),
    'email_on_failure': False,
    'retries': 1,
```

```
'retry_delay': timedelta(minutes=5),
}
with DAG('customdag',
    max_active_runs=3,
    schedule_interval='@once',
    default_args=default_args) as dag:
sens = MySensor(
    task_id='taskA'
)
op = MyOperator(
    task_id='taskB',
    my_field='some text'
)
hello_task = HelloOperator(task_id='sample-task', name='foo_bar')
sens >> op >> hello_task
```

Example plugins/my_airflow_plugin.py

```
from airflow.plugins_manager import AirflowPlugin
from hooks.my_airflow_hook import *
from operators.my_airflow_operator import *
class PluginName(AirflowPlugin):
    name = 'my_airflow_plugin'
    hooks = [MyHook]
    operators = [MyOperator]
    sensors = [MySensor]
```

The following examples show each of the import statements needed in the custom plugin files.

Example hooks/my_airflow_hook.py

```
from airflow.hooks.base import BaseHook
```

```
class MyHook(BaseHook):
```

def my_method(self):
 print("Hello World")

Example sensors/my_airflow_sensor.py

Example operators/my_airflow_operator.py

hook.my_method()

Example operators/hello_operator.py

```
from airflow.models.baseoperator import BaseOperator
from airflow.utils.decorators import apply_defaults
class HelloOperator(BaseOperator):
    @apply_defaults
    def __init__(
        self,
        name: str,
        **kwargs) -> None:
        super().__init__(**kwargs)
        self.name = name
    def execute(self, context):
        message = "Hello {}".format(self.name)
        print(message)
        return message
```

Follow the steps in <u>Testing custom plugins using the Amazon MWAA CLI utility</u>, and then <u>Creating a plugins.zip file</u> to zip the contents **within** your plugins directory. For example, cd plugins.

Apache Airflow v1

The following example shows a plugins.zip file with separate directories for hooks, operators, and a sensors directory for Apache Airflow v1.10.12.

Example plugins.zip

```
sensors/
   |-- __init__.py
   |-- my_airflow_sensor.py
```

The following example shows the import statements in the DAG (<u>DAGs folder</u>) that uses the custom plugins.

Example dags/your_dag.py

```
from airflow import DAG
from datetime import datetime, timedelta
from operators.my_operator import MyOperator
from sensors.my_sensor import MySensor
from operators.hello_operator import HelloOperator
default_args = {
 'owner': 'airflow',
 'depends_on_past': False,
 'start_date': datetime(2018, 1, 1),
 'email_on_failure': False,
 'email_on_retry': False,
 'retries': 1,
 'retry_delay': timedelta(minutes=5),
}
with DAG('customdag',
  max_active_runs=3,
   schedule_interval='@once',
   default_args=default_args) as dag:
 sens = MySensor(
 task_id='taskA'
 )
 op = MyOperator(
 task_id='taskB',
 my_field='some text'
 )
 hello_task = HelloOperator(task_id='sample-task', name='foo_bar')
```

sens >> op >> hello_task

Example plugins/my_airflow_plugin.py

```
from airflow.plugins_manager import AirflowPlugin
from hooks.my_airflow_hook import *
from operators.my_airflow_operator import *
from utils.my_utils import *
class PluginName(AirflowPlugin):
    name = 'my_airflow_plugin'
    hooks = [MyHook]
    operators = [MyOperator]
    sensors = [MySensor]
```

The following examples show each of the import statements needed in the custom plugin files.

Example hooks/my_airflow_hook.py

```
from airflow.hooks.base_hook import BaseHook
class MyHook(BaseHook):
    def my_method(self):
        print("Hello World")
```

Example sensors/my_airflow_sensor.py

```
super(MySensor, self).__init__(*args, **kwargs)
def poke(self, context):
    return True
```

Example operators/my_airflow_operator.py

Example operators/hello_operator.py

```
from airflow.models.baseoperator import BaseOperator
from airflow.utils.decorators import apply_defaults
class HelloOperator(BaseOperator):
    @apply_defaults
    def __init__(
        self,
        name: str,
        **kwargs) -> None:
        super().__init__(**kwargs)
        self.name = name
    def execute(self, context):
        message = "Hello {}".format(self.name)
```

print(message) return message

Follow the steps in <u>Testing custom plugins using the Amazon MWAA CLI utility</u>, and then <u>Creating a plugins.zip file</u> to zip the contents **within** your plugins directory. For example, cd plugins.

Creating a plugins.zip file

The following steps describe the steps we recommend to create a plugins.zip file locally.

Step one: Test custom plugins using the Amazon MWAA CLI utility

- The command line interface (CLI) utility replicates an Amazon Managed Workflows for Apache Airflow environment locally.
- The CLI builds a Docker container image locally that's similar to an Amazon MWAA production image. This allows you to run a local Apache Airflow environment to develop and test DAGs, custom plugins, and dependencies before deploying to Amazon MWAA.
- To run the CLI, refer to the <u>aws-mwaa-local-runner</u> on GitHub.

Step two: Create the plugins.zip file

You can use a built-in ZIP archive utility, or any other ZIP utility (such as 7zip) to create a .zip file.

1 Note

The built-in zip utility for Windows OS may add subfolders when you create a .zip file. We recommend verifying the contents of the plugins.zip file before uploading to your Amazon S3 bucket to ensure no additional directories were added.

1. Change directories to your local Airflow plugins directory. For example:

myproject\$ cd plugins

2. Run the following command to ensure that the contents have executable permissions (macOS and Linux only).

plugins\$ chmod -R 755 .

3. Zip the contents **within** your plugins folder.

```
plugins$ zip -r plugins.zip .
```

Uploading plugins.zip to Amazon S3

You can use the Amazon S3 console or the AWS Command Line Interface (AWS CLI) to upload a plugins.zip file to your Amazon S3 bucket.

Using the AWS CLI

The AWS Command Line Interface (AWS CLI) is an open source tool that enables you to interact with AWS services using commands in your command-line shell. To complete the steps on this page, you need the following:

- AWS CLI Install version 2.
- AWS CLI Quick configuration with aws configure.

To upload using the AWS CLI

 In your command prompt, navigate to the directory where your plugins.zip file is stored. For example:

cd plugins

2. Use the following command to list all of your Amazon S3 buckets.

aws s3 ls

3. Use the following command to list the files and folders in the Amazon S3 bucket for your environment.

```
aws s3 ls s3://YOUR_S3_BUCKET_NAME
```

4. Use the following command to upload the plugins.zip file to the Amazon S3 bucket for your environment.

aws s3 cp plugins.zip s3://amzn-s3-demo-bucket/plugins.zip

Using the Amazon S3 console

The Amazon S3 console is a web-based user interface that allows you to create and manage the resources in your Amazon S3 bucket.

To upload using the Amazon S3 console

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Select the **S3 bucket** link in the **DAG code in S3** pane to open your storage bucket on the Amazon S3 console.
- 4. Choose Upload.
- 5. Choose Add file.
- 6. Select the local copy of your plugins.zip, choose **Upload**.

Installing custom plugins on your environment

This section describes how to install the custom plugins you uploaded to your Amazon S3 bucket by specifying the path to the plugins.zip file, and specifying the version of the plugins.zip file each time the zip file is updated.

Specifying the path to plugins.zip on the Amazon MWAA console (the first time)

If this is the first time you're uploading a plugins.zip to your Amazon S3 bucket, you also need to specify the path to the file on the Amazon MWAA console. You only need to complete this step once.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose Edit.
- 4. On the **DAG code in Amazon S3** pane, choose **Browse S3** next to the **Plugins file optional** field.

- 5. Select the plugins.zip file on your Amazon S3 bucket.
- 6. Choose Choose.
- 7. Choose Next, Update environment.

Specifying the plugins.zip version on the Amazon MWAA console

You need to specify the version of your plugins.zip file on the Amazon MWAA console each time you upload a new version of your plugins.zip in your Amazon S3 bucket.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose Edit.
- 4. On the **DAG code in Amazon S3** pane, choose a plugins.zip version in the dropdown list.
- 5. Choose Next.

Example use cases for plugins.zip

- Learn how to create a custom plugin in <u>Custom plugin with Apache Hive and Hadoop</u>.
- Learn how to create a custom plugin in Custom plugin to patch PythonVirtualenvOperator.
- Learn how to create a custom plugin in <u>Custom plugin with Oracle</u>.
- Learn how to create a custom plugin in the section called "Changing a DAG's timezone".

What's next?

 Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> <u>runner</u> on GitHub.

Installing Python dependencies

A Python dependency is any package or distribution that is not included in the Apache Airflow base install for your Apache Airflow version on your Amazon Managed Workflows for Apache Airflow environment. This topic describes the steps to install Apache Airflow Python dependencies on your Amazon MWAA environment using a requirements.txt file in your Amazon S3 bucket.

Contents

- Prerequisites
- How it works
- Python dependencies overview
 - Python dependencies location and size limits
- Creating a requirements.txt file
 - Step one: Test Python dependencies using the Amazon MWAA CLI utility
 - <u>Step two: Create the requirements.txt</u>
- Uploading requirements.txt to Amazon S3
 - Using the AWS CLI
 - Using the Amazon S3 console
- Installing Python dependencies on your environment
 - Specifying the path to requirements.txt on the Amazon MWAA console (the first time)
 - Specifying the requirements.txt version on the Amazon MWAA console
- <u>Viewing logs for your requirements.txt</u>
- What's next?

Prerequisites

You'll need the following before you can complete the steps on this page.

- Permissions Your AWS account must have been granted access by your administrator to the <u>AmazonMWAAFullConsoleAccess</u> access control policy for your environment. In addition, your Amazon MWAA environment must be permitted by your <u>execution role</u> to access the AWS resources used by your environment.
- Access If you require access to public repositories to install dependencies directly on the web server, your environment must be configured with **public network** web server access. For more information, refer to <u>the section called "Apache Airflow access modes"</u>.
- Amazon S3 configuration The <u>Amazon S3 bucket</u> used to store your DAGs, custom plugins in plugins.zip, and Python dependencies in requirements.txt must be configured with *Public Access Blocked* and *Versioning Enabled*.

How it works

On Amazon MWAA, you install all Python dependencies by uploading a requirements.txt file to your Amazon S3 bucket, then specifying the version of the file on the Amazon MWAA console each time you update the file. Amazon MWAA runs pip3 install -r requirements.txt to install the Python dependencies on the Apache Airflow scheduler and each of the workers.

To run Python dependencies on your environment, you must do three things:

- 1. Create a requirements.txt file locally.
- 2. Upload the local requirements.txt to your Amazon S3 bucket.
- 3. Specify the version of this file in the **Requirements file** field on the Amazon MWAA console.

Note

If this is the first time you're creating and uploading a requirements.txt to your Amazon S3 bucket, you also need to specify the path to the file on the Amazon MWAA console. You only need to complete this step once.

Python dependencies overview

You can install Apache Airflow extras and other Python dependencies from the Python Package Index (PyPi.org), Python wheels (.wh1), or Python dependencies hosted on a private PyPi/PEP-503 Compliant Repo on your environment.

Python dependencies location and size limits

The Apache Airflow Scheduler and the Workers look for the packages in the requirements.txt file and the packages are installed on the environment at /usr/local/airflow/.local/bin.

• Size limit. We recommend a requirements.txt file that references libraries whose combined size is less than than 1 GB. The more libraries Amazon MWAA needs to install, the longer the *startup* time on an environment. Although Amazon MWAA doesn't limit the size of installed libraries explicitly, if dependencies can't be installed within ten minutes, the Fargate service will time-out and attempt to rollback the environment to a stable state.

Creating a requirements.txt file

The following steps describe the steps we recommend to create a requirements.txt file locally.

Step one: Test Python dependencies using the Amazon MWAA CLI utility

- The command line interface (CLI) utility replicates an Amazon Managed Workflows for Apache Airflow environment locally.
- The CLI builds a Docker container image locally that's similar to an Amazon MWAA production image. This allows you to run a local Apache Airflow environment to develop and test DAGs, custom plugins, and dependencies before deploying to Amazon MWAA.
- To run the CLI, refer to the <u>aws-mwaa-local-runner</u> on GitHub.

Step two: Create the requirements.txt

The following section describes how to specify Python dependencies from the <u>Python Package</u> <u>Index</u> in a requirements.txt file.

Apache Airflow v2

- 1. **Test locally**. Add additional libraries iteratively to find the right combination of packages and their versions, before creating a requirements.txt file. To run the Amazon MWAA CLI utility, refer to the aws-mwaa-local-runner on GitHub.
- 2. **Review the Apache Airflow package extras**. To view a list of the packages installed for Apache Airflow v2 on Amazon MWAA, refer to <u>Amazon MWAA local runner</u> <u>requirements.txt</u> on the GitHub website.
- 3. Add a constraints statement. Add the constraints file for your Apache Airflow v2 environment at the top of your requirements.txt file. Apache Airflow constraints files specify the provider versions available at the time of a Apache Airflow release.

Beginning with Apache Airflow v2.7.2, your requirements file must include a -constraint statement. If you do not provide a constraint, Amazon MWAA will specify one for you to ensure the packages listed in your requirements are compatible with the version of Apache Airflow you are using.

In the following example, replace *{environment-version}* with your environment's version number, and *{Python-version}* with the version of Python that's compatible with your environment.

For information on the version of Python compatible with your Apache Airflow environment, refer to Apache Airflow Versions.

```
--constraint "https://raw.githubusercontent.com/apache/airflow/
constraints-{Airflow-version}/constraints-{Python-version}.txt"
```

If the constraints file determines that xyz==1.0 package is not compatible with other packages in your environment, pip3 install will fail in order to prevent incompatible libraries from being installed to your environment. If installation fails for any packages, you can view error logs for each Apache Airflow component (the scheduler, worker, and web server) in the corresponding log stream on CloudWatch Logs. For more information on log types, refer to the section called "Viewing Airflow logs".

4. **Apache Airflow packages**. Add the <u>package extras</u> and the version (==). This helps to prevent packages of the same name, but different version, from being installed on your environment.

```
apache-airflow[package-extra]==2.5.1
```

 Python libraries. Add the package name and the version (==) in your requirements.txt file. This helps to prevent a future breaking update from <u>PyPi.org</u> from being automatically applied.

library == version

Example Boto3 and psycopg2-binary

This example is provided for demonstration purposes. The boto and psycopg2-binary libraries are included with the Apache Airflow v2 base install and don't need to be specified in a requirements.txt file.

```
boto3==1.17.54
boto==2.49.0
botocore==1.20.54
psycopg2-binary==2.8.6
```

If a package is specified without a version, Amazon MWAA installs the latest version of the package from <u>PyPi.org</u>. This version may conflict with other packages in your requirements.txt.

Apache Airflow v1

- 1. **Test locally**. Add additional libraries iteratively to find the right combination of packages and their versions, before creating a requirements.txt file. To run the Amazon MWAA CLI utility, refer to the aws-mwaa-local-runner on GitHub.
- 2. **Review the Airflow package extras**. Review the list of packages available for Apache Airflow v1.10.12 at <u>https://raw.githubusercontent.com/apache/airflow/</u> constraints-1.10.12/constraints-3.7.txt.
- 3. Add the constraints file. Add the constraints file for Apache Airflow v1.10.12 to the top of your requirements.txt file. If the constraints file determines that xyz==1.0 package is not compatible with other packages on your environment, the pip3 install will fail to prevent incompatible libraries from being installed to your environment.

```
--constraint "https://raw.githubusercontent.com/apache/airflow/ constraints-1.10.12/constraints-3.7.txt"
```

4. **Apache Airflow v1.10.12 packages**. Add the <u>Airflow package extras</u> and the Apache Airflow v1.10.12 version (==). This helps to prevent packages of the same name, but different version, from being installed on your environment.

```
apache-airflow[package]==1.10.12
```

Example Secure Shell (SSH)

The following example requirements.txt file installs SSH for Apache Airflow v1.10.12.

```
apache-airflow[ssh]==1.10.12
```

5. **Python libraries**. Add the package name and the version (==) in your requirements.txt file. This helps to prevent a future breaking update from <u>PyPi.org</u> from being automatically applied.

```
library == version
```

Example Boto3

The following example requirements.txt file installs the Boto3 library for Apache Airflow v1.10.12.

boto3 == 1.17.4

If a package is specified without a version, Amazon MWAA installs the latest version of the package from <u>PyPi.org</u>. This version may conflict with other packages in your requirements.txt.

Uploading requirements.txt to Amazon S3

You can use the Amazon S3 console or the AWS Command Line Interface (AWS CLI) to upload a requirements.txt file to your Amazon S3 bucket.

Using the AWS CLI

The AWS Command Line Interface (AWS CLI) is an open source tool that enables you to interact with AWS services using commands in your command-line shell. To complete the steps on this page, you need the following:

- AWS CLI Install version 2.
- AWS CLI Quick configuration with aws configure.

To upload using the AWS CLI

1. Use the following command to list all of your Amazon S3 buckets.

aws s3 ls

2. Use the following command to list the files and folders in the Amazon S3 bucket for your environment.

aws s3 ls s3://YOUR_S3_BUCKET_NAME

3. The following command uploads a requirements.txt file to an Amazon S3 bucket.

Using the Amazon S3 console

The Amazon S3 console is a web-based user interface that allows you to create and manage the resources in your Amazon S3 bucket.

To upload using the Amazon S3 console

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Select the **S3 bucket** link in the **DAG code in S3** pane to open your storage bucket on the Amazon S3 console.
- 4. Choose Upload.
- 5. Choose Add file.
- 6. Select the local copy of your requirements.txt, choose **Upload**.

Installing Python dependencies on your environment

This section describes how to install the dependencies you uploaded to your Amazon S3 bucket by specifying the path to the requirements.txt file, and specifying the version of the requirements.txt file each time it's updated.

Specifying the path to requirements.txt on the Amazon MWAA console (the first time)

If this is the first time you're creating and uploading a requirements.txt to your Amazon S3 bucket, you also need to specify the path to the file on the Amazon MWAA console. You only need to complete this step once.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose Edit.
- 4. On the **DAG code in Amazon S3** pane, choose **Browse S3** next to the **Requirements file - optional** field.

- 5. Select the requirements.txt file on your Amazon S3 bucket.
- 6. Choose Choose.
- 7. Choose Next, Update environment.

You can begin using the new packages immediately after your environment finishes updating.

Specifying the requirements.txt version on the Amazon MWAA console

You need to specify the version of your requirements.txt file on the Amazon MWAA console each time you upload a new version of your requirements.txt in your Amazon S3 bucket.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose Edit.
- On the DAG code in Amazon S3 pane, choose a requirements.txt version in the dropdown list.
- 5. Choose Next, Update environment.

You can begin using the new packages immediately after your environment finishes updating.

Viewing logs for your requirements.txt

You can view Apache Airflow logs for the *Scheduler* scheduling your workflows and parsing your dags folder. The following steps describe how to open the log group for the *Scheduler* on the Amazon MWAA console, and view Apache Airflow logs on the CloudWatch Logs console.

To view logs for a requirements.txt

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose the **Airflow scheduler log group** on the **Monitoring** pane.
- 4. Choose the requirements_install_ip log in Log streams.
- 5. You should see the list of packages that were installed on the environment at /usr/local/ airflow/.local/bin. For example:

Collecting appdirs==1.4.4 (from -r /usr/local/airflow/.local/bin (line 1))

```
Downloading https://files.pythonhosted.org/
packages/3b/00/2344469e2084fb28kjdsfiuyweb47389789vxbmnbjhsdgf5463acd6cf5e3db69324/
appdirs-1.4.4-py2.py3-none-any.whl
Collecting astroid==2.4.2 (from -r /usr/local/airflow/.local/bin (line 2))
```

6. Review the list of packages and whether any of these encountered an error during installation. If something went wrong, you may see an error similar to the following:

```
2021-03-05T14:34:42.731-07:00
No matching distribution found for LibraryName==1.0.0 (from -r /usr/local/
airflow/.local/bin (line 4))
No matching distribution found for LibraryName==1.0.0 (from -r /usr/local/
airflow/.local/bin (line 4))
```

What's next?

 Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> <u>runner</u> on GitHub.

Deleting files on Amazon S3

This page describes how versioning works in an Amazon S3 bucket for an Amazon Managed Workflows for Apache Airflow environment, and the steps to delete a DAG, plugins.zip, or requirements.txt file.

Contents

- Prerequisites
- Versioning overview
- How it works
- Deleting a DAG on Amazon S3
- Removing a "current" requirements.txt or plugins.zip from an environment
- Deleting a "non-current" (previous) requirements.txt or plugins.zip version
- Using lifecycles to delete "non-current" (previous) versions and delete markers automatically
- Example lifecycle policy to delete requirements.txt "non-current" versions and delete markers automatically
- What's next?

Prerequisites

You'll need the following before you can complete the steps on this page.

- Permissions Your AWS account must have been granted access by your administrator to the <u>AmazonMWAAFullConsoleAccess</u> access control policy for your environment. In addition, your Amazon MWAA environment must be permitted by your <u>execution role</u> to access the AWS resources used by your environment.
- Access If you require access to public repositories to install dependencies directly on the web server, your environment must be configured with **public network** web server access. For more information, refer to <u>the section called "Apache Airflow access modes"</u>.
- Amazon S3 configuration The <u>Amazon S3 bucket</u> used to store your DAGs, custom plugins in plugins.zip, and Python dependencies in requirements.txt must be configured with *Public Access Blocked* and *Versioning Enabled*.

Versioning overview

The requirements.txt and plugins.zip in your Amazon S3 bucket are versioned. When Amazon S3 bucket versioning is enabled for an object, and an artifact (for example, plugins.zip) is deleted from an Amazon S3 bucket, the file doesn't get deleted entirely. Anytime an artifact is deleted on Amazon S3, a new copy of the file is created that is a 404 (Object not found) error/Ok file that says "I'm not here." Amazon S3 calls this a *delete marker*. A delete marker is a "null" version of the file with a key name (or key) and version ID like any other object.

We recommend deleting file versions and delete markers periodically to reduce storage costs for your Amazon S3 bucket. To delete "non-current" (previous) file versions entirely, you must delete the versions of the file(s), and then the *delete marker* for the version.

How it works

Amazon MWAA runs a sync operation on your Amazon S3 bucket every thirty seconds. This causes any DAG deletions in an Amazon S3 bucket to be synced to the Airflow image of your Fargate container.

For plugins.zip and requirements.txt files, changes occur only after an environment update when Amazon MWAA builds a new Airflow image of your Fargate container with the custom plugins and Python dependencies. If you delete the *current* version of any of a requirements.txt or plugins.zip file, and then update your environment without providing a new version for the deleted file, then the update will fail with an error message, such as, "Unable to read version {version} of file {file}".

Deleting a DAG on Amazon S3

A DAG file (.py) is not versioned and can be deleted directly on the Amazon S3 console. The following steps describe how to delete a DAG on your Amazon S3 bucket.

To delete a DAG

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Select the **S3 bucket** link in the **DAG code in S3** pane to open your storage bucket on the Amazon S3 console.
- 4. Choose the dags folder.
- 5. Select the DAG, **Delete**.
- 6. Under **Delete objects?**, type delete.
- 7. Choose **Delete objects**.

Note

Apache Airflow preserves historical DAG runs. After a DAG has been run in Apache Airflow, it remains in the Airflow DAGs list regardless of the file status, until you delete it in Apache Airflow. To delete a DAG in Apache Airflow, choose the red "delete" button under the **Links** column.

Removing a "current" requirements.txt or plugins.zip from an environment

Currently, there isn't a way to remove a plugins.zip or requirements.txt from an environment after they've been added, but we're working on the issue. In the interim, a workaround is to point to an empty text or zip file, respectively.

Deleting a "non-current" (previous) requirements.txt or plugins.zip version

The requirements.txt and plugins.zip files in your Amazon S3 bucket are versioned on Amazon MWAA. If you want to delete these files on your Amazon S3 bucket entirely, you must retrieve the current version (121212) of the object (for example, plugins.zip), delete the version, and then remove the *delete marker* for the file version(s).

You can also delete "non-current" (previous) file versions on the Amazon S3 console; however, you'll still need to delete the *delete marker* using one of the following options.

- To retrieve the object version, refer to <u>Retrieving object versions from a versioning-enabled</u> <u>bucket</u> *in the Amazon S3 guide*.
- To delete the object version, refer to <u>Deleting object versions from a versioning-enabled bucket</u> *in the Amazon S3 guide*.
- To remove a delete marker, refer to <u>Managing delete markers</u> in the Amazon S3 guide.

Using lifecycles to delete "non-current" (previous) versions and delete markers automatically

You can configure a lifecycle policy for your Amazon S3 bucket to delete "non-current" (previous) versions of the plugins.zip and requirements.txt files in your Amazon S3 bucket after a certain number of days, or to remove an expired object's delete marker.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Under **DAG code in Amazon S3**, choose your Amazon S3 bucket.
- 4. Choose Create lifecycle rule.

Example lifecycle policy to delete requirements.txt "non-current" versions and delete markers automatically

The following example shows how to create a lifecycle rule that permanently deletes "non-current" versions of a requirements.txt file and their delete markers after thirty days.

1. Open the Environments page on the Amazon MWAA console.

- 2. Choose an environment.
- 3. Under **DAG code in Amazon S3**, choose your Amazon S3 bucket.
- 4. Choose **Create lifecycle rule**.
- 5. In **Lifecycle rule name**, type Delete previous requirements.txt versions and delete markers after thirty days.
- 6. In **Prefix**, **requirements**.
- 7. In Lifecycle rule actions, choose Permanently delete previous versions of objects and Delete expired delete markers or incomplete multipart uploads.
- 8. In Number of days after objects become previous versions, type 30.
- 9. In Expired object delete markers, choose Delete expired object delete markers, objects are permanently deleted after 30 days.

What's next?

- Learn more about Amazon S3 delete markers in Managing delete markers.
- Learn more about Amazon S3 lifecycles in Expiring objects.

Networking

This guide describes the Amazon VPC network setup you'll need for an Amazon MWAA environment.

Sections

- About networking on Amazon MWAA
- Security in your VPC on Amazon MWAA
- Managing access to service-specific Amazon VPC endpoints on Amazon MWAA
- Creating the required VPC service endpoints in an Amazon VPC with private routing
- Managing your own Amazon VPC endpoints on Amazon MWAA

About networking on Amazon MWAA

An Amazon VPC is a virtual network that is linked to your AWS account. It gives you cloud security and the ability to scale dynamically by providing fine-grained control over your virtual infrastructure and network traffic segmentation. This page describes the Amazon VPC infrastructure with *public routing* or *private routing* that's needed to support an Amazon Managed Workflows for Apache Airflow environment.

Contents

- <u>Terms</u>
- What's supported
- VPC infrastructure overview
 - Public routing over the Internet
 - Private routing without Internet access
- Example use cases for an Amazon VPC and Apache Airflow access mode
 - Internet access is allowed new Amazon VPC network
 - Internet access is not allowed new Amazon VPC network
 - Internet access is not allowed existing Amazon VPC network

Terms

Public routing

An Amazon VPC network that has access to the Internet.

Private routing

An Amazon VPC network **without** access to the Internet.

What's supported

The following table describes the types of Amazon VPCs Amazon MWAA supports.

Amazon VPC types	Supported
An Amazon VPC owned by the account that is attemptin g to create the environment.	Yes
A shared Amazon VPC where multiple AWS accounts create their AWS resources.	Yes

VPC infrastructure overview

When you create an Amazon MWAA environment, Amazon MWAA creates between one to two VPC endpoints for your environment based on the Apache Airflow access mode you chose for your environment. These endpoints appear as Elastic Network Interfaces (ENIs) with private IPs in your Amazon VPC. After these endpoints are created, any traffic destined to these IPs is privately or publicly routed to the corresponding AWS services used by your environment.

The following section describes the Amazon VPC infrastructure required to route traffic publicly *over the Internet*, or privately *within your Amazon VPC*.

Public routing over the Internet

This section describes the Amazon VPC infrastructure of an environment with public routing. You'll need the following VPC infrastructure:

- **One VPC security group**. A VPC security group acts as a virtual firewall to control ingress (inbound) and egress (outbound) network traffic on an instance.
 - Up to 5 security groups can be specified.
 - The security group must specify a self-referencing inbound rule to itself.
 - The security group must specify an outbound rule for all traffic (0.0.0/0; for IPv6, use ::/0).
 - The security group must allow all traffic in the self-referencing rule. For example, (Recommended) Example all access self-referencing security group .
 - The security group can *optionally* restrict traffic further by specifying the port range for HTTPS port range 443 and a TCP port range 5432. For example, <u>(Optional) Example security group</u> that restricts inbound access to port 5432 and <u>(Optional) Example security group that restricts</u> inbound access to port 443.
- **Two public subnets**. A public subnet is a subnet that's associated with a route table that has a route to an Internet gateway.
 - Two public subnets are required. This allows Amazon MWAA to build a new container image for your environment in your other availability zone, if one container fails.
 - The subnets must be in different Availability Zones. For example, us-east-1a, us-east-1b.
 - The subnets must route to a NAT gateway (or NAT instance) with an Elastic IP Address (EIP).
 - The subnets must have a route table that directs internet-bound traffic to an Internet gateway.
- **Two private subnets**. A private subnet is a subnet that's **not** associated with a route table that has a route to an Internet gateway.
 - Two private subnets are required. This allows Amazon MWAA to build a new container image for your environment in your other availability zone, if one container fails.
 - The subnets must be in different Availability Zones. For example, us-east-1a, us-east-1b.
 - The subnets *must* have a route table to a NAT device (gateway or instance).
 - The subnets **must not** route to an Internet gateway.
 - Set assignIpV6AddressOnCreation to true for IPv6 subnets.
 - For IPv6 private subnets, you must have a connection to an egress-only internet gateway (EIGW).
- A network access control list (ACL). An NACL manages (by allow or deny rules) inbound and outbound traffic at the subnet level.

• The NACL must have an inbound rule that allows all traffic (0.0.0.0/0; for IPv6, use ::/0). VPC infrastructure overview

- The NACL must have an outbound rule that allows all traffic (0.0.0/0; for IPv6, use ::/0).
- For example, (Recommended) Example ACLs.
- **Two NAT gateways (or NAT instances)**. A NAT device forwards traffic from the instances in the private subnet to the Internet or other AWS services, and then routes the response back to the instances.
 - The NAT device must be attached to a public subnet. (One NAT device per public subnet.)
 - The NAT device must have an Elastic IPv4 Address (EIP) attached to each public subnet.
- An Internet gateway. An Internet gateway connects an Amazon VPC to the Internet and other AWS services.
 - An Internet gateway must be attached to the Amazon VPC.

Private routing without Internet access

This section describes the Amazon VPC infrastructure of an environment with *private routing*. You'll need the following VPC infrastructure:

- **One VPC security group**. A VPC security group acts as a virtual firewall to control ingress (inbound) and egress (outbound) network traffic on an instance.
 - Up to 5 security groups can be specified.
 - The security group must specify a self-referencing inbound rule to itself.
 - The security group must specify an outbound rule for all traffic (0.0.0/0; for IPv6, use ::/0).
 - The security group must allow all traffic in the self-referencing rule. For example, (Recommended) Example all access self-referencing security group .
 - The security group can *optionally* restrict traffic further by specifying the port range for HTTPS port range 443 and a TCP port range 5432. For example, <u>(Optional) Example security group</u> that restricts inbound access to port 5432 and <u>(Optional) Example security group that restricts</u> inbound access to port 443.
- **Two private subnets**. A private subnet is a subnet that's **not** associated with a route table that has a route to an Internet gateway.
 - Two private subnets are required. This allows Amazon MWAA to build a new container image for your environment in your other availability zone, if one container fails.
 - The subnets must be in different Availability Zones. For example, us-east-1a, us-east-1b.
 - The subnets must have a route table to your VPC endpoints.

- The subnets must have a route table to an EIGW in order to download from the internet as part of a DAG.
- The subnets must not have a route table to a NAT device (gateway or instance), nor an Internet gateway.
- A network access control list (ACL). An NACL manages (by allow or deny rules) inbound and outbound traffic at the subnet level.
 - The NACL must have an inbound rule that allows all traffic (0.0.0.0/0; for IPv6, use ::/0).
 - The NACL must have an outbound rule that denies all traffic (0.0.0.0/0; for IPv6, use ::/0).
 - For example, (Recommended) Example ACLs.
- A local route table. A local route table is a default route for communication within the VPC.
 - The local route table must be associated to your private subnets.
 - The local route table must enable instances in your VPC to communicate with your own network. For example, if you're using an AWS Client VPN to access the VPC interface endpoint for your Apache Airflow *Web server*, the route table must route to the VPC endpoint.
- VPC endpoints for each AWS service used by your environment, and Apache Airflow VPC endpoints in the same AWS Region and Amazon VPC as your Amazon MWAA environment.
 - A VPC endpoint for each AWS service used by the environment and VPC endpoints for Apache Airflow. For example, (Required) VPC endpoints.
 - The VPC endpoints must have private DNS enabled.
 - The VPC endpoints must be associated to your environment's two private subnets.
 - The VPC endpoints must be associated to your environment's security group.
 - The VPC endpoint policy for each endpoint should be configured to allow access to AWS services used by the environment. For example, <u>(Recommended) Example VPC endpoint policy</u> <u>to allow all access</u>.
 - A VPC endpoint policy for Amazon S3 should be configured to allow bucket access. For example, <u>(Recommended) Example Amazon S3 gateway endpoint policy to allow bucket</u> <u>access</u>.

Example use cases for an Amazon VPC and Apache Airflow access mode

This section descibes the different use cases for network access in your Amazon VPC and the Apache Airflow *Web server* access mode you should choose on the Amazon MWAA console.

If Internet access in your VPC is allowed by your organization, *and* you would like users to access your Apache Airflow *Web server* over the Internet:

- 1. Create an Amazon VPC network with Internet access.
- 2. Create an environment with the **Public network** access mode for your Apache Airflow *Web server*.
- 3. What we recommend: We recommend using the AWS CloudFormation quick-start template that creates the Amazon VPC infrastructure, an Amazon S3 bucket, and an Amazon MWAA environment at the same time. To learn more, refer to <u>Quick start tutorial for Amazon Managed Workflows for Apache Airflow</u>.

If Internet access in your VPC is allowed by your organization, *and* you would like to limit Apache Airflow *Web server* access to users within your VPC:

- 1. Create an Amazon VPC network *with Internet access*.
- 2. Create a mechanism to access the VPC interface endpoint for your Apache Airflow *Web server* from your computer.
- 3. Create an environment with the **Private network** access mode for your Apache Airflow *Web server*.
- 4. What we recommend:
 - a. We recommend using the Amazon MWAA console in <u>Option one: Creating the VPC</u> <u>network on the Amazon MWAA console</u>, or the AWS CloudFormation template in <u>Option</u> two: Creating an Amazon VPC network *with* Internet access.
 - b. We recommend configuring access using an AWS Client VPN to your Apache Airflow *Web server* in Tutorial: Configuring private network access using an AWS Client VPN.

Internet access is not allowed - new Amazon VPC network

If Internet access in your VPC is **not allowed** by your organization:

- 1. Create an Amazon VPC network *without Internet access*.
- 2. Create a mechanism to access the VPC interface endpoint for your Apache Airflow *Web server* from your computer.

Example use cases for an Amazon VPC and Apache Airflow access mode

- 3. Create VPC endpoints for each AWS service used by your environment.
- 4. Create an environment with the **Private network** access mode for your Apache Airflow *Web server*.

5. What we recommend:

- a. We recommend using the AWS CloudFormation template to create an Amazon VPC without Internet access and the VPC endpoints for each AWS service used by Amazon MWAA in Option three: Creating an Amazon VPC network *without* Internet access.
- b. We recommend configuring access using an AWS Client VPN to your Apache Airflow *Web server* in Tutorial: Configuring private network access using an AWS Client VPN.

Internet access is not allowed - existing Amazon VPC network

If Internet access in your VPC is **not allowed** by your organization, *and* you already have the required Amazon VPC network *without Internet access*:

- 1. Create VPC endpoints for each AWS service used by your environment.
- 2. Create VPC endpoints for Apache Airflow.
- 3. Create a mechanism to access the VPC interface endpoint for your Apache Airflow *Web server* from your computer.
- 4. Create an environment with the **Private network** access mode for your Apache Airflow *Web server*.
- 5. What we recommend:
 - a. We recommend creating and attaching the VPC endpoints needed for each AWS service used by Amazon MWAA, and the VPC endpoints needed for Apache Airflow in <u>Creating the</u> required VPC service endpoints in an Amazon VPC with private routing.
 - b. We recommend configuring access using an AWS Client VPN to your Apache Airflow *Web server* in Tutorial: Configuring private network access using an AWS Client VPN.

Security in your VPC on Amazon MWAA

This page describes the Amazon VPC components used to secure your Amazon Managed Workflows for Apache Airflow environment and the configurations needed for these components.

Contents

- Terms
- Security overview
- Network access control lists (ACLs)
- (Recommended) Example ACLs
- VPC security groups
 - (Recommended) Example all access self-referencing security group
 - (Optional) Example security group that restricts inbound access to port 5432
 - (Optional) Example security group that restricts inbound access to port 443
- VPC endpoint policies (private routing only)
 - (Recommended) Example VPC endpoint policy to allow all access
 - (Recommended) Example Amazon S3 gateway endpoint policy to allow bucket access

Terms

Public routing

An Amazon VPC network that has access to the Internet.

Private routing

An Amazon VPC network without access to the Internet.

Security overview

Security groups and access control lists (ACLs) provide ways to control the network traffic across the subnets and instances in your Amazon VPC using rules you specify.

- Network traffic to and from a subnet can be controlled by Access Control Lists (ACLs). You only need one ACL, and the same ACL can be used on multiple environments.
- Network traffic to and from an instance can be controlled by an Amazon VPC security group. You can use between one to five security groups per environment.
- Network traffic to and from an instance can also be controlled by VPC endpoint policies. If
 Internet access within your Amazon VPC is not allowed by your organization and you're using an
 Amazon VPC network with *private routing*, a VPC endpoint policy is required for the <u>AWS VPC</u>
 endpoints and Apache Airflow VPC endpoints.

Network access control lists (ACLs)

A <u>network access control list (ACL)</u> can manage (by allow or deny rules) inbound and outbound traffic at the *subnet* level. An ACL is stateless, which means that inbound and outbound rules must be specified separately and explicitly. It is used to specify the types of network traffic that are allowed in or out from the instances in a VPC network.

Every Amazon VPC has a default ACL that allows all inbound and outbound traffic. You can edit the default ACL rules, or create a custom ACL and attach it to your subnets. A subnet can only have one ACL attached to it at any time, but one ACL can be attached to multiple subnets.

(Recommended) Example ACLs

The following example shows the *inbound* and *outbound* ACL rules that can be used for an Amazon VPC with *public routing* or *private routing*.

Rule number	Туре	Protocol	Port range	Source	Allow/Deny
100	All IPv4 traffic	All	All	0.0.0.0/0	Allow
*	All IPv4 traffic	All	All	0.0.0.0/0	Deny

VPC security groups

A <u>VPC security group</u> acts as a virtual firewall that controls the network traffic at the *instance* level. A security group is stateful, which means that when an inbound connection is permitted, it is allowed to reply. It is used to specify the types of network traffic that are allowed in from the instances in a VPC network.

Every Amazon VPC has a default security group. By default, it has no inbound rules. It has an outbound rule that allows all outbound traffic. You can edit the default security group rules, or create a custom security group and attach it to your Amazon VPC. On Amazon MWAA, you need to configure inbound and outbound rules to direct traffic on your NAT gateways.

(Recommended) Example all access self-referencing security group

The following example shows the *inbound* security group rules that allows all traffic for an Amazon VPC with *public routing* or *private routing*. The security group in this example is a self-referencing rule to itself.

Туре	Protocol	Source Type	Source
All traffic	All	All	sg-0909e8 e81919 / my-mwaa-v pc-security- group

The following example shows the *outbound* security group rules.

Туре	Protocol	Source Type	Source
All traffic	All	All	0.0.0/0

(Optional) Example security group that restricts inbound access to port 5432

The following example shows the *inbound* security group rules that allow all HTTPS traffic on port 5432 for the Amazon Aurora PostgreSQL metadata database (owned by Amazon MWAA) for your environment.

🚯 Note

If you choose to restrict traffic using this rule, you'll need to add another rule to allow TCP traffic on port 443.

Туре	Protocol	Port range	Source type	Source
Custom TCP	ТСР	5432	Custom	sg-0909e8 e81919 /

Туре	Protocol	Port range	Source type	Source	
				my-mwaa-v pc-security- group	

(Optional) Example security group that restricts inbound access to port 443

The following example shows the *inbound* security group rules that allow all TCP traffic on port 443 for the Apache Airflow *Web server*.

Туре	Protocol	Port range	Source type	Source
HTTPS	ТСР	443	Custom	sg-0909e8 e81919 / my-mwaa-v pc-security- group

VPC endpoint policies (private routing only)

A <u>VPC endpoint (AWS PrivateLink)</u> policy controls access to AWS services from your private subnet. A VPC endpoint policy is an IAM resource policy that you attach to your VPC gateway or interface endpoint. This section describes the permissions needed for the VPC endpoint policies for each VPC endpoint.

We recommend using a VPC interface endpoint policy for each of the VPC endpoints you created that allows full access to all AWS services, and using your execution role exclusively for AWS permissions.

(Recommended) Example VPC endpoint policy to allow all access

The following example shows a VPC interface endpoint policy for an Amazon VPC with *private routing*.

```
{
    "Statement": [
    {
```

```
"Action": "*",
"Effect": "Allow",
"Resource": "*",
"Principal": "*"
}
]
}
```

(Recommended) Example Amazon S3 gateway endpoint policy to allow bucket access

The following example shows a VPC gateway endpoint policy that provides access to the Amazon S3 buckets required for Amazon ECR operations for an Amazon VPC with *private routing*. This is required for your Amazon ECR image to be retrieved, in addition to the bucket where your DAGs and supporting files are stored.

```
{
   "Statement": [
   {
      "Sid": "Access-to-specific-bucket-only",
      "Principal": "*",
      "Action": [
      "s3:GetObject"
      ],
      "Effect": "Allow",
      "Resource": ["arn:aws:s3:::prod-us-east-1-starport-layer-bucket/*"]
    }
]
```

Managing access to service-specific Amazon VPC endpoints on Amazon MWAA

A VPC endpoint (AWS PrivateLink) enables you to privately connect your VPC to services hosted on AWS without requiring an Internet gateway, a NAT device, VPN, or firewall proxies. These endpoints are horizontally scalable and highly available virtual devices that allow communication between instances in your VPC and AWS services. This page describes the VPC endpoints created by Amazon MWAA, and how to access the VPC endpoint for your Apache Airflow *Web server* if you've chosen the **Private network** access mode on Amazon Managed Workflows for Apache Airflow.

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 - <u>Private network access mode</u>
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 - Identifying the private IP addresses of your Apache Airflow Web server and its VPC endpoint
- Accessing the VPC endpoint for your Apache Airflow Web server (private network access)
 - Using an AWS Client VPN
 - Using a Linux Bastion Host
 - Using a Load Balancer (advanced)

Pricing

AWS PrivateLink Pricing

VPC endpoint overview

When you create an Amazon MWAA environment, Amazon MWAA creates between one to two VPC endpoints for your environment. These endpoints appear as Elastic Network Interfaces (ENIs) with private IPs in your Amazon VPC. After these endpoints are created, any traffic destined to these IPs is privately or publicly routed to the corresponding AWS services used by your environment.

Public network access mode

If you chose the **Public network** access mode for your Apache Airflow *Web server*, network traffic is publicly routed *over the Internet*.

• Amazon MWAA creates a VPC interface endpoint for your Amazon Aurora PostgreSQL metadata database. The endpoint is created in the Availability Zones mapped to your private subnets and is independent from other AWS accounts.

 Amazon MWAA then binds an IP address from your private subnets to the interface endpoints. This is designed to support the best practice of binding a single IP from each Availability Zone of the Amazon VPC.

Private network access mode

If you chose the **Private network** access mode for your Apache Airflow *Web server*, network traffic is privately routed *within your Amazon VPC*.

- Amazon MWAA creates a VPC interface endpoint for your Apache Airflow Web server, and an interface endpoint for your Amazon Aurora PostgreSQL metadata database. The endpoints are created in the Availability Zones mapped to your private subnets and is independent from other AWS accounts.
- Amazon MWAA then binds an IP address from your private subnets to the interface endpoints. This is designed to support the best practice of binding a single IP from each Availability Zone of the Amazon VPC.

Permission to use other AWS services

The interface endpoints use the execution role for your environment in AWS Identity and Access Management (IAM) to manage permission to AWS resources used by your environment. As more AWS services are enabled for an environment, each service will require you to configure permission using your environment's execution role. To add permissions, refer to <u>Amazon MWAA execution</u> role.

If you've chosen the **Private network** access mode for your Apache Airflow *Web server*, you must also allow permission in the VPC endpoint policy for each endpoint. To learn more, refer to <u>the</u> <u>section called "VPC endpoint policies (private routing only)"</u>.

Viewing VPC endpoints

This section describes how to view the VPC endpoints created by Amazon MWAA, and how to identify the private IP addresses for your Apache Airflow VPC endpoint.

Viewing VPC endpoints on the Amazon VPC console

The following section shows the steps to view the VPC endpoint(s) created by Amazon MWAA, and any VPC endpoints you may have created if you're using *private routing* for your Amazon VPC.

To view the VPC endpoint(s)

- 1. Open the Endpoints page on the Amazon VPC console.
- 2. Use the AWS Region selector to select your region.
- 3. You should see the VPC interface endpoint(s) created by Amazon MWAA, and any VPC endpoints you may have created if you're using *private routing* in your Amazon VPC.

To learn more about the VPC service endpoints that are required for an Amazon VPC with *private routing*, refer to <u>Creating the required VPC service endpoints in an Amazon VPC with private</u> routing.

Identifying the private IP addresses of your Apache Airflow Web server and its VPC endpoint

The following steps describe how to retrieve the host name of your Apache Airflow Web server and its VPC interface endpoint, and their private IP addresses.

1. Use the following AWS Command Line Interface (AWS CLI) command to retrieve the host name for your Apache Airflow *Web server*.

```
aws mwaa get-environment --name YOUR_ENVIRONMENT_NAME --query
'Environment.WebserverUrl'
```

You should see something similar to the following response:

"99aa99aa-55aa-44a1-a91f-f4552cf4e2f5-vpce.c10.us-west-2.airflow.amazonaws.com"

2. Run a *dig* command on the host name returned in the response of the previous command. For example:

```
dig CNAME +short 99aa99aa-55aa-44a1-a91f-f4552cf4e2f5-vpce.c10.us-
west-2.airflow.amazonaws.com
```

You should see something similar to the following response:

```
vpce-0699aa333a0a0a0-bf90xjtr.vpce-svc-00bb7c2ca2213bc37.us-
west-2.vpce.amazonaws.com.
```

3. Use the following AWS Command Line Interface (AWS CLI) command to retrieve the VPC endpoint DNS name returned in the response of the previous command. For example:

```
aws ec2 describe-vpc-endpoints | grep vpce-0699aa333a0a0a0-bf90xjtr.vpce-
svc-00bb7c2ca2213bc37.us-west-2.vpce.amazonaws.com.
```

You should see something similar to the following response:

```
"DnsName": "vpce-066777a0a0a0-bf90xjtr.vpce-svc-00bb7c2ca2213bc37.us-
west-2.vpce.amazonaws.com",
```

4. Run either an *nslookup* or *dig* command on your Apache Airflow host name and its VPC endpoint DNS name to retrieve the IP addresses. For example:

dig +short YOUR_AIRFLOW_HOST_NAME YOUR_AIRFLOW_VPC_ENDPOINT_DNS

You should see something similar to the following response:

192.0.5.1 192.0.6.1

Accessing the VPC endpoint for your Apache Airflow Web server (private network access)

If you've chosen the **Private network** access mode for your Apache Airflow *Web server*, you'll need to create a mechanism to access the VPC interface endpoint for your Apache Airflow *Web server*. You must use the same Amazon VPC, VPC security group, and private subnets as your Amazon MWAA environment for these resources.

Using an AWS Client VPN

AWS Client VPN is a managed client-based VPN service that enables you to securely access your AWS resources and resources in your on-premises network. It provides a secure TLS connection from any location using the OpenVPN client.

We recommend following the Amazon MWAA tutorial to configure a Client VPN: <u>Tutorial</u>: Configuring private network access using an AWS Client VPN.

Using a Linux Bastion Host

A bastion host is a server whose purpose is to provide access to a private network from an external network, such as over the Internet from your computer. Linux instances are in a public subnet, and they are set up with a security group that allows SSH access from the security group attached to the underlying Amazon EC2 instance running the bastion host.

We recommend following the Amazon MWAA tutorial to configure a Linux Bastion Host: <u>Tutorial</u>: <u>Configuring private network access using a Linux Bastion Host</u>.

Using a Load Balancer (advanced)

The following section shows the configurations you'll need to apply to an <u>Application Load</u> <u>Balancer</u>.

- Target groups. You'll need to use target groups that point to the private IP addresses for your Apache Airflow *Web server*, and its VPC interface endpoint. We recommend specifying both private IP addresses as your registered targets, as using only one can reduce availability. For more information on how to identify the private IP addresses, refer to <u>the section called</u> <u>"Identifying the private IP addresses of your Apache Airflow Web server and its VPC endpoint"</u>.
- Status codes. We recommend using 200 and 302 status codes in your target group settings. Otherwise, the targets may be flagged as unhealthy if the VPC endpoint for the Apache Airflow Web server responds with a 302 Redirect error.
- 3. **HTTPS Listener**. You'll need to specify the target port for the Apache Airflow *Web server*. For example:

Protocol	Port
HTTPS	443

- 4. **ACM new domain**. If you want to associate an SSL/TLS certificate in AWS Certificate Manager, you'll need to create a new domain for the HTTPS listener for your load balancer.
- 5. **ACM certificate region**. If you want to associate an SSL/TLS certificate in AWS Certificate Manager, you'll need to upload to the same AWS Region as your environment. For example:

• Example region to upload certificate

```
aws acm import-certificate --certificate fileb://Certificate.pem --certificate-
chain fileb://CertificateChain.pem --private-key fileb://PrivateKey.pem --
region us-west-2
```

Creating the required VPC service endpoints in an Amazon VPC with private routing

An existing Amazon VPC network *without Internet access* needs additional VPC service endpoints (AWS PrivateLink) to use Apache Airflow on Amazon Managed Workflows for Apache Airflow. This page describes the VPC endpoints required for the AWS services used by Amazon MWAA, the VPC endpoints required for Apache Airflow, and how to create and attach the VPC endpoints to an existing Amazon VPC with private routing.

Contents

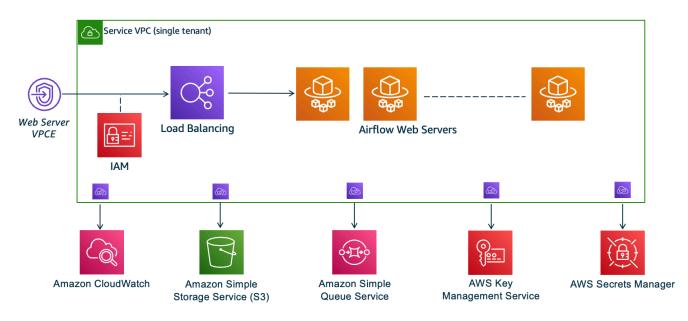
- Pricing
- Private network and private routing
- (Required) VPC endpoints
- Attaching the required VPC endpoints
 - VPC endpoints required for AWS services
 - VPC endpoints required for Apache Airflow
- (Optional) Enable private IP addresses for your Amazon S3 VPC interface endpoint
 - Using Route 53
 - <u>VPCs with custom DNS</u>

Pricing

AWS PrivateLink Pricing

Private network and private routing

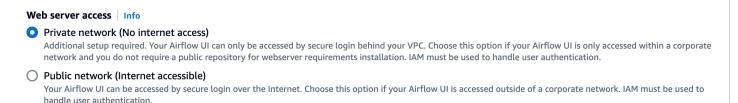
Private Web Server Option



The private network access mode limits access to the Apache Airflow UI to users *within your Amazon VPC* that have been granted access to the IAM policy for your environment.

When you create an environment with private web server access, you must package all of your dependencies in a Python wheel archive (.whl), then reference the .whl in your requirements.txt. For instructions on packaging and installing your dependencies using wheel, refer to Managing dependencies using Python wheel.

The following image shows where to find the **Private network** option on the Amazon MWAA console.



 Private routing. An <u>Amazon VPC without Internet access</u> limits network traffic within the VPC. This page assumes your Amazon VPC does not have Internet access and requires VPC endpoints for each AWS service used by your environment, and VPC endpoints for Apache Airflow in the same AWS Region and Amazon VPC as your Amazon MWAA environment.

(Required) VPC endpoints

The following section shows the required VPC endpoints needed for an Amazon VPC *without Internet access*. It lists the VPC endpoints for each AWS service used by Amazon MWAA, including the VPC endpoints needed for Apache Airflow.

```
com.amazonaws.us-east-1.s3
com.amazonaws.us-east-1.monitoring
com.amazonaws.us-east-1.logs
com.amazonaws.us-east-1.sqs
com.amazonaws.us-east-1.kms
```

1 Note

When using Transit Gateway or any other routing that does not go directly to the AWS API endpoints, we recommend you to add AWS PrivateLink to your Amazon MWAA private subnets for the following services:

- Amazon S3
- Amazon SQS
- CloudWatch Logs
- CloudWatch metrics
- AWS KMS (if applicable)

This ensures that your Amazon MWAA environment can securely and efficiently communicate with these services without routing traffic through the public internet, thereby improving security and performance.

Attaching the required VPC endpoints

This section describes the steps to attach the required VPC endpoints for an Amazon VPC with private routing.

VPC endpoints required for AWS services

The following section shows the steps to attach the VPC endpoints for the AWS services used by an environment to an existing Amazon VPC.

To attach VPC endpoints to your private subnets

- 1. Open the Endpoints page on the Amazon VPC console.
- 2. Use the AWS Region selector to select your region.
- 3. Create the endpoint for Amazon S3:
 - a. Choose Create Endpoint.
 - b. In the *Filter by attributes or search by keyword* text field, type: **.s3**, then press *Enter* on your keyboard.
 - c. We recommend choosing the service endpoint listed for the **Gateway** type.

For example, com.amazonaws.us-west-2.s3 amazon Gateway

- d. Choose your environment's Amazon VPC in **VPC**.
- e. Ensure that your two private subnets in different Availability Zones are selected, and that that private DNS is enabled by selecting **Enable DNS name**.
- f. Choose your environment's Amazon VPC security group(s).
- g. Choose Full Access in Policy.
- h. Choose **Create endpoint**.
- 4. Create the endpoint for CloudWatch Logs:
 - a. Choose **Create Endpoint**.
 - b. In the *Filter by attributes or search by keyword* text field, type: **.logs**, then press *Enter* on your keyboard.
 - c. Select the service endpoint.
 - d. Choose your environment's Amazon VPC in VPC.
 - e. Ensure that your two private subnets in different Availability Zones are selected, and that **Enable DNS name** is enabled.
 - f. Choose your environment's Amazon VPC security group(s).
 - g. Choose **Full Access** in **Policy**.

h. Choose Create endpoint.

- 5. Create the endpoint for CloudWatch Monitoring:
 - Choose Create Endpoint. a.
 - b. In the *Filter by attributes or search by keyword* text field, type: **.monitoring**, then press *Enter* on your keyboard.
 - Select the service endpoint. с.
 - d. Choose your environment's Amazon VPC in VPC.
 - Ensure that your two private subnets in different Availability Zones are selected, and that e. Enable DNS name is enabled.
 - f. Choose your environment's Amazon VPC security group(s).
 - Choose Full Access in Policy. q.
 - Choose Create endpoint. h.
- Create the endpoint for Amazon SQS: 6.
 - Choose Create Endpoint. а.
 - b. In the *Filter by attributes or search by keyword* text field, type: **.sqs**, then press *Enter* on your keyboard.
 - Select the service endpoint. с.
 - d. Choose your environment's Amazon VPC in **VPC**.
 - Ensure that your two private subnets in different Availability Zones are selected, and that e. Enable DNS name is enabled.
 - f. Choose your environment's Amazon VPC security group(s).
 - Choose Full Access in Policy. g.
 - h. Choose Create endpoint.
- Create the endpoint for AWS KMS: 7.
 - Choose Create Endpoint. a.
 - b. In the *Filter by attributes or search by keyword* text field, type: **.kms**, then press *Enter* on your keyboard.
 - Select the service endpoint. с.
 - d. Choose your environment's Amazon VPC in VPC.
- e. Ensure that your two private subnets in different Availability Zones are selected, and that Attaching the Enable / DNS pame is enabled.

- f. Choose your environment's Amazon VPC security group(s).
- g. Choose **Full Access** in **Policy**.
- h. Choose **Create endpoint**.

VPC endpoints required for Apache Airflow

The following section shows the steps to attach the VPC endpoints for Apache Airflow to an existing Amazon VPC.

To attach VPC endpoints to your private subnets

- 1. Open the Endpoints page on the Amazon VPC console.
- 2. Use the AWS Region selector to select your region.
- 3. Create the endpoint for the Apache Airflow API:
 - a. Choose **Create Endpoint**.
 - b. In the *Filter by attributes or search by keyword* text field, type: **.airflow.api**, then press *Enter* on your keyboard.
 - c. Select the service endpoint.
 - d. Choose your environment's Amazon VPC in **VPC**.
 - e. Ensure that your two private subnets in different Availability Zones are selected, and that **Enable DNS name** is enabled.
 - f. Choose your environment's Amazon VPC security group(s).
 - g. Choose Full Access in Policy.
 - h. Choose Create endpoint.
- 4. Create the first endpoint for the Apache Airflow environment:
 - a. Choose **Create Endpoint**.
 - b. In the *Filter by attributes or search by keyword* text field, type: **.airflow.env**, then press *Enter* on your keyboard.
 - c. Select the service endpoint.
 - d. Choose your environment's Amazon VPC in **VPC**.
 - e. Ensure that your two private subnets in different Availability Zones are selected, and that **Enable DNS name** is enabled.

- f. Choose your environment's Amazon VPC security group(s).
- g. Choose **Full Access** in **Policy**.
- h. Choose Create endpoint.
- 5. Create the second endpoint for Apache Airflow operations:
 - a. Choose **Create Endpoint**.
 - b. In the *Filter by attributes or search by keyword* text field, type: **.airflow.ops**, then press *Enter* on your keyboard.
 - c. Select the service endpoint.
 - d. Choose your environment's Amazon VPC in **VPC**.
 - e. Ensure that your two private subnets in different Availability Zones are selected, and that **Enable DNS name** is enabled.
 - f. Choose your environment's Amazon VPC security group(s).
 - g. Choose Full Access in Policy.
 - h. Choose **Create endpoint**.

(Optional) Enable private IP addresses for your Amazon S3 VPC interface endpoint

Amazon S3 **Interface** endpoints don't support private DNS. The S3 endpoint requests still resolves to a *public* IP address. To resolve the S3 address to a *private* IP address, you need to add a <u>private</u> hosted zone in Route 53 for the S3 regional endpoint.

Using Route 53

This section describes the steps to enable private IP addresses for an S3 **Interface** endpoint using Route 53.

- 1. Create a Private Hosted Zone for your Amazon S3 VPC interface endpoint (such as, s3.euwest-1.amazonaws.com) and associate it with your Amazon VPC.
- 2. Create an ALIAS A record for your Amazon S3 VPC interface endpoint (such as, s3.euwest-1.amazonaws.com) that resolves to your VPC Interface Endpoint DNS name.
- 3. Create an ALIAS A wildcard record for your Amazon S3 interface endpoint (such as, *.s3.euwest-1.amazonaws.com) that resolves to the VPC Interface Endpoint DNS name.

VPCs with custom DNS

If your Amazon VPC uses custom DNS routing, you need to make the changes in your DNS resolver (not Route 53, typically an EC2 instance running a DNS server) by creating a CNAME record. For example:

```
Name: s3.us-west-2.amazonaws.com
Type: CNAME
Value: *.vpce-0f67d23e37648915c-e2q2e2j3.s3.us-west-2.vpce.amazonaws.com
```

Managing your own Amazon VPC endpoints on Amazon MWAA

Amazon MWAA uses Amazon VPC endpoints to integrate with various AWS services necessary to set up an Apache Airflow environment. Managing your own endpoints has two primary use-cases:

- 1. It means you can create Apache Airflow environments in a shared Amazon VPC when you use an AWS Organizations to manage multiple AWS accounts and share resources.
- 2. It let's you use more restrictive access policies by narrowing down your permissions to the specific resources that use your endpoints.

If you choose to manage your own VPC endpoints, you are responsible for creating your own endpoints for the environment RDS for PostgreSQL database, and for the environment web server.

For more information about how Amazon MWAA deploys Apache Airflow in the cloud, refer to the Amazon MWAA architecture diagram.

<u> Important</u>

Amazon MWAA does not validate the IP address type (AddressType) selection for customer-managed endpoints, so make sure you correctly specify AddressType (valid options are IPv4 or IPv6).

Creating an environment in a shared Amazon VPC

If you use <u>AWS Organizations</u> to manage multiple AWS accounts that share resources, you can use customer managed VPC endpoints with Amazon MWAA to share environment resources with another account in your organization.

When you configure shared VPC access, the account that owns the main Amazon VPC (*owner*) shares the two private subnets required by Amazon MWAA with other accounts (*participants*) that belong to the same organization. Participant accounts that share those subnets can view, create, modify, and delete environments in the shared Amazon VPC.

Assume you have an account, Owner, which acts as the Root account in the organization and owns the Amazon VPC resources, and a participant account, Participant, a member of the same organization. When Participant creates a new Amazon MWAA in Amazon VPC it shares with Owner, Amazon MWAA will first create the service VPC resources, then enter a <u>PENDING</u> state for up to 72 hours.

After the environment status changes from CREATING to PENDING, a principal acting on behalf of Owner creates the required endpoints. To do this, Amazon MWAA lists the database and web server endpoint in the Amazon MWAA console. You can also call the <u>GetEnvironment</u> API action to get the service endpoints.

Note

If the Amazon VPC you use to share resources is a private Amazon VPC, you must still complete the steps described in <u>the section called "Managing access to VPC endpoints"</u>. The topic covers setting up a different set of Amazon VPC endpoints related to other AWS services that AWS integrates with, such as Amazon ECR, Amazon ECS, and Amazon SQS. These services are essential in operating, and managing, your Apache Airflow environment in the cloud.

Prerequisites

Before you create an Amazon MWAA environment in a shared VPC, you need the following resources:

- An AWS account, Owner to be used as the account that owns the Amazon VPC.
- An <u>AWS Organizations</u> organization unit, MyOrganization created as a *root*.
- A second AWS account, Participant, under MyOrganization to serve the participant account that creates the new environment.

In addition, we recommend that you familiarize yourself with the <u>responsibilities and permissions</u> for owners and participants when sharing resources in Amazon VPC.

Create the Amazon VPC

First, create a new Amazon VPC that the owner and participant accounts will share:

1. Sign in to the console using Owner, then, open the AWS CloudFormation console. Use the following template to create a stack. This stack provisions a number of networking resources including a Amazon VPC, and the subnets that the two accounts will share in this scenario.

```
AWSTemplateFormatVersion: "2010-09-09"
      Description: >-
     This template deploys a VPC, with a pair of public and private subnets spread
     across two Availability Zones. It deploys an internet gateway, with a default
      route on the public subnets. It deploys a pair of NAT gateways (one in each
     AZ), and default routes for them in the private subnets.
      Parameters:
     EnvironmentName:
     Description: An environment name that is prefixed to resource names
     Type: String
      Default: mwaa-
     VpcCIDR:
     Description: Please enter the IP range (CIDR notation) for this VPC
     Type: String
      Default: 10.192.0.0/16
      PublicSubnet1CIDR:
     Description: >-
     Please enter the IP range (CIDR notation) for the public subnet in the
     first Availability Zone
     Type: String
      Default: 10.192.10.0/24
      PublicSubnet2CIDR:
     Description: >-
      Please enter the IP range (CIDR notation) for the public subnet in the
     second Availability Zone
     Type: String
     Default: 10.192.11.0/24
      PrivateSubnet1CIDR:
     Description: >-
     Please enter the IP range (CIDR notation) for the private subnet in the
     first Availability Zone
     Type: String
     Default: 10.192.20.0/24
      PrivateSubnet2CIDR:
     Description: >-
```

```
User Guide
```

```
Please enter the IP range (CIDR notation) for the private subnet in the
second Availability Zone
Type: String
Default: 10.192.21.0/24
Resources:
VPC:
Type: 'AWS::EC2::VPC'
Properties:
CidrBlock: !Ref VpcCIDR
EnableDnsSupport: true
EnableDnsHostnames: true
Tags:
- Key: Name
Value: !Ref EnvironmentName
InternetGateway:
Type: 'AWS::EC2::InternetGateway'
Properties:
Tags:
- Key: Name
Value: !Ref EnvironmentName
InternetGatewayAttachment:
Type: 'AWS::EC2::VPCGatewayAttachment'
Properties:
InternetGatewayId: !Ref InternetGateway
VpcId: !Ref VPC
PublicSubnet1:
Type: 'AWS::EC2::Subnet'
Properties:
VpcId: !Ref VPC
AvailabilityZone: !Select
- 0
- !GetAZs ''
CidrBlock: !Ref PublicSubnet1CIDR
MapPublicIpOnLaunch: true
Tags:
- Key: Name
Value: !Sub '${EnvironmentName} Public Subnet (AZ1)'
PublicSubnet2:
Type: 'AWS::EC2::Subnet'
Properties:
VpcId: !Ref VPC
AvailabilityZone: !Select
- 1
- !GetAZs ''
```

```
CidrBlock: !Ref PublicSubnet2CIDR
MapPublicIpOnLaunch: true
Tags:
- Key: Name
Value: !Sub '${EnvironmentName} Public Subnet (AZ2)'
PrivateSubnet1:
Type: 'AWS::EC2::Subnet'
Properties:
VpcId: !Ref VPC
AvailabilityZone: !Select
- 0
- !GetAZs ''
CidrBlock: !Ref PrivateSubnet1CIDR
MapPublicIpOnLaunch: false
Tags:
- Key: Name
Value: !Sub '${EnvironmentName} Private Subnet (AZ1)'
PrivateSubnet2:
Type: 'AWS::EC2::Subnet'
Properties:
VpcId: !Ref VPC
AvailabilityZone: !Select
- 1
- !GetAZs ''
CidrBlock: !Ref PrivateSubnet2CIDR
MapPublicIpOnLaunch: false
Tags:
- Key: Name
Value: !Sub '${EnvironmentName} Private Subnet (AZ2)'
NatGateway1EIP:
Type: 'AWS::EC2::EIP'
DependsOn: InternetGatewayAttachment
Properties:
Domain: vpc
NatGateway2EIP:
Type: 'AWS::EC2::EIP'
DependsOn: InternetGatewayAttachment
Properties:
Domain: vpc
NatGateway1:
Type: 'AWS::EC2::NatGateway'
Properties:
AllocationId: !GetAtt NatGateway1EIP.AllocationId
SubnetId: !Ref PublicSubnet1
```

NatGateway2: Type: 'AWS::EC2::NatGateway' Properties: AllocationId: !GetAtt NatGateway2EIP.AllocationId SubnetId: !Ref PublicSubnet2 PublicRouteTable: Type: 'AWS::EC2::RouteTable' **Properties:** VpcId: !Ref VPC Tags: - Key: Name Value: !Sub '\${EnvironmentName} Public Routes' DefaultPublicRoute: Type: 'AWS::EC2::Route' DependsOn: InternetGatewayAttachment **Properties:** RouteTableId: !Ref PublicRouteTable DestinationCidrBlock: 0.0.0.0/0 GatewayId: !Ref InternetGateway PublicSubnet1RouteTableAssociation: Type: 'AWS::EC2::SubnetRouteTableAssociation' **Properties:** RouteTableId: !Ref PublicRouteTable SubnetId: !Ref PublicSubnet1 PublicSubnet2RouteTableAssociation: Type: 'AWS::EC2::SubnetRouteTableAssociation' **Properties:** RouteTableId: !Ref PublicRouteTable SubnetId: !Ref PublicSubnet2 PrivateRouteTable1: Type: 'AWS::EC2::RouteTable' Properties: VpcId: !Ref VPC Tags: - Key: Name Value: !Sub '\${EnvironmentName} Private Routes (AZ1)' DefaultPrivateRoute1: Type: 'AWS::EC2::Route' Properties: RouteTableId: !Ref PrivateRouteTable1 DestinationCidrBlock: 0.0.0.0/0 NatGatewayId: !Ref NatGateway1 PrivateSubnet1RouteTableAssociation: Type: 'AWS::EC2::SubnetRouteTableAssociation'

Properties: RouteTableId: !Ref PrivateRouteTable1 SubnetId: !Ref PrivateSubnet1 PrivateRouteTable2: Type: 'AWS::EC2::RouteTable' Properties: VpcId: !Ref VPC Tags: - Key: Name Value: !Sub '\${EnvironmentName} Private Routes (AZ2)' DefaultPrivateRoute2: Type: 'AWS::EC2::Route' **Properties:** RouteTableId: !Ref PrivateRouteTable2 DestinationCidrBlock: 0.0.0.0/0 NatGatewayId: !Ref NatGateway2 PrivateSubnet2RouteTableAssociation: Type: 'AWS::EC2::SubnetRouteTableAssociation' **Properties:** RouteTableId: !Ref PrivateRouteTable2 SubnetId: !Ref PrivateSubnet2 SecurityGroup: Type: 'AWS::EC2::SecurityGroup' Properties: GroupName: mwaa-security-group GroupDescription: Security group with a self-referencing inbound rule. VpcId: !Ref VPC SecurityGroupIngress: Type: 'AWS::EC2::SecurityGroupIngress' Properties: GroupId: !Ref SecurityGroup IpProtocol: '-1' SourceSecurityGroupId: !Ref SecurityGroup Outputs: VPC: Description: A reference to the created VPC Value: !Ref VPC PublicSubnets: Description: A list of the public subnets Value: !Join - ',' - - !Ref PublicSubnet1 - !Ref PublicSubnet2 PrivateSubnets:

```
Description: A list of the private subnets
Value: !Join
- ','
- - !Ref PrivateSubnet1
- !Ref PrivateSubnet2
PublicSubnet1:
Description: A reference to the public subnet in the 1st Availability Zone
Value: !Ref PublicSubnet1
PublicSubnet2:
Description: A reference to the public subnet in the 2nd Availability Zone
Value: !Ref PublicSubnet2
PrivateSubnet1:
Description: A reference to the private subnet in the 1st Availability Zone
Value: !Ref PrivateSubnet1
PrivateSubnet2:
Description: A reference to the private subnet in the 2nd Availability Zone
Value: !Ref PrivateSubnet2
SecurityGroupIngress:
Description: Security group with self-referencing inbound rule
Value: !Ref SecurityGroupIngress
```

- 2. After the new Amazon VPC resources have been provisioned, navigate to the AWS Resource Access Manager console, then choose **Create resource share**.
- 3. Choose the subnets you created in the first step from the list of available subnets you can share with Participant.

Create the environment

Complete the following steps to create an Amazon MWAA environment with customer-managed Amazon VPC endpoints.

- Sign in using Participant, and open the Amazon MWAA console. Complete Step one: Specify details to specify an Amazon S3 bucket, a DAG folder, and dependencies for your new environment. For more information, refer to getting started.
- 2. On the **Configure advanced settings** page, under **Networking**, choose the subnets from the shared Amazon VPC.
- 3. Under Endpoint management choose CUSTOMER from the dropdown list.
- 4. Keep the default for the remaining options on the page, then, choose **Create environment** on the **Review and create** page.

The environment begins in a CREATING state, then changes to PENDING. When the environment is PENDING, write down the **Database endpoint service name** and **Web server endpoint service name** (if you set up a private web server) using the console.

When you create a new environment using the Amazon MWAA console. Amazon MWAA creates a new security group with the required inbound and outbound rules. Write down the security group ID.

In the next section, Owner will use the service endpoints and the security group ID to create new Amazon VPC endpoints in the shared Amazon VPC.

Create the Amazon VPC endpoints

Complete the following steps to create the required Amazon VPC endpoints for your environment.

- 1. Sign in to the AWS Management Console using Owner, the open https://console.aws.amazon.com/vpc/.
- 2. Choose **Security groups** from the left navigation panel, then create a new security group in the shared Amazon VPC using the following inbound, and outbound, rules:

	Туре	Protocol	Source type	Source
Inbound	All traffic	All	All	Your environme nt security group
Outbound	All traffic	All	All	0.0.0.0/0

<u> Marning</u>

The Owner account must set up a security group in the Owner account to allow traffic from the new environment to the shared Amazon VPC. You can do this by creating a new security group in Owner, or editing an existing one.

3. Choose **Endpoints**, then create new endpoints for the environment database and the web server (if in private mode) using the endpoint service names from the previous steps. Choose

the shared Amazon VPC, the subnets you used for the environment, and the environment's security group.

If successful, the environment will change from PENDING back to CREATING, then finally to AVAILABLE. When it is AVAILABLE, you can sign in to the Apache Airflow console.

Shared Amazon VPC Troubleshooting

Use the following reference to resolve issues you encounter when creating environments in a shared Amazon VPC.

Environment in CREATE_FAILED after PENDING status

- Verify that Owner is sharing the subnets with Participant using <u>AWS Resource Access</u> <u>Manager</u>.
- Verify that the Amazon VPC endpoints for the database and web server are created in the same subnets associated with the environment.
- Verify that the security group used with your endpoints allows traffic from the security groups used for the environment. The Owner account creates rules that reference the security group in Participant as 123456789012/security-group-id:.

Туре	Protocol	Source type	Source
All traffic	All	All	123456789 012 /sg-0909e8 e81919

For more information, refer to Responsibilities and permissions for owners and participants

Environment stuck in PENDING status

Verify each VPC endpoint status to ensure it is Available. If you configure an environment with a private web server, you must also create an endpoint for the web server. If the environment is stuck in PENDING, this might indicate that the private web server endpoint is missing.

Received The Vpc Endpoint Service '*vpce-service-name*' does not exist error

If you see the following error, verify that the account creating the endpoints in the Owner account that owns the shared VPC:

ClientError: An error occurred (InvalidServiceName) when calling the CreateVpcEndpoint operation:

The Vpc Endpoint Service '*vpce-service-name*' does not exist

Tutorials for Amazon Managed Workflows for Apache Airflow

This guide includes step-by-step tutorials to using and configuring an Amazon Managed Workflows for Apache Airflow environment.

Topics

- Tutorial: Configuring private network access using an AWS Client VPN
- Tutorial: Configuring private network access using a Linux Bastion Host
- Tutorial: Restricting an Amazon MWAA user's access to a subset of DAGs
- Tutorial: Automate managing your own environment endpoints on Amazon MWAA

Tutorial: Configuring private network access using an AWS Client VPN

This tutorial walks you through the steps to create a VPN tunnel from your computer to the Apache Airflow *Web server* for your Amazon Managed Workflows for Apache Airflow environment. To connect to the Internet through a VPN tunnel, you'll first need to create a AWS Client VPN endpoint. Once set up, a Client VPN endpoint acts as a VPN server allowing a secure connection from your computer to the resources in your VPC. You'll then connect to the Client VPN from your computer using the <u>AWS Client VPN for Desktop</u>.

Sections

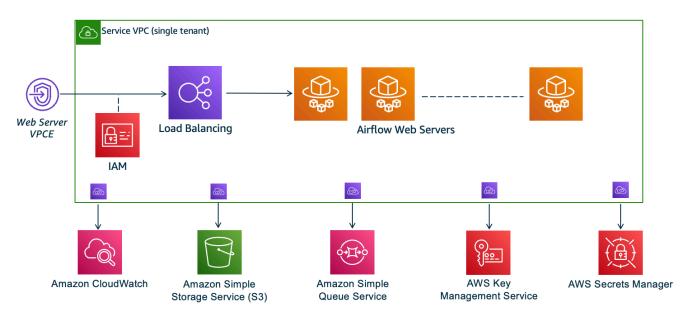
- Private network
- Use cases
- Before you begin
- Objectives
- (Optional) Step one: Identify your VPC, CIDR rules, and VPC security(s)
- Step two: Create the server and client certificates
- Step three: Save the AWS CloudFormation template locally
- Step four: Create the Client VPN AWS CloudFormation stack
- Step five: Associate subnets to your Client VPN

- Step six: Add an authorization ingress rule to your Client VPN
- Step seven: Download the Client VPN endpoint configuration file
- Step eight: Connect to the AWS Client VPN
- What's next?

Private network

This tutorial assumes you've chosen the **Private network** access mode for your Apache Airflow *Web* server.

Private Web Server Option



The private network access mode limits access to the Apache Airflow UI to users *within your Amazon VPC* that have been granted access to the <u>IAM policy for your environment</u>.

When you create an environment with private web server access, you must package all of your dependencies in a Python wheel archive (.whl), then reference the .whl in your requirements.txt. For instructions on packaging and installing your dependencies using wheel, refer to Managing dependencies using Python wheel.

The following image shows where to find the **Private network** option on the Amazon MWAA console.

Web server access Info

Private network (No internet access)

Additional setup required. Your Airflow UI can only be accessed by secure login behind your VPC. Choose this option if your Airflow UI is only accessed within a corporate network and you do not require a public repository for webserver requirements installation. IAM must be used to handle user authentication.

Public network (Internet accessible)

Your Airflow UI can be accessed by secure login over the Internet. Choose this option if your Airflow UI is accessed outside of a corporate network. IAM must be used to handle user authentication.

Use cases

You can use this tutorial before or after you've created an Amazon MWAA environment. You must use the same Amazon VPC, VPC security group(s), and private subnets as your environment. If you use this tutorial after you've created an Amazon MWAA environment, once you've completed the steps, you can return to the Amazon MWAA console and change your Apache Airflow *Web server* access mode to **Private network**.

Before you begin

- Check for user permissions. Be sure that your account in AWS Identity and Access Management (IAM) has sufficient permissions to create and manage VPC resources.
- Use your Amazon MWAA VPC. This tutorial assumes that you are associating the Client VPN to an existing VPC. The Amazon VPC must be in the same AWS Region as an Amazon MWAA environment and have two private subnets. If you haven't created an Amazon VPC, use the AWS CloudFormation template in <u>Option three: Creating an Amazon VPC network without</u> <u>Internet access</u>.

Objectives

In this tutorial, you'll do the following:

- 1. Create a AWS Client VPN endpoint using a AWS CloudFormation template for an existing Amazon VPC.
- 2. Generate server and client certificates and keys, and then upload the server certificate and key to AWS Certificate Manager in the same AWS Region as an Amazon MWAA environment.
- 3. Download and modify a Client VPN endpoint configuration file for your Client VPN, and use the file to create a VPN profile to connect using the Client VPN for Desktop.

(Optional) Step one: Identify your VPC, CIDR rules, and VPC security(s)

The following section describes how to find IDs for your Amazon VPC, VPC security group, and a way to identify the CIDR rules you'll need to create your Client VPN in subsequent steps.

Identify your CIDR rules

The following section shows how to identify the CIDR rules, which you'll need to create your Client VPN.

To identify the CIDR for your Client VPN

- 1. Open the Your Amazon VPCs page on the Amazon VPC console.
- 2. Use the region selector in the navigation bar to choose the same AWS Region as an Amazon MWAA environment.
- 3. Choose your Amazon VPC.
- 4. Assuming the CIDRs for your private subnets are:
 - Private Subnet 1: 10.192.10.0/24
 - Private Subnet 2: 10.192.11.0/24

If the CIDR for your Amazon VPC is 10.192.0.0/16, then the **Client IPv4 CIDR** you'd specify for your Client VPN would be 10.192.0.0/22.

5. Save this CIDR value, and the value of your VPC ID for subsequent steps.

Identify your VPC and security group(s)

The following section shows how to find the ID of your Amazon VPC and security group(s), which you'll need to create your Client VPN.

🚯 Note

You may be using more than one security group. You'll need to specify all of your VPC's security groups in subsequent steps.

To identify the security group(s)

- 1. Open the <u>Security Groups page</u> on the Amazon VPC console.
- 2. Use the region selector in the navigation bar to choose the AWS Region.
- 3. Look for the Amazon VPC in **VPC ID**, and identify the security groups associated with the VPC.
- 4. Save the ID of your security group(s) and VPC for subsequent steps.

Step two: Create the server and client certificates

A Client VPN endpoint supports 1024-bit and 2048-bit RSA key sizes only. The following section shows how to use OpenVPN easy-rsa to generate the server and client certificates and keys, and then upload the certificates to ACM using the AWS Command Line Interface (AWS CLI).

To create the client certificates

- 1. Follow these quick steps to create and upload the certificates to ACM via the AWS CLI in <u>Client</u> authentication and authorization: Mutual authentication.
- 2. In these steps, you **must** specify the same AWS Region as an Amazon MWAA environment in the AWS CLI command when uploading your server and client certificates. Here's some examples of how to specify the region in these commands:
 - a. Example region for server certificate

```
aws acm import-certificate --certificate fileb://server.crt --private-key
fileb://server.key --certificate-chain fileb://ca.crt --region us-west-2
```

b. Example region for client certificate

```
aws acm import-certificate --certificate fileb://client1.domain.tld.crt
    --private-key fileb://client1.domain.tld.key --certificate-chain fileb://
ca.crt --region us-west-2
```

- c. After these steps, save the value returned in the AWS CLI response for the server certificate and client certificate ARNs. You'll be specifying these ARNs in your AWS CloudFormation template to create the Client VPN.
- 3. In these steps, a client certificate and a private key are saved to your computer. Here's an example of where to find these credentials:

a. Example on macOS

On macOS the contents are saved at /Users/your-user/custom_folder. If you list all (1s -a) contents of this directory, you should see something similar to the following:

```
...
ca.crt
client1.domain.tld.crt
client1.domain.tld.key
server.crt
server.key
```

b. After these steps, save the contents or note the location of the client certificate in client1.domain.tld.crt, and the private key in client1.domain.tld.key.You'll be adding these values to the configuration file for your Client VPN.

Step three: Save the AWS CloudFormation template locally

The following section contains the AWS CloudFormation template to create the Client VPN. You must specify the same Amazon VPC, VPC security group(s), and private subnets as your Amazon MWAA environment.

Copy the contents of the following template and save locally as mwaa_vpn_client.yaml.
 You can also download the template.

Substitute the following values:

- YOUR_CLIENT_ROOT_CERTIFICATE_ARN The ARN for your client1.domain.tld certificate in ClientRootCertificateChainArn.
- YOUR_SERVER_CERTIFICATE_ARN The ARN for your server certificate in ServerCertificateArn.
- The Client IPv4 CIDR rule in ClientCidrBlock. A CIDR rule of 10.192.0.0/22 is provided.
- Your Amazon VPC ID in VpcId. A VPC of vpc-010101010101 is provided.
- Your VPC security group ID(s) in SecurityGroupIds. A security group of sg-0101010101 is provided.

```
AWSTemplateFormatVersion: 2010-09-09
Description: This template deploys a VPN Client Endpoint.
Resources:
 ClientVpnEndpoint:
    Type: 'AWS::EC2::ClientVpnEndpoint'
    Properties:
      AuthenticationOptions:
        - Type: "certificate-authentication"
          MutualAuthentication:
            ClientRootCertificateChainArn: "YOUR_CLIENT_ROOT_CERTIFICATE_ARN"
      ClientCidrBlock: 10.192.0.0/22
      ClientConnectOptions:
        Enabled: false
      ConnectionLogOptions:
        Enabled: false
      Description: "MWAA Client VPN"
      DnsServers: []
      SecurityGroupIds:
        - sg-0101010101
      SelfServicePortal: ''
      ServerCertificateArn: "YOUR_SERVER_CERTIFICATE_ARN"
      SplitTunnel: true
      TagSpecifications:
        - ResourceType: "client-vpn-endpoint"
          Tags:
          - Key: Name
            Value: MWAA-Client-VPN
      TransportProtocol: udp
     VpcId: vpc-010101010101
      VpnPort: 443
```

🚺 Note

If you're using more than one security group for your environment, you can specify multiple security groups in the following format:

- sg-0223344556677889f

Step four: Create the Client VPN AWS CloudFormation stack

To create the AWS Client VPN

- 1. Open the AWS CloudFormation console.
- 2. Choose Template is ready, Upload a template file.
- 3. Choose **Choose file**, and select your mwaa_vpn_client.yaml file.
- 4. Choose Next, Next.
- 5. Select the acknowledgement, and then choose **Create stack**.

Step five: Associate subnets to your Client VPN

To associate private subnets to the AWS Client VPN

- 1. Open the Amazon VPC console.
- 2. Choose the **Client VPN Endpoints** page.
- 3. Select your Client VPN, and then choose the Associations tab, Associate.
- 4. Choose the following in the dropdown list:
 - Your Amazon VPC in VPC.
 - One of your private subnets in Choose a subnet to associate.
- 5. Choose **Associate**.

Note

It takes several minutes for the VPC and subnet to be associated to the Client VPN.

Step six: Add an authorization ingress rule to your Client VPN

You need to add an authorization ingress rule using the CIDR rule for your VPC to your Client VPN. If you want to authorize specific users or groups from your Active Directory Group or SAML-based Identity Provider (IdP), refer to the <u>Authorization rules</u> in the *Client VPN guide*.

To add the CIDR to the AWS Client VPN

- 1. Open the Amazon VPC console.
- 2. Choose the **Client VPN Endpoints** page.
- 3. Select your Client VPN, and then choose the **Authorization** tab, **Authorize Ingress**.
- 4. Specify the following:
 - Your Amazon VPC's CIDR rule in **Destination network to enable**. For example:

10.192.0.0/16

- Choose Allow access to all users in Grant access to.
- Enter a descriptive name in **Description**.
- 5. Choose Add Authorization rule.

🚺 Note

Depending on the networking components for your Amazon VPC, you may also need to this authorization ingress rule to your network access control list (NACL).

Step seven: Download the Client VPN endpoint configuration file

To download the configuration file

- Follow these quick steps to download the Client VPN configuration file at <u>Download the Client</u> <u>VPN endpoint configuration file</u>.
- 2. In these steps, you're asked to prepend a string to your Client VPN endpoint DNS name. Here's an example:

• Example endpoint DNS name

If your Client VPN endpoint DNS name looks like this:

remote cvpn-endpoint-0909091212aaee1.prod.clientvpn.us-west-1.amazonaws.com 443

You can add a string to identify your Client VPN endpoint like this:

```
remote mwaavpn.cvpn-endpoint-0909091212aaee1.prod.clientvpn.us-
west-1.amazonaws.com 443
```

- 3. In these steps, you're asked to add the contents of the client certificate between a new set of <cert></cert> tags and the contents of the private key between a new set of <key></key> tags. Here's an example:
 - a. Open a command prompt and change directories to the location of your client certificate and private key.
 - b. Example macOS client1.domain.tld.crt

To show the contents of the client1.domain.tld.crt file on macOS, you can use cat client1.domain.tld.crt.

Copy the value from terminal and paste in downloaded-client-config.ovpn like this:

```
ZZZ1111dddaBBB
-----END CERTIFICATE-----
</ca>
<cert>
----BEGIN CERTIFICATE-----
YOUR client1.domain.tld.crt
----END CERTIFICATE-----
</cert>
```

c. Example macOS client1.domain.tld.key

To show the contents of the client1.domain.tld.key, you can use cat client1.domain.tld.key.

Copy the value from terminal and paste in downloaded-client-config.ovpn like this:

```
ZZZ1111dddaBBB
-----END CERTIFICATE-----
</ca>
<cert>
----BEGIN CERTIFICATE-----
YOUR client1.domain.tld.crt
----END CERTIFICATE-----
</cert>
<key>
-----BEGIN CERTIFICATE-----
YOUR client1.domain.tld.key
-----END CERTIFICATE-----
</key>
```

Step eight: Connect to the AWS Client VPN

The client for AWS Client VPN is provided free of charge. You can connect your computer directly to AWS Client VPN for an end-to-end VPN experience.

To connect to the Client VPN

- 1. Download and install the AWS Client VPN for Desktop.
- 2. Open the AWS Client VPN.
- 3. Choose File, Managed profiles in the VPN client menu.
- 4. Choose Add profile, and then choose the downloaded-client-config.ovpn.
- 5. Enter a descriptive name in **Display Name**.
- 6. Choose Add profile, Done.
- 7. Choose **Connect**.

After you connect to the Client VPN, you'll need to disconnect from other VPNs to view any of the resources in your Amazon VPC.

1 Note

You may need to quit the client, and start again before you're able to get connected.

What's next?

 Learn how to create an Amazon MWAA environment in <u>Get started with Amazon Managed</u> <u>Workflows for Apache Airflow</u>. You must create an environment in the same AWS Region as the Client VPN, and using the same VPC, private subnets, and security group as the Client VPN.

Tutorial: Configuring private network access using a Linux Bastion Host

This tutorial walks you through the steps to create an SSH tunnel from your computer to the to the Apache Airflow *Web server* for your Amazon Managed Workflows for Apache Airflow environment. It assumes you've already created an Amazon MWAA environment. Once set up, a Linux Bastion Host acts as a jump server allowing a secure connection from your computer to the resources in your VPC. You'll then use a SOCKS proxy management add-on to control the proxy settings in your browser to access your Apache Airflow UI.

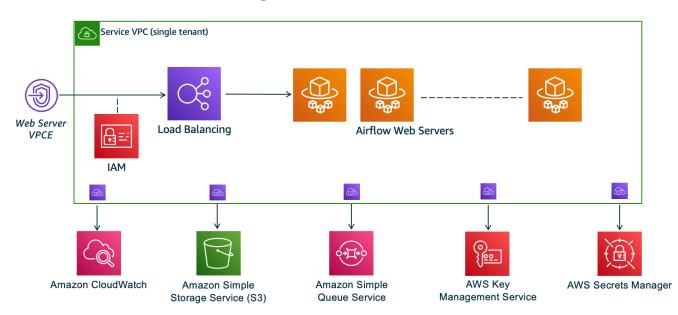
Sections

- Private network
- Use cases
- Before you begin
- Objectives
- Step one: Create the bastion instance
- Step two: Create the ssh tunnel
- Step three: Configure the bastion security group as an inbound rule
- <u>Step four: Copy the Apache Airflow URL</u>
- Step five: Configure proxy settings
- Step six: Open the Apache Airflow UI
- What's next?

Private network

This tutorial assumes you've chosen the **Private network** access mode for your Apache Airflow *Web server*.

Private Web Server Option



The private network access mode limits access to the Apache Airflow UI to users *within your Amazon VPC* that have been granted access to the <u>IAM policy for your environment</u>.

When you create an environment with private web server access, you must package all of your dependencies in a Python wheel archive (.whl), then reference the .whl in your requirements.txt. For instructions on packaging and installing your dependencies using wheel, refer to Managing dependencies using Python wheel.

The following image shows where to find the **Private network** option on the Amazon MWAA console.

Web server access Info O Private network (No internet access)

Additional setup required. Your Airflow UI can only be accessed by secure login behind your VPC. Choose this option if your Airflow UI is only accessed within a corporate network and you do not require a public repository for webserver requirements installation. IAM must be used to handle user authentication.

Public network (Internet accessible)

Your Airflow UI can be accessed by secure login over the Internet. Choose this option if your Airflow UI is accessed outside of a corporate network. IAM must be used to handle user authentication.

Use cases

You can use this tutorial after you've created an Amazon MWAA environment. You must use the same Amazon VPC, VPC security group(s), and public subnets as your environment.

Before you begin

- 1. Check for user permissions. Be sure that your account in AWS Identity and Access Management (IAM) has sufficient permissions to create and manage VPC resources.
- Use your Amazon MWAA VPC. This tutorial assumes that you are associating the bastion host to an existing VPC. The Amazon VPC must be in the same region as your Amazon MWAA environment and have two private subnets, as defined in <u>Create the VPC network</u>.
- Create an SSH key. You need to create an Amazon EC2 SSH key (.pem) in the same Region as your Amazon MWAA environment to connect to the virtual servers. If you don't have an SSH key, refer to <u>Create or import a key pair</u> in the *Amazon EC2 User Guide*.

Objectives

In this tutorial, you'll do the following:

- Create a Linux Bastion Host instance using a <u>AWS CloudFormation template for an existing</u> VPC.
- Authorize inbound traffic to the bastion instance's security group using an ingress rule on port 22.
- 3. Authorize inbound traffic from an Amazon MWAA environment's security group to the bastion instance's security group.
- 4. Create an SSH tunnel to the bastion instance.
- 5. Install and configure the FoxyProxy add-on for the Firefox browser to view the Apache Airflow UI.

Step one: Create the bastion instance

The following section describes the steps to create the linux bastion instance using a <u>AWS</u> <u>CloudFormation template for an existing VPC</u> on the AWS CloudFormation console.

To create the Linux Bastion Host

- 1. Open the <u>Deploy Quick Start</u> page on the AWS CloudFormation console.
- 2. Use the region selector in the navigation bar to choose the same AWS Region as your Amazon MWAA environment.

- 3. Choose Next.
- 4. Type a name in the **Stack name** text field, such as mwaa-linux-bastion.
- 5. On the **Parameters**, **Network configuration** pane, choose the following options:
 - a. Choose your Amazon MWAA environment's VPC ID.
 - b. Choose your Amazon MWAA environment's **Public subnet 1 ID**.
 - c. Choose your Amazon MWAA environment's **Public subnet 2 ID**.
 - d. Enter the narrowest possible address range (for example, an internal CIDR range) in **Allowed bastion external access CIDR**.

🚯 Note

The simplest way to identify a range is to use the same CIDR range as your public subnets. For example, the public subnets in the AWS CloudFormation template on the <u>Create the VPC network</u> page are 10.192.10.0/24 and 10.192.11.0/24.

- 6. On the Amazon EC2 configuration pane, choose the following:
 - a. Choose your SSH key in the dropdown list in **Key pair name**.
 - b. Enter a name in **Bastion Host Name**.
 - c. Choose **true** for **TCP forwarding**.

🔥 Warning

TCP forwarding must be set to **true** in this step. Otherwise, you won't be able to create an SSH tunnel in the next step.

- 7. Choose Next, Next.
- 8. Select the acknowledgement, and then choose **Create stack**.

To learn more about the architecture of your Linux Bastion Host, refer to <u>Linux Bastion Hosts on</u> the AWS Cloud: Architecture.

Step two: Create the ssh tunnel

The following steps describe how to create the ssh tunnel to your linux bastion. An SSH tunnel recieves the request from your local IP address to the linux bastion, which is why TCP forwarding for the linux bastion was set to true in previous steps.

macOS/Linux

To create a tunnel via command line

- 1. Open the Instances page on the Amazon EC2 console.
- 2. Choose an instance.
- 3. Copy the address in **Public IPv4 DNS**. For example, ec2-4-82-142-1.compute-1.amazonaws.com.
- 4. In your command prompt, navigate to the directory where your SSH key is stored.
- 5. Run the following command to connect to the bastion instance using ssh. Substitute the sample value with your SSH key name in mykeypair.pem.

ssh -i mykeypair.pem -N -D 8157 ec2-user@YOUR_PUBLIC_IPV4_DNS

Windows (PuTTY)

To create a tunnel using PuTTY

- 1. Open the Instances page on the Amazon EC2 console.
- 2. Choose an instance.
- 3. Copy the address in **Public IPv4 DNS**. For example, ec2-4-82-142-1.compute-1.amazonaws.com.
- 4. Open <u>PuTTY</u>, select **Session**.
- Enter the host name in Host Name as ec2-user@YOUR_PUBLIC_IPV4_DNS and the port as 22.
- 6. Expand the **SSH** tab, select **Auth**. In **Private Key file for authentication**, choose your local "ppk" file.
- 7. Under SSH, choose the **Tunnels** tab, and then select the *Dynamic* and *Auto* options.

- 8. In **Source Port**, add the 8157 port (or any other unused port), and then leave the **Destination** port blank. Choose **Add**.
- 9. Choose the **Session** tab and enter a session name. For example SSH Tunnel.
- 10. Choose Save, Open.

🚯 Note

You may need to enter a pass phrase for your public key.

Note

If you receive a Permission denied (publickey) error, we recommend using the <u>AWSSupport-TroubleshootSSH</u> tool, and choose **Run this Automation (console)** to troubleshoot your SSH setup.

Step three: Configure the bastion security group as an inbound rule

Access to the servers and regular internet access from the servers is allowed with a special maintenance security group attached to those servers. The following steps describe how to configure the bastion security group as an inbound source of traffic to an environment's VPC security group.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. On the **Networking** pane, choose **VPC security group**.
- 4. Choose Edit inbound rules.
- 5. Choose Add rule.
- 6. Choose your VPC security group ID in the **Source** dropdown list.
- 7. Leave the remaining options blank, or set to their default values.
- 8. Choose **Save rules**.

Step four: Copy the Apache Airflow URL

The following steps describe how to open the Amazon MWAA console and copy the URL to the Apache Airflow UI.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Copy the URL in Airflow UI for subsequent steps.

Step five: Configure proxy settings

If you use an SSH tunnel with dynamic port forwarding, you must use a SOCKS proxy management add-on to control the proxy settings in your browser. For example, you can use the --proxy-server feature of Chromium to kick off a browser session, or use the FoxyProxy extension in the Mozilla FireFox browser.

Option one: Setup an SSH Tunnel using local port forwarding

If you do not wish to use a SOCKS proxy, you can set up an SSH tunnel using local port forwarding. The following example command accesses the Amazon EC2 *ResourceManager* web interface by forwarding traffic on local port 8157.

- 1. Open a new command prompt window.
- 2. Type the following command to open an SSH tunnel.

```
ssh -i mykeypair.pem -N -L 8157:YOUR_VPC_ENDPOINT_ID-vpce.us-
east-1.airflow.amazonaws.com:443 ubuntu@YOUR_PUBLIC_IPV4_DNS.us-
east-1.compute.amazonaws.com
```

-L signifies the use of local port forwarding which allows you to specify a local port used to forward data to the identified remote port on the node's local web server.

3. Type http://localhost:8157/ in your browser.

🚯 Note

You may need to use https://localhost:8157/.

Option two: Proxies via command line

Most web browsers allow you to configure proxies via a command line or configuration parameter. For example, with Chromium you can start the browser with the following command:

```
chromium --proxy-server="socks5://localhost:8157"
```

This starts a browser session which uses the ssh tunnel you created in previous steps to proxy its requests. You can open your Private Amazon MWAA environment URL (with *https://*) as follows:

https://YOUR_VPC_ENDPOINT_ID-vpce.us-east-1.airflow.amazonaws.com/home.

Option three: Proxies using FoxyProxy for Mozilla Firefox

The following example demonstrates a FoxyProxy Standard (version 7.5.1) configuration for Mozilla Firefox. FoxyProxy provides a set of proxy management tools. It lets you use a proxy server for URLs that match patterns corresponding to domains used by the Apache Airflow UI.

- 1. In Firefox, open the FoxyProxy Standard extension page.
- 2. Choose Add to Firefox.
- 3. Choose Add.
- 4. Choose the FoxyProxy icon in your browser's toolbar, choose **Options**.
- 5. Copy the following code and save locally as mwaa-proxy.json. Substitute the sample value in *YOUR_HOST_NAME* with your **Apache Airflow URL**.

```
{
    "e0b7kh1606694837384": {
        "type": 3,
        "color": "#66cc66",
        "title": "airflow",
        "active": true,
        "address": "localhost",
        "port": 8157,
        "proxyDNS": false,
        "username": "",
        "password": "",
        "whitePatterns": [
        {
        {
        }
        }
    }
}
```

```
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```

```
"title": "airflow-ui",
        "pattern": "YOUR_HOST_NAME",
        "type": 1,
        "protocols": 1,
        "active": true
      }
    ],
    "blackPatterns": [],
    "pacURL": "",
    "index": -1
  },
  "k20d21508277536715": {
    "active": true,
    "title": "Default",
    "notes": "These are the settings that are used when no patterns match a URL.",
    "color": "#0055E5",
    "type": 5,
    "whitePatterns": [
      {
        "title": "all URLs",
        "active": true,
        "pattern": "*",
        "type": 1,
        "protocols": 1
      }
    ],
    "blackPatterns": [],
    "index": 9007199254740991
  },
  "logging": {
    "active": true,
    "maxSize": 500
  },
  "mode": "patterns",
  "browserVersion": "82.0.3",
  "foxyProxyVersion": "7.5.1",
  "foxyProxyEdition": "standard"
}
```

- 6. On the **Import Settings from FoxyProxy 6.0+** pane, choose **Import Settings** and select the mwaa-proxy.json file.
- 7. Choose OK.

Step six: Open the Apache Airflow UI

The following steps describe how to open your Apache Airflow UI.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose **Open Airflow UI**.

What's next?

- Learn how to run Airflow CLI commands on an SSH tunnel to a bastion host in <u>Apache Airflow</u> <u>CLI command reference</u>.
- Learn how to upload DAG code to your Amazon S3 bucket in Adding or updating DAGs.

Tutorial: Restricting an Amazon MWAA user's access to a subset of DAGs

Amazon MWAA manages access to your environment by mapping your IAM principals to one or more of Apache Airflow's <u>default roles</u>. The following tutorial shows how you can restrict individual Amazon MWAA users to only view and interact with a specific DAG or a set of DAGs.

🚺 Note

The steps in this tutorial can be completed using federated access, as long as the IAM roles can be assumed.

Topics

- Prerequisites
- <u>Step one: Provide Amazon MWAA web server access to your IAM principal with the default Public</u> Apache Airflow role.
- Step two: Create a new Apache Airflow custom role
- Step three: Assign the role you created to your Amazon MWAA user
- Next steps
- Related resources

Prerequisites

To complete the steps in this tutorial, you'll need the following:

- An Amazon MWAA environment with multiple DAGs
- An IAM principal, Admin with <u>AdministratorAccess</u> permissions, and an IAM user, MWAAUser, as the principal for which you can limit DAG access. For more information about admin roles, refer to <u>Administrator job function</u> in the *IAM User Guide*

í) Note

Do not attach permission policies directly to your IAM users. We recommend setting up IAM roles that users can assume to gain temporary access to your Amazon MWAA resources.

• AWS Command Line Interface version 2 installed.

Step one: Provide Amazon MWAA web server access to your IAM principal with the default Public Apache Airflow role.

To grant permission using the AWS Management Console

- 1. Sign in to your AWS account with an Admin role and open the IAM console.
- 2. In the left navigation pane, choose **Users**, then choose your Amazon MWAA IAM user from the users table.
- 3. On the user details page, under **Summary**, choose the **Permissions** tab, then choose **Permissions policies** to expand the card and choose **Add permissions**.
- 4. In the **Grant permissions** section, choose **Attach existing policies directly**, then choose **Create policy** to create and attach your own custom permissions policy.
- 5. On the **Create policy** page, choose **JSON**, then copy and paste the following JSON permissions policy in the policy editor. Tha policy grants web server access to the user with the default Public Apache Airflow role.

JSON

{

```
"Version": "2012-10-17",
"Statement": [
{
        "Effect": "Allow",
        "Action": "airflow:CreateWebLoginToken",
        "Resource": [
        "arn:aws:airflow:us-
east-1:111122223333:role/YOUR_ENVIRONMENT_NAME/Public"
        ]
        }
]
```

Step two: Create a new Apache Airflow custom role

To create a new role using the Apache Airflow UI

- 1. Using your administrator IAM role, open the <u>Amazon MWAA console</u> and launch your environment's Apache Airflow UI.
- 2. From the navigation pane at the top, hover on **Security** to open the dropdown list, then choose **List Roles** to view the default Apache Airflow roles.
- 3. From the roles list, select **User**, then at the top of the page choose **Actions** to open the dropdown. Choose **Copy Role**, and confirm **Ok**

Note

Copy the **Ops** or **Viewer** roles to grant more or less access, respectively.

- 4. Locate the new role you created in the table and choose **Edit record**.
- 5. On the **Edit Role** page, do the following:
 - For Name, type a new name for the role in the text field. For example, **Restricted**.
 - For the list of Permissions, remove can read on DAGs and can edit on DAGs, then add read and write permissions for the set of DAGs you want to provide access to. For example, for a DAG, example_dag.py, add can read on DAG:example_dag and can edit on DAG:example_dag.

Choose **Save**. You should now have a new role that limits access to a subset of DAGs available in your Amazon MWAA environment. You can now assign this role to any existing Apache Airflow users.

Step three: Assign the role you created to your Amazon MWAA user

To assign the new role

1. Using access credentials for MWAAUser, run the following CLI command to retrieve your environment's web server URL.

```
$ aws mwaa get-environment --name YOUR_ENVIRONMENT_NAME | jq
'.Environment.WebserverUrl'
```

If successful, you'll see the following output:

"ab1b2345-678a-90a1-a2aa-34a567a8a901.c13.us-west-2.airflow.amazonaws.com"

2. With MWAAUser signed in to the AWS Management Console, open a new browser window and access the following URI. Replace Webserver-URL with your information.

https://<Webserver-URL>/home

If successful, you'll see a Forbidden error page because MWAAUser has not been granted permission to access the Apache Airflow UI yet.

- 3. With Admin signed in to the AWS Management Console, open the Amazon MWAA console again and launch your environment's Apache Airflow UI.
- 4. From the UI dashboard, expand the **Security** dropdown, and this time choose **List Users**.
- 5. In the users table, find the new Apache Airflow user and choose **Edit record**. The user's first name will match your IAM user name in the following pattern: user/mwaa-user.
- 6. On the **Edit User** page, in the **Role** section, add the new custom role you created, then choose **Save**.

🚯 Note

The Last Name field is required, but a space satisfies the requirement.

The IAM Public principal grants the MWAAUser permission to access the Apache Airflow UI, while the new role provides the additional permissions needed to see their DAGs.

🔥 Important

Any of the 5 default roles (such as Admin) not authorized by IAM which are added using the Apache Airflow UI will be removed on next user login.

Next steps

 To learn more about managing access to your Amazon MWAA environment, and to see sample JSON IAM policies you can use for your environment users, refer to <u>the section called "Accessing</u> <u>an Amazon MWAA environment"</u>

Related resources

• <u>Access Control</u> (Apache Airflow Documentation) – Learn more about the default Apache Airflow roles on the Apache Airflow documentation website.

Tutorial: Automate managing your own environment endpoints on Amazon MWAA

If you use <u>AWS Organizations</u> to manage multiple AWS accounts that share resources, Amazon MWAA lets you create, and manage, your own Amazon VPC endpoints. This means you can use stricter security policies that allow access only the resources required by your environment.

When you create an environment in a shared Amazon VPC, the account that owns the main Amazon VPC (*owner*) shares the two private subnets required by Amazon MWAA with other

accounts (*participants*) that belong to the same organization. Participant accounts that share those subnets can then view, create, modify, and delete environments in the shared VPC.

When you create an environment in a shared, or otherwise policy-restricted, Amazon VPC, Amazon MWAA will first create the service VPC resources, then enter a PENDING state for up to 72 hours.

When the environment status changes from CREATING to PENDING, Amazon MWAA sends an Amazon EventBridge notification of the change in state. This lets the owner account create the required endpoints on behalf of participants based on endpoint service information from the Amazon MWAA console or API, or programmatically In the following, we create new Amazon VPC endpoints using an Lambda function and an EventBridge rule that listens to Amazon MWAA state change notifications.

Here, we create the new endpoints in the same Amazon VPC as the environment. To set up a shared Amazon VPC, create the EventBridge rule and Lambda function would in the owner account, and the Amazon MWAA environment in the participant account.

Topics

- Prerequisites
- Create the Amazon VPC
- Create the Lambda function
- Create the EventBridge rule
- <u>Create the Amazon MWAA environment</u>

Prerequisites

To complete the steps in this tutorial, you will need the following:

• ...

Create the Amazon VPC

Use the following AWS CloudFormation template and AWS CLI command to create a new Amazon VPC. The template sets up the Amazon VPC resources and modifies the endpoint policy to restrict access to a specific queue.

1. Download the AWS CloudFormation template, then unzip the .yml file.

 In a new command prompt window, navigate to the folder where you saved the template, then use <u>create-stack</u> to create the stack. The --template-body flag specifies the path to the template.

```
$ aws cloudformation create-stack --stack-name stack-name --template-body file://
cfn-vpc-private-network.yml
```

In the next section, you'll create the Lambda function.

Create the Lambda function

Use the following Python code and IAM JSON policy to create a new Lambda function and execution role. This function creates Amazon VPC endpoints for a private Apache Airflow web server and an Amazon SQS queue. Amazon MWAA uses Amazon SQS to queue tasks with Celery among multiple workers when scaling your environment.

- 1. Download the Python <u>function code</u>.
- 2. Download the IAM permission policy, then unzip the file.
- 3. Open a command prompt, then navigate to the folder where you saved the JSON permission policy. Use the IAM create-role command to create the new role.

```
$ aws iam create-role --role-name function-role \
--assume-role-policy-document file://lambda-mwaa-vpce-policy.json
```

Note the role ARN from the AWS CLI response. In the next step, we specify this new role as the function's execution role using its ARN.

4. Navigate to the folder where you saved the function code, then use the <u>create-function</u> command to create a new function.

```
$ aws lambda create-function --function-name mwaa-vpce-lambda \
--zip-file file://mwaa-lambda-shared-vpc.zip --runtime python3.8 --role
arn:aws:iam::123456789012:role/function-role --handler lambda_handler
```

Note the function ARN from the AWS CLI response. In the next step we specify the ARN to configure the function as a target for a new EventBridge rule.

In the next section, you will create the EventBridge rule that invokes this function when the environment enters a PENDING state.

Create the EventBridge rule

Do the following to create a new rule that listens for Amazon MWAA notifications and targets your new Lambda function.

1. Use the EventBridge put-rule command to create a new EventBridge rule.

```
$ aws events put-rule --name "mwaa-lambda-rule" \
--event-pattern "{\"source\":[\"aws.airflow\"],\"detail-type\":[\"MWAA Environment
Status Change\"]}"
```

The event pattern listens for notifications that Amazon MWAA sends whenever an environment status changes.

```
{
   "source": ["aws.airflow"],
   "detail-type": ["MWAA Environment Status Change"]
}
```

2. Use the put-targets command to add the Lambda function as a target for the new rule.

```
$ aws events put-targets --rule "mwaa-lambda-rule" \
--targets "Id"="1","Arn"="arn:aws::lambda:us-east-1:123456789012:function:mwaa-
vpce-lambda"
```

You're ready to create a new Amazon MWAA environment with customer-managed Amazon VPC endpoints.

Create the Amazon MWAA environment

Use the Amazon MWAA console to create a new environment with customer-managed Amazon VPC endpoints.

- 1. Open the <u>Amazon MWAA</u> console, and choose **Create an environment**.
- 2. For **Name** enter a unique name.
- 3. For **Airflow version** choose the latest version.

- 4. Choose an **Amazon S3 bucket** and a **DAGs folder**, such as dags/ to use with the environment, then choose **Next**.
- 5. On the **Configure advanced settings** page, do the following:
 - a. For **Virtual Private Cloud**, choose the Amazon VPC you created in the previous step.
 - b. For Web server access, choose Public network (Internet accessible).
 - c. For **Security groups**, choose the security group you created with AWS CloudFormation. Because the security groups for the AWS PrivateLink endpoints from the earlier step are self-referencing, you must choose the same security group for your environment.
 - d. For **Endpoint management**, choose **Customer managed endpoints**.
- 6. Keep the remaining default settings, then choose **Next**.
- 7. Review your selections, then choose **Create environment**.

🚺 Tip

For more information about setting up a new environment, refer to <u>Getting started with</u> <u>Amazon MWAA</u>.

When the environment is PENDING, Amazon MWAA sends a notification that matches the event pattern you set for your rule. The rule invokes your Lambda function. The function parses the notification event and gets the required endpoint information for the web server and the Amazon SQS queue. It then creates the endpoints in your Amazon VPC.

When the endpoints are available, Amazon MWAA resumes creating your environment. When ready, the environment status changes to AVAILABLE and you can access the Apache Airflow web server using the Amazon MWAA console.

Code examples for Amazon Managed Workflows for Apache Airflow

This guide contains code samples, including DAGs and custom plugins, that you can use on an Amazon Managed Workflows for Apache Airflow environment. For more examples of using Apache Airflow with AWS services, refer to the <u>dags</u> directory in the Apache Airflow GitHub repository.

Samples

- Using a DAG to import variables in the CLI
- <u>Creating an SSH connection using the SSHOperator</u>
- Using a secret key in AWS Secrets Manager for an Apache Airflow Snowflake connection
- Using a DAG to write custom metrics in CloudWatch
- Aurora PostgreSQL database cleanup on an Amazon MWAA environment
- Exporting environment metadata to CSV files on Amazon S3
- Using a secret key in AWS Secrets Manager for an Apache Airflow variable
- Using a secret key in AWS Secrets Manager for an Apache Airflow connection
- Creating a custom plugin with Oracle
- <u>Creating a custom plugin that generates runtime environment variables</u>
- Changing a DAG's timezone on Amazon MWAA
- <u>Refreshing a CodeArtifact token</u>
- Creating a custom plugin with Apache Hive and Hadoop
- <u>Creating a custom plugin for Apache Airflow PythonVirtualenvOperator</u>
- Invoking DAGs with a Lambda function
- Invoking DAGs in different Amazon MWAA environments
- Using Amazon MWAA with Amazon RDS for Microsoft SQL Server
- Using Amazon MWAA with Amazon EMR
- Using Amazon MWAA with Amazon EKS
- <u>Connecting to Amazon ECS using the ECSOperator</u>
- Using dbt with Amazon MWAA
- AWS blogs and tutorials

Using a DAG to import variables in the CLI

The following sample code imports variables using the CLI on Amazon Managed Workflows for Apache Airflow.

Topics

- Version
- Prerequisites
- Permissions
- Dependencies
- Code sample
- What's next?

Version

• You can use the code example on this page with Apache Airflow v2 in Python 3.10.

Prerequisites

• No additional permissions are required to use the code example on this page.

Permissions

Your AWS account needs access to the AmazonMWAAAirflowCliAccess policy. To learn more, refer to Apache Airflow CLI policy: AmazonMWAAAirflowCliAccess.

Dependencies

 To use this code example with Apache Airflow v2, no additional dependencies are required. The code uses the <u>Apache Airflow v2 base install</u> on your environment.

Code sample

The following sample code takes three inputs: your Amazon MWAA environment name (in mwaa_env), the AWS Region of your environment (in aws_region), and the local file that contains the variables you want to import (in var_file).

```
import boto3
import json
import requests
import base64
import getopt
import sys
argv = sys.argv[1:]
mwaa_env=''
aws_region=''
var_file=''
try:
    opts, args = getopt.getopt(argv, 'e:v:r:', ['environment', 'variable-
file','region'])
    #if len(opts) == 0 and len(opts) > 3:
    if len(opts) != 3:
        print ('Usage: -e MWAA environment -v variable file location and filename -r
 aws region')
    else:
        for opt, arg in opts:
            if opt in ("-e"):
                mwaa_env=arg
            elif opt in ("-r"):
                aws_region=arg
            elif opt in ("-v"):
                var_file=arg
        boto3.setup_default_session(region_name="{}".format(aws_region))
        mwaa_env_name = "{}".format(mwaa_env)
        client = boto3.client('mwaa')
        mwaa_cli_token = client.create_cli_token(
            Name=mwaa_env_name
        )
        with open ("{}".format(var_file), "r") as myfile:
```

```
fileconf = myfile.read().replace('\n', '')
        json_dictionary = json.loads(fileconf)
        for key in json_dictionary:
            print(key, " ", json_dictionary[key])
            val = (key + " " + json_dictionary[key])
            mwaa_auth_token = 'Bearer ' + mwaa_cli_token['CliToken']
            mwaa_webserver_hostname = 'https://{0}/aws_mwaa/
cli'.format(mwaa_cli_token['WebServerHostname'])
            raw_data = "variables set {0}".format(val)
            mwaa_response = requests.post(
                mwaa_webserver_hostname,
                headers={
                    'Authorization': mwaa_auth_token,
                    'Content-Type': 'text/plain'
                    },
                data=raw_data
                )
            mwaa_std_err_message = base64.b64decode(mwaa_response.json()
['stderr']).decode('utf8')
            mwaa_std_out_message = base64.b64decode(mwaa_response.json()
['stdout']).decode('utf8')
            print(mwaa_response.status_code)
            print(mwaa_std_err_message)
            print(mwaa_std_out_message)
except:
    print('Use this script with the following options: -e MWAA environment -v variable
 file location and filename -r aws region')
    print("Unexpected error:", sys.exc_info()[0])
    sys.exit(2)
```

What's next?

• Learn how to upload the DAG code in this example to the dags folder in your Amazon S3 bucket in Adding or updating DAGs.

Creating an SSH connection using the SSHOperator

The following example describes how you can use the SSHOperator in a directed acyclic graph (DAG) to connect to a remote Amazon EC2 instance from your Amazon Managed Workflows for

Apache Airflow environment. You can use a similar approach to connect to any remote instance with SSH access.

In the following example, you upload a SSH secret key (.pem) to your environment's dags directory on Amazon S3. Then, you install the necessary dependencies using requirements.txt and create a new Apache Airflow connection in the UI. Finally, you write a DAG that creates an SSH connection to the remote instance.

Topics

- Version
- Prerequisites
- Permissions
- <u>Requirements</u>
- Copy your secret key to Amazon S3
- <u>Create a new Apache Airflow connection</u>
- <u>Code sample</u>

Version

• You can use the code example on this page with **Apache Airflow v2** in <u>Python 3.10</u>.

Prerequisites

To use the sample code on this page, you'll need the following:

- An Amazon MWAA environment.
- An SSH secret key. The code sample assumes you have an Amazon EC2 instance and a .pem in the same Region as your Amazon MWAA environment. If you don't have a key, refer to <u>Create or</u> <u>import a key pair</u> in the Amazon EC2 User Guide.

Permissions

• No additional permissions are required to use the code example on this page.

Requirements

Add the following parameter to requirements.txt to install the apache-airflowproviders-ssh package on the web server. Once your environment updates and Amazon MWAA successfully installs the dependency, you will see a new **SSH** connection type in the UI.

```
-c https://raw.githubusercontent.com/apache/airflow/constraints-Airflow-version/
constraints-Python-version.txt
apache-airflow-providers-ssh
```

🚺 Note

-c defines the constraints URL in requirements.txt. This ensures that Amazon MWAA installs the correct package version for your environemnt.

Copy your secret key to Amazon S3

Use the following AWS Command Line Interface command to copy your . pem key to your environment's dags directory in Amazon S3.

\$ aws s3 cp your-secret-key.pem s3://amzn-s3-demo-bucket/dags/

Amazon MWAA copies the content in dags, including the .pem key, to the local /usr/local/ airflow/dags/ directory, By doing this, Apache Airflow can access the key.

Create a new Apache Airflow connection

To create a new SSH connection using the Apache Airflow UI

- 1. Open the Environments page on the Amazon MWAA console.
- 2. From the list of environments, choose Open Airflow UI for your environment.
- 3. On the Apache Airflow UI page, choose **Admin** from the top navigation bar to expand the dropdown list, then choose **Connections**.
- 4. On the **List Connections** page, choose +, or **Add a new record** button to add a new connection.
- 5. On the Add Connection page, add the following information:

- a. For **Connection Id**, enter **ssh_new**.
- b. For Connection Type, choose SSH from the dropdown list.

🚯 Note

If the **SSH** connection type is not available in the list, Amazon MWAA hasn't installed the required apache-airflow-providers-ssh package. Update your requirements.txt file to include this package, then try again.

- c. For **Host**, enter the IP address for the Amazon EC2 instance that you want to connect to. For example, **12.345.67.89**.
- d. For **Username**, enter **ec2-user** if you are connecting to an Amazon EC2 instance. Your username might be different, depending on the type of remote instance you want Apache Airflow to connect to.
- e. For Extra, enter the following key-value pair in JSON format:

{ "key_file": "/usr/local/airflow/dags/your-secret-key.pem" }

This key-value pair instructs Apache Airflow to look for the secret key in the local /dags directory.

Code sample

The following DAG uses the SSHOperator to connect to your target Amazon EC2 instance, then runs the hostname Linux command to print the name of the instance. You can modify the DAG to run any command or script on the remote instance.

1. Open a terminal, and navigate to the directory where your DAG code is stored. For example:

cd dags

2. Copy the contents of the following code sample and save locally as ssh.py.

```
from airflow.decorators import dag
from datetime import datetime
from airflow.providers.ssh.operators.ssh import SSHOperator
```

```
@dag(
    dag_id="ssh_operator_example",
    schedule_interval=None,
    start_date=datetime(2022, 1, 1),
    catchup=False,
    )
def ssh_dag():
    task_1=SSH0perator(
       task_id="ssh_task",
        ssh_conn_id='ssh_new',
        command='hostname',
    )
my_ssh_dag = ssh_dag()
```

3. Run the following AWS CLI command to copy the DAG to your environment's bucket, then trigger the DAG using the Apache Airflow UI.

\$ aws s3 cp your-dag.py s3://your-environment-bucket/dags/

4. If successful, you'll see output similar to the following in the task logs for ssh_task in the ssh_operator_example DAG:

```
[2022-01-01, 12:00:00 UTC] {{base.py:79}} INFO - Using connection to: id: ssh_new.
Host: 12.345.67.89, Port: None,
Schema: , Login: ec2-user, Password: None, extra: {'key_file': '/usr/local/airflow/
dags/your-secret-key.pem'}
[2022-01-01, 12:00:00 UTC] {{ssh.py:264}} WARNING - Remote Identification Change is
not verified. This won't protect against Man-In-The-Middle attacks
[2022-01-01, 12:00:00 UTC] {{ssh.py:270}} WARNING - No Host Key Verification. This
won't protect against Man-In-The-Middle attacks
[2022-01-01, 12:00:00 UTC] {{transport.py:1819}} INFO - Connected (version 2.0,
client OpenSSH_7.4)
[2022-01-01, 12:00:00 UTC] {{transport.py:1819}} INFO - Authentication (publickey)
successful!
[2022-01-01, 12:00:00 UTC] {{ssh.py:139}} INFO - Running command: hostname
[2022-01-01, 12:00:00 UTC]{{ssh.py:171}} INF0 - ip-123-45-67-89.us-
west-2.compute.internal
[2022-01-01, 12:00:00 UTC] {{taskinstance.py:1280}} INFO - Marking task as SUCCESS.
dag_id=ssh_operator_example, task_id=ssh_task, execution_date=20220712T200914,
 start_date=20220712T200915, end_date=20220712T200916
```

Using a secret key in AWS Secrets Manager for an Apache Airflow Snowflake connection

The following sample calls AWS Secrets Manager to get a secret key for an Apache Airflow Snowflake connection on Amazon Managed Workflows for Apache Airflow. It assumes you've completed the steps in <u>Configuring an Apache Airflow connection using a AWS Secrets Manager</u> secret.

Topics

- Version
- Prerequisites
- Permissions
- <u>Requirements</u>
- Code sample
- What's next?

Version

• You can use the code example on this page with **Apache Airflow v2** in <u>Python 3.10</u>.

Prerequisites

To use the sample code on this page, you'll need the following:

- The Secrets Manager backend as an Apache Airflow configuration option as shown in <u>Configuring</u> an Apache Airflow connection using a AWS Secrets Manager secret.
- An Apache Airflow connection string in Secrets Manager as shown in <u>Configuring an Apache</u> <u>Airflow connection using a AWS Secrets Manager secret</u>.

Permissions

 Secrets Manager permissions as shown in <u>Configuring an Apache Airflow connection using a AWS</u> <u>Secrets Manager secret</u>.

Requirements

To use the sample code on this page, add the following dependencies to your requirements.txt. To learn more, refer to Installing Python dependencies.

```
apache-airflow-providers-snowflake==1.3.0
```

Code sample

The following steps describe how to create the DAG code that calls Secrets Manager to get the secret.

1. In your command prompt, navigate to the directory where your DAG code is stored. For example:

cd dags

 Copy the contents of the following code sample and save locally as snowflake_connection.py.

.....

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from airflow.providers.snowflake.operators.snowflake import SnowflakeOperator
from airflow.utils.dates import days_ago

snowflake_query = [

```
"""use warehouse "MY_WAREHOUSE";""",
    """select * from "SNOWFLAKE_SAMPLE_DATA"."WEATHER"."WEATHER_14_TOTAL" limit
100;""",
]
with DAG(dag_id='snowflake_test', schedule_interval=None, catchup=False,
start_date=days_ago(1)) as dag:
    snowflake_select = SnowflakeOperator(
        task_id="snowflake_select",
        sql=snowflake_guery,
        snowflake_conn_id="snowflake_conn",
    )
```

What's next?

• Learn how to upload the DAG code in this example to the dags folder in your Amazon S3 bucket in Adding or updating DAGs.

Using a DAG to write custom metrics in CloudWatch

You can use the following code example to write a directed acyclic graph (DAG) that runs a PythonOperator to retrieve OS-level metrics for an Amazon MWAA environment. The DAG then publishes the data as custom metrics to Amazon CloudWatch.

Custom OS-level metrics provide you with additional visibility about how your environment workers are utilizing resources such as virtual memory and CPU. You can use this information to select the <u>environment class</u> that best suits your workload.

Topics

- Version
- Prerequisites
- Permissions
- Dependencies
- <u>Code example</u>

Version

• You can use the code example on this page with **Apache Airflow v2** in Python 3.10.

Prerequisites

To use the code example on this page, you need the following:

• An Amazon MWAA environment.

Permissions

• No additional permissions are required to use the code example on this page.

Dependencies

• No additional dependencies are required to use the code example on this page.

Code example

1. In your command prompt, navigate to the folder where your DAG code is stored. For example:

cd dags

 Copy the contents of the following code example and save it locally as dag-custommetrics.py. Replace MWAA-ENV-NAME with your environment name.

```
from airflow import DAG
from airflow.operators.python_operator import PythonOperator
from airflow.utils.dates import days_ago
from datetime import datetime
import os,json,boto3,psutil,socket

def publish_metric(client,name,value,cat,unit='None'):
    environment_name = os.getenv("MWAA_ENV_NAME")
    value_number=float(value)
    hostname = socket.gethostname()
    ip_address = socket.gethostbyname(hostname)
```

```
User Guide
```

```
print('writing value',value_number,'to metric',name)
    response = client.put_metric_data(
        Namespace='MWAA-Custom',
        MetricData=[
            {
                'MetricName': name,
                'Dimensions': [
                    {
                        'Name': 'Environment',
                        'Value': environment_name
                    },
                    {
                        'Name': 'Category',
                        'Value': cat
                    },
                    {
                        'Name': 'Host',
                        'Value': ip_address
                    },
                ],
                'Timestamp': datetime.now(),
                'Value': value_number,
                'Unit': unit
            },
        1
    )
    print(response)
    return response
def python_fn(**kwargs):
    client = boto3.client('cloudwatch')
    cpu_stats = psutil.cpu_stats()
    print('cpu_stats', cpu_stats)
   virtual = psutil.virtual_memory()
    cpu_times_percent = psutil.cpu_times_percent(interval=0)
    publish_metric(client=client, name='virtual_memory_total',
cat='virtual_memory', value=virtual.total, unit='Bytes')
    publish_metric(client=client, name='virtual_memory_available',
cat='virtual_memory', value=virtual.available, unit='Bytes')
    publish_metric(client=client, name='virtual_memory_used', cat='virtual_memory',
 value=virtual.used, unit='Bytes')
```

```
publish_metric(client=client, name='virtual_memory_free', cat='virtual_memory',
 value=virtual.free, unit='Bytes')
    publish_metric(client=client, name='virtual_memory_active',
 cat='virtual_memory', value=virtual.active, unit='Bytes')
    publish_metric(client=client, name='virtual_memory_inactive',
 cat='virtual_memory', value=virtual.inactive, unit='Bytes')
    publish_metric(client=client, name='virtual_memory_percent',
 cat='virtual_memory', value=virtual.percent, unit='Percent')
    publish_metric(client=client, name='cpu_times_percent_user',
 cat='cpu_times_percent', value=cpu_times_percent.user, unit='Percent')
    publish_metric(client=client, name='cpu_times_percent_system',
 cat='cpu_times_percent', value=cpu_times_percent.system, unit='Percent')
    publish_metric(client=client, name='cpu_times_percent_idle',
 cat='cpu_times_percent', value=cpu_times_percent.idle, unit='Percent')
   return "OK"
with DAG(dag_id=os.path.basename(__file__).replace(".py", ""),
 schedule_interval='*/5 * * * *', catchup=False, start_date=days_ago(1)) as dag:
    t = PythonOperator(task_id="memory_test", python_callable=python_fn,
 provide_context=True)
```

3. Run the following AWS CLI command to copy the DAG to your environment's bucket, then trigger the DAG using the Apache Airflow UI.

\$ aws s3 cp your-dag.py s3://your-environment-bucket/dags/

4. If the DAG runs successfully, you should see something similar to the following in your Apache Airflow logs:

```
[2022-08-16, 10:54:46 UTC] {{logging_mixin.py:109}} INFO -
cpu_stats scpustats(ctx_switches=3253992384, interrupts=1964237163,
soft_interrupts=492328209, syscalls=0)
[2022-08-16, 10:54:46 UTC] {{logging_mixin.py:109}} INFO - writing value
16024199168.0 to metric virtual_memory_total
[2022-08-16, 10:54:46 UTC] {{logging_mixin.py:109}} INFO - {'ResponseMetadata':
    {'RequestId': 'fad289ac-aa51-46a9-8b18-24e4e4063f4d', 'HTTPStatusCode': 200,
    'HTTPHeaders': {'x-amzn-requestid': 'fad289ac-aa51-46a9-8b18-24e4e4063f4d',
    'content-type': 'text/xml', 'content-length': '212', 'date': 'Tue, 16 Aug 2022
17:54:45 GMT'}, 'RetryAttempts': 0}
```

```
User Guide
```

```
[2022-08-16, 10:54:46 UTC] {{logging_mixin.py:109}} INFO - writing value
14356287488.0 to metric virtual_memory_available
[2022-08-16, 10:54:46 UTC] {{logging_mixin.py:109}} INFO - {'ResponseMetadata':
 {'RequestId': '6ef60085-07ab-4865-8abf-dc94f90cab46', 'HTTPStatusCode': 200,
 'HTTPHeaders': {'x-amzn-requestid': '6ef60085-07ab-4865-8abf-dc94f90cab46',
 'content-type': 'text/xml', 'content-length': '212', 'date': 'Tue, 16 Aug 2022
17:54:45 GMT'}, 'RetryAttempts': 0}}
[2022-08-16, 10:54:46 UTC] {{logging_mixin.py:109}} INFO - writing value
1342296064.0 to metric virtual_memory_used
[2022-08-16, 10:54:46 UTC] {{logging_mixin.py:109}} INF0 - {'ResponseMetadata':
 {'RequestId': 'd5331438-5d3c-4df2-bc42-52dcf8d60a00', 'HTTPStatusCode': 200,
 'HTTPHeaders': {'x-amzn-requestid': 'd5331438-5d3c-4df2-bc42-52dcf8d60a00',
 'content-type': 'text/xml', 'content-length': '212', 'date': 'Tue, 16 Aug 2022
17:54:45 GMT'}, 'RetryAttempts': 0}}
. . .
[2022-08-16, 10:54:46 UTC] {{python.py:152}} INFO - Done. Returned value was: OK
[2022-08-16, 10:54:46 UTC] {{taskinstance.py:1280}} INFO - Marking task as SUCCESS.
dag_id=dag-custom-metrics, task_id=memory_test, execution_date=20220816T175444,
start_date=20220816T175445, end_date=20220816T175446
[2022-08-16, 10:54:46 UTC] {{local_task_job.py:154}} INFO - Task exited with return
 code 0
```

Aurora PostgreSQL database cleanup on an Amazon MWAA environment

Amazon Managed Workflows for Apache Airflow uses an Aurora PostgreSQL database as the Apache Airflow metadata database, where DAG runs and task instances are stored. The following sample code periodically clears out entries from the dedicated Aurora PostgreSQL database for your Amazon MWAA environment.

Topics

- Version
- Prerequisites
- Dependencies
- <u>Code sample</u>

Version

• You can use the code example on this page with **Apache Airflow v2** in Python 3.10.

Prerequisites

To use the sample code on this page, you'll need the following:

• An Amazon MWAA environment.

Dependencies

• To use this code example with Apache Airflow v2, no additional dependencies are required. The code uses the Apache Airflow v2 base install on your environment.

Code sample

The following DAG cleans the metadata database for the tables specified in TABLES_TO_CLEAN. The example deletes data from the specified tables that is older than 30 days. To adjust how far back the entries are deleted, set MAX_AGE_IN_DAYS to a different value.

Apache Airflow v2.4 and later

```
from airflow import DAG
from airflow.models.param import Param
from airflow.operators.bash_operator import BashOperator
from airflow.utils.dates import days_ago
from datetime import datetime, timedelta
# Note: Database commands may time out if running longer than 5 minutes. If this
occurs, please increase the MAX_AGE_IN_DAYS (or change
# timestamp parameter to an earlier date) for initial runs, then reduce on
subsequent runs until the desired retention is met.
MAX_AGE_IN_DAYS = 30
# To clean specific tables, please provide a comma-separated list per
```

```
# https://airflow.apache.org/docs/apache-airflow/stable/cli-and-env-variables-
ref.html#clean
# A value of None will clean all tables
TABLES_TO_CLEAN = None
with DAG(
    dag_id="clean_db_dag",
    schedule_interval=None,
    catchup=False,
    start_date=days_ago(1),
    params={
        "timestamp": Param(
            default=(datetime.now()-timedelta(days=MAX_AGE_IN_DAYS)).strftime("%Y-
%m-%d %H:%M:%S"),
            type="string",
            minLength=1,
            maxLength=255,
        ),
    }
) as dag:
    if TABLES_TO_CLEAN:
        bash_command="airflow db clean --clean-before-timestamp
 '{{ params.timestamp }}' --tables '"+TABLES_TO_CLEAN+"' --skip-archive --yes"
    else:
        bash_command="airflow db clean --clean-before-timestamp
 '{{ params.timestamp }}' --skip-archive --yes"
    cli_command = BashOperator(
        task_id="bash_command",
        bash_command=bash_command
    )
```

Apache Airflow v2.2 and earlier

from airflow import settings
from airflow.utils.dates import days_ago
from airflow.models import DagTag, DagModel, DagRun, ImportError, Log, SlaMiss,
 RenderedTaskInstanceFields, TaskInstance, TaskReschedule, XCom
from airflow.decorators import dag, task
from airflow.utils.dates import days_ago
from time import sleep

```
from airflow.version import version
major_version, minor_version = int(version.split('.')[0]), int(version.split('.')
[1])
if major_version >= 2 and minor_version >= 6:
    from airflow.jobs.job import Job
else:
    # The BaseJob class was renamed as of Apache Airflow v2.6
   from airflow.jobs.base_job import BaseJob as Job
# Delete entries for the past 30 days. Adjust MAX_AGE_IN_DAYS to set how far back
this DAG cleans the database.
MAX\_AGE\_IN\_DAYS = 30
MIN_AGE_IN_DAYS = 0
DECREMENT = -7
# This is a list of (table, time) tuples.
# table = the table to clean in the metadata database
# time = the column in the table associated to the timestamp of an entry
          or None if not applicable.
#
TABLES_TO_CLEAN = [[Job, Job.latest_heartbeat],
    [TaskInstance, TaskInstance.execution_date],
    [TaskReschedule, TaskReschedule.execution_date],
    [DagTag, None],
    [DagModel, DagModel.last_parsed_time],
    [DagRun, DagRun.execution_date],
    [ImportError, ImportError.timestamp],
    [Log, Log.dttm],
    [SlaMiss, SlaMiss.execution_date],
    [RenderedTaskInstanceFields, RenderedTaskInstanceFields.execution_date],
    [XCom, XCom.execution_date],
1
@task()
def cleanup_db_fn(x):
    session = settings.Session()
    if x[1]:
        for oldest_days_ago in range(MAX_AGE_IN_DAYS, MIN_AGE_IN_DAYS, DECREMENT):
            earliest_days_ago = max(oldest_days_ago + DECREMENT, MIN_AGE_IN_DAYS)
            print(f"deleting {str(x[0])} entries between {earliest_days_ago} and
 {oldest_days_ago} days old...")
            earliest_date = days_ago(earliest_days_ago)
            oldest_date = days_ago(oldest_days_ago)
```

```
query = session.query(x[0]).filter(x[1] >= earliest_date).filter(x[1] <=</pre>
 oldest_date)
            query.delete(synchronize_session= False)
            session.commit()
            sleep(5)
    else:
        # No time column specified for the table. Delete all entries
        print("deleting", str(x[0]), "...")
        query = session.query(x[0])
        query.delete(synchronize_session= False)
        session.commit()
    session.close()
@dag(
    dag_id="cleanup_db",
    schedule_interval="@weekly",
    start_date=days_ago(7),
    catchup=False,
    is_paused_upon_creation=False
)
def clean_db_dag_fn():
    t last=None
    for x in TABLES_TO_CLEAN:
        t=cleanup_db_fn(x)
        if t_last:
            t_last >> t
        t_last = t
clean_db_dag = clean_db_dag_fn()
```

Exporting environment metadata to CSV files on Amazon S3

The following code example shows how you can create a directed acyclic graph (DAG) that queries the database for a range of DAG run information, and writes the data to .csv files stored on Amazon S3.

You might want to export information from the your environment's Aurora PostgreSQL database in order to inspect the data locally, archive them in object storage, or combine them with tools like the <u>Amazon S3 to Amazon Redshift operator</u> and the <u>database cleanup</u>, in order to move Amazon MWAA metadata out of the environment, but preserve them for future analysis.

You can query the database for any of the objects listed in <u>Apache Airflow models</u>. This code sample uses three models, DagRun, TaskFail, and TaskInstance, which provide information relevant to DAG runs.

Topics

- Version
- Prerequisites
- Permissions
- Requirements
- Code sample

Version

• You can use the code example on this page with Apache Airflow v2 in Python 3.10.

Prerequisites

To use the sample code on this page, you'll need the following:

- An Amazon MWAA environment.
- A new Amazon S3 bucket where you want to export your metadata information.

Permissions

Amazon MWAA needs permission for the Amazon S3 action s3:PutObject to write the queried metadata information to Amazon S3. Add the following policy statement to your environment's execution role.

```
{
   "Effect": "Allow",
   "Action": "s3:PutObject*",
   "Resource": "arn:aws:s3:::amzn-s3-demo-bucket"
}
```

This policy limits write access to only *amzn-s3-demo-bucket*.

Requirements

• To use this code example with Apache Airflow v2, no additional dependencies are required. The code uses the Apache Airflow v2 base install on your environment.

Code sample

The following steps describe how you can create a DAG that queries the Aurora PostgreSQL and writes the result to your new Amazon S3 bucket.

1. In your terminal, navigate to the directory where your DAG code is stored. For example:

```
cd dags
```

 Copy the contents of the following code example and save it locally as metadata_to_csv.py. You can change the value assigned to MAX_AGE_IN_DAYS to control the age of the oldest records your DAG queries from the metadata database.

```
from airflow.decorators import dag, task
from airflow import settings
import os
import boto3
from airflow.utils.dates import days_ago
from airflow.models import DagRun, TaskFail, TaskInstance
import csv, re
from io import StringIO
DAG_ID = os.path.basename(__file__).replace(".py", "")
MAX_AGE_IN_DAYS = 30
S3_BUCKET = '<your-export-bucket>'
S3_KEY = 'files/export/{0}.csv'
# You can add other objects to export from the metadatabase,
OBJECTS_TO_EXPORT = [
    [DagRun, DagRun.execution_date],
    [TaskFail, TaskFail.execution_date],
    [TaskInstance, TaskInstance.execution_date],
]
```

```
@task()
def export_db_task(**kwargs):
    session = settings.Session()
    print("session: ",str(session))
    oldest_date = days_ago(MAX_AGE_IN_DAYS)
    print("oldest_date: ",oldest_date)
   s3 = boto3.client('s3')
   for x in OBJECTS_TO_EXPORT:
        query = session.query(x[0]).filter(x[1] >= days_ago(MAX_AGE_IN_DAYS))
        print("type",type(query))
        allrows=query.all()
        name=re.sub("[<>']", "", str(x[0]))
        print(name,": ",str(allrows))
        if len(allrows) > 0:
            outfileStr=""
            f = StringIO(outfileStr)
            w = csv.DictWriter(f, vars(allrows[0]).keys())
            w.writeheader()
            for y in allrows:
                w.writerow(vars(y))
            outkey = S3_KEY.format(name[6:])
            s3.put_object(Bucket=S3_BUCKET, Key=outkey, Body=f.getvalue())
@dag(
    dag_id=DAG_ID,
    schedule_interval=None,
    start_date=days_ago(1),
    )
def export_db():
    t = export_db_task()
metadb_to_s3_test = export_db()
```

3. Run the following AWS CLI command to copy the DAG to your environment's bucket, then trigger the DAG using the Apache Airflow UI.

\$ aws s3 cp your-dag.py s3://your-environment-bucket/dags/

4. If successful, you'll output similar to the following in the task logs for the export_db task:

```
[2022-01-01, 12:00:00 PDT] {{logging_mixin.py:109}} INFO - type <class
 'sqlalchemy.orm.query.Query'>
[2022-01-01, 12:00:00 PDT] {{logging_mixin.py:109}} INFO - class
airflow.models.dagrun.DagRun : [your-tasks]
[2022-01-01, 12:00:00 PDT] {{logging_mixin.py:109}} INFO - type <class
 'sqlalchemy.orm.query.Query'>
[2022-01-01, 12:00:00 PDT] {{logging_mixin.py:109}} INFO - class
airflow.models.taskfail.TaskFail : [your-tasks]
[2022-01-01, 12:00:00 PDT] {{logging_mixin.py:109}} INFO - type <class
 'sqlalchemy.orm.query.Query'>
[2022-01-01, 12:00:00 PDT] {{logging_mixin.py:109}} INFO - class
airflow.models.taskinstance.TaskInstance : [your-tasks]
[2022-01-01, 12:00:00 PDT] {{python.py:152}} INFO - Done. Returned value was: OK
[2022-01-01, 12:00:00 PDT] {{taskinstance.py:1280}} INFO - Marking task as
SUCCESS. dag_id=metadb_to_s3, task_id=export_db, execution_date=20220101T000000,
start_date=20220101T000000, end_date=20220101T000000
[2022-01-01, 12:00:00 PDT] {{local_task_job.py:154}} INFO - Task exited with return
code 0
[2022-01-01, 12:00:00 PDT] {{local_task_job.py:264}} INFO - 0 downstream tasks
 scheduled from follow-on schedule check
```

You can now access and download the exported .csv files in your new Amazon S3 bucket in / files/export/.

Using a secret key in AWS Secrets Manager for an Apache Airflow variable

The following sample calls AWS Secrets Manager to get a secret key for an Apache Airflow variable on Amazon Managed Workflows for Apache Airflow. It assumes you've completed the steps in Configuring an Apache Airflow connection using a AWS Secrets Manager secret.

Topics

- Version
- Prerequisites
- Permissions
- <u>Requirements</u>

- Code sample
- What's next?

Version

- The sample code on this page can be used with **Apache Airflow v1** in Python 3.7.
- You can use the code example on this page with **Apache Airflow v2** in Python 3.10.

Prerequisites

To use the sample code on this page, you'll need the following:

- The Secrets Manager backend as an Apache Airflow configuration option as shown in <u>Configuring</u> an Apache Airflow connection using a AWS Secrets Manager secret.
- An Apache Airflow variable string in Secrets Manager as shown in <u>Configuring an Apache Airflow</u> connection using a AWS Secrets Manager secret.

Permissions

 Secrets Manager permissions as shown in <u>Configuring an Apache Airflow connection using a AWS</u> Secrets Manager secret.

Requirements

- To use this code example with Apache Airflow v1, no additional dependencies are required. The code uses the Apache Airflow v1 base install on your environment.
- To use this code example with Apache Airflow v2, no additional dependencies are required. The code uses the Apache Airflow v2 base install on your environment.

Code sample

The following steps describe how to create the DAG code that calls Secrets Manager to get the secret.

1. In your command prompt, navigate to the directory where your DAG code is stored. For example:

cd dags

2. Copy the contents of the following code sample and save locally as secrets-managervar.py.

```
from airflow import DAG
from airflow.operators.python_operator import PythonOperator
from airflow.models import Variable
from airflow.utils.dates import days_ago
from datetime import timedelta
import os
DAG_ID = os.path.basename(__file__).replace(".py", "")
DEFAULT_ARGS = {
    'owner': 'airflow',
    'depends_on_past': False,
    'email': ['airflow@example.com'],
    'email_on_failure': False,
    'email_on_retry': False,
}
def get_variable_fn(**kwargs):
    my_variable_name = Variable.get("test-variable", default_var="undefined")
    print("my_variable_name: ", my_variable_name)
    return my_variable_name
with DAG(
    dag_id=DAG_ID,
    default_args=DEFAULT_ARGS,
    dagrun_timeout=timedelta(hours=2),
    start_date=days_ago(1),
    schedule_interval='@once',
   tags=['variable']
) as dag:
    qet_variable = PythonOperator(
        task_id="get_variable",
        python_callable=get_variable_fn,
```

provide_context=True

What's next?

)

• Learn how to upload the DAG code in this example to the dags folder in your Amazon S3 bucket in Adding or updating DAGs.

Using a secret key in AWS Secrets Manager for an Apache Airflow connection

The following sample calls AWS Secrets Manager to get a secret key for an Apache Airflow connection on Amazon Managed Workflows for Apache Airflow. It assumes you've completed the steps in <u>Configuring an Apache Airflow connection using a AWS Secrets Manager secret</u>.

Topics

- Version
- Prerequisites
- Permissions
- <u>Requirements</u>
- Code sample
- What's next?

Version

- The sample code on this page can be used with Apache Airflow v1 in Python 3.7.
- You can use the code example on this page with Apache Airflow v2 in Python 3.10.

Prerequisites

To use the sample code on this page, you'll need the following:

- The Secrets Manager backend as an Apache Airflow configuration option as shown in <u>Configuring</u> an Apache Airflow connection using a AWS Secrets Manager secret.
- An Apache Airflow connection string in Secrets Manager as shown in <u>Configuring an Apache</u> <u>Airflow connection using a AWS Secrets Manager secret</u>.

Permissions

 Secrets Manager permissions as shown in <u>Configuring an Apache Airflow connection using a AWS</u> <u>Secrets Manager secret</u>.

Requirements

- To use this code example with Apache Airflow v1, no additional dependencies are required. The code uses the Apache Airflow v1 base install on your environment.
- To use this code example with Apache Airflow v2, no additional dependencies are required. The code uses the Apache Airflow v2 base install on your environment.

Code sample

The following steps describe how to create the DAG code that calls Secrets Manager to get the secret.

Apache Airflow v2

1. In your command prompt, navigate to the directory where your DAG code is stored. For example:

cd dags

 Copy the contents of the following code sample and save locally as secretsmanager.py.

```
"""
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```

```
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IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
.....
from airflow import DAG, settings, secrets
from airflow.operators.python import PythonOperator
from airflow.utils.dates import days_ago
from airflow.providers.amazon.aws.hooks.base_aws import AwsBaseHook
from datetime import timedelta
import os
### The steps to create this secret key can be found at: https://
docs.aws.amazon.com/mwaa/latest/userguide/connections-secrets-manager.html
sm_secretId_name = 'airflow/connections/myconn'
default_args = {
    'owner': 'airflow',
    'start_date': days_ago(1),
    'depends_on_past': False
}
### Gets the secret myconn from Secrets Manager
def read_from_aws_sm_fn(**kwargs):
    ### set up Secrets Manager
    hook = AwsBaseHook(client_type='secretsmanager')
    client = hook.get_client_type(region_name='us-east-1')
    response = client.get_secret_value(SecretId=sm_secretId_name)
    myConnSecretString = response["SecretString"]
    return myConnSecretString
### 'os.path.basename(__file__).replace(".py", "")' uses the file name secrets-
manager.py for a DAG ID of secrets-manager
with DAG(
```

Apache Airflow v1

1. In your command prompt, navigate to the directory where your DAG code is stored. For example:

cd dags

 Copy the contents of the following code sample and save locally as secretsmanager.py.

```
from airflow import DAG, settings, secrets
from airflow.operators.python_operator import PythonOperator
from airflow.utils.dates import days_ago
from airflow.contrib.hooks.aws_hook import AwsHook
from datetime import timedelta
import os
### The steps to create this secret key can be found at: https://
docs.aws.amazon.com/mwaa/latest/userguide/connections-secrets-manager.html
sm_secretId_name = 'airflow/connections/myconn'
default_args = {
    'owner': 'airflow',
    'start_date': days_ago(1),
    'depends_on_past': False
}
### Gets the secret myconn from Secrets Manager
```

```
def read_from_aws_sm_fn(**kwargs):
    ### set up Secrets Manager
    hook = AwsHook()
    client = hook.get_client_type('secretsmanager')
    response = client.get_secret_value(SecretId=sm_secretId_name)
    myConnSecretString = response["SecretString"]
    return myConnSecretString
### 'os.path.basename(__file__).replace(".py", "")' uses the file name secrets-
manager.py for a DAG ID of secrets-manager
with DAG(
        dag_id=os.path.basename(__file__).replace(".py", ""),
        default_args=default_args,
        dagrun_timeout=timedelta(hours=2),
        start_date=days_ago(1),
        schedule_interval=None
) as dag:
    write_all_to_aws_sm = PythonOperator(
        task_id="read_from_aws_sm",
        python_callable=read_from_aws_sm_fn,
        provide_context=True
    )
```

What's next?

• Learn how to upload the DAG code in this example to the dags folder in your Amazon S3 bucket in Adding or updating DAGs.

Creating a custom plugin with Oracle

The following sample walks you through the steps to create a custom plugin using Oracle for Amazon MWAA and can be combined with other custom plugins and binaries in your plugins.zip file.

Contents

- Version
- Prerequisites
- Permissions

- Requirements
- Code sample
- Create the custom plugin
 - Download dependencies
 - Custom plugin
 - Plugins.zip
- <u>Airflow configuration options</u>
- What's next?

Version

- The sample code on this page can be used with Apache Airflow v1 in Python 3.7.
- You can use the code example on this page with Apache Airflow v2 in Python 3.10.

Prerequisites

To use the sample code on this page, you'll need the following:

- An Amazon MWAA environment.
- Worker logging enabled at any log level, CRITICAL or above, for your environment. For more
 information about Amazon MWAA log types and how to manage your log groups, refer to <u>the
 section called "Viewing Airflow logs"</u>

Permissions

• No additional permissions are required to use the code example on this page.

Requirements

To use the sample code on this page, add the following dependencies to your requirements.txt. To learn more, refer to <u>Installing Python dependencies</u>.

Apache Airflow v2

```
-c https://raw.githubusercontent.com/apache/airflow/constraints-2.0.2/
constraints-3.7.txt
cx_Oracle
apache-airflow-providers-oracle
```

Apache Airflow v1

cx_Oracle==8.1.0
apache-airflow[oracle]==1.10.12

Code sample

The following steps describe how to create the DAG code that will test the custom plugin.

1. In your command prompt, navigate to the directory where your DAG code is stored. For example:

cd dags

2. Copy the contents of the following code sample and save locally as oracle.py.

```
from airflow import DAG
from airflow.operators.python_operator import PythonOperator
from airflow.utils.dates import days_ago
import os
import os
import cx_Oracle
DAG_ID = os.path.basename(__file__).replace(".py", "")
def testHook(**kwargs):
    cx_Oracle.init_oracle_client()
    version = cx_Oracle.clientversion()
    print("cx_Oracle.clientversion",version)
    return version
with DAG(dag_id=DAG_ID, schedule_interval=None, catchup=False,
    start_date=days_ago(1)) as dag:
    hook_test = PythonOperator(
        task_id="hook_test",
```

```
python_callable=testHook,
provide_context=True
)
```

Create the custom plugin

This section describes how to download the dependencies, create the custom plugin and the plugins.zip.

Download dependencies

Amazon MWAA will extract the contents of plugins.zip into /usr/local/airflow/plugins on each Amazon MWAA scheduler and worker container. This is used to add binaries to your environment. The following steps describe how to assemble the files needed for the custom plugin.

Pull the Amazon Linux container image

1. In your command prompt, pull the Amazon Linux container image, and run the container locally. For example:

docker pull amazonlinux
docker run -it amazonlinux:latest /bin/bash

Your command prompt should invoke a bash command line. For example:

bash-4.2#

2. Install the Linux-native asynchronous I/O facility (libaio).

```
yum -y install libaio
```

3. Keep this window open for subsequent steps. We'll be copying the following files locally: lib64/libaio.so.1, lib64/libaio.so.1.0.0, lib64/libaio.so.1.0.1.

Download client folder

1. Install the unzip package locally. For example:

sudo yum install unzip

2. Create an oracle_plugin directory. For example:

```
mkdir oracle_plugin
cd oracle_plugin
```

 Use the following curl command to download the <u>instantclient-basic-</u> linux.x64-18.5.0.0.0dbru.zip from Oracle Instant Client Downloads for Linux x86-64 (64-bit).

```
curl https://download.oracle.com/otn_software/linux/instantclient/185000/
instantclient-basic-linux.x64-18.5.0.0.0dbru.zip > client.zip
```

4. Unzip the client.zip file. For example:

unzip *.zip

Extract files from Docker

1. In a new command prompt, display and write down your Docker container ID. For example:

docker container ls

Your command prompt should return all containers and their IDs. For example:

```
debc16fd6970
```

2. In your oracle_plugin directory, extract the lib64/libaio.so.1, lib64/ libaio.so.1.0.0, lib64/libaio.so.1.0.1 files to the local instantclient_18_5 folder. For example:

```
docker cp debc16fd6970:/lib64/libaio.so.1 instantclient_18_5/
docker cp debc16fd6970:/lib64/libaio.so.1.0.0 instantclient_18_5/
docker cp debc16fd6970:/lib64/libaio.so.1.0.1 instantclient_18_5/
```

Custom plugin

Apache Airflow will execute the contents of Python files in the plugins folder at startup. This is used to set and modify environment variables. The following steps describe the sample code for the custom plugin.

Copy the contents of the following code sample and save locally as env_var_plugin_oracle.py.

```
from airflow.plugins_manager import AirflowPlugin
import os
os.environ["LD_LIBRARY_PATH"]='/usr/local/airflow/plugins/instantclient_18_5'
os.environ["DPI_DEBUG_LEVEL"]="64"
class EnvVarPlugin(AirflowPlugin):
    name = 'env_var_plugin'
```

Plugins.zip

The following steps show how to create the plugins.zip. The contents of this example can be combined with your other plugins and binaries into a single plugins.zip file.

Zip the contents of the plugin directory

1. In your command prompt, navigate to the oracle_plugin directory. For example:

```
cd oracle_plugin
```

2. Zip the instantclient_18_5 directory in plugins.zip. For example:

zip -r ../plugins.zip ./

3. You should see the following in your command prompt:

```
oracle_plugin$ ls
client.zip instantclient_18_5
```

4. Remove the client.zip file. For example:

```
rm client.zip
```

Zip the env_var_plugin_oracle.py file

1. Add the env_var_plugin_oracle.py file to the root of the plugins.zip. For example:

zip plugins.zip env_var_plugin_oracle.py

2. Your plugins.zip should now include the following:

```
env_var_plugin_oracle.py
instantclient_18_5/
```

Airflow configuration options

If you're using Apache Airflow v2, add core.lazy_load_plugins : False as an Apache Airflow configuration option. To learn more, refer to <u>Using configuration options to load plugins in</u> <u>2</u>.

What's next?

- Learn how to upload the requirements.txt file in this example to your Amazon S3 bucket in Installing Python dependencies.
- Learn how to upload the DAG code in this example to the dags folder in your Amazon S3 bucket in Adding or updating DAGs.
- Learn more about how to upload the plugins.zip file in this example to your Amazon S3 bucket in Installing custom plugins.

Creating a custom plugin that generates runtime environment variables

The following sample walks you through the steps to create a custom plugin that generates environment variables at runtime on an Amazon Managed Workflows for Apache Airflow environment.

Topics

- Version
- Prerequisites
- Permissions
- <u>Requirements</u>

- Custom plugin
- Plugins.zip
- Airflow configuration options
- What's next?

Version

• The sample code on this page can be used with Apache Airflow v1 in Python 3.7.

Prerequisites

To use the sample code on this page, you'll need the following:

• An Amazon MWAA environment.

Permissions

• No additional permissions are required to use the code example on this page.

Requirements

• To use this code example with Apache Airflow v1, no additional dependencies are required. The code uses the Apache Airflow v1 base install on your environment.

Custom plugin

Apache Airflow will execute the contents of Python files in the plugins folder at startup. This is used to set and modify environment variables. The following steps describe the sample code for the custom plugin.

1. In your command prompt, navigate to the directory where your plugins are stored. For example:

cd plugins

2. Copy the contents of the following code sample and save locally as env_var_plugin.py in the above folder.

```
from airflow.plugins_manager import AirflowPlugin
import os
os.environ["PATH"] = os.getenv("PATH") + ":/usr/local/airflow/.local/lib/python3.7/
site-packages"
os.environ["JAVA_HOME"]="/usr/lib/jvm/java-1.8.0-
openjdk-1.8.0.272.b10-1.amzn2.0.1.x86_64"
class EnvVarPlugin(AirflowPlugin):
    name = 'env_var_plugin'
```

Plugins.zip

The following steps show how to create plugins.zip. The contents of this example can be combined with other plugins and binaries into a single plugins.zip file.

1. In your command prompt, navigate to the hive_plugin directory from the previous step. For example:

cd plugins

2. Zip the contents within your plugins folder.

zip -r ../plugins.zip ./

Airflow configuration options

If you're using Apache Airflow v2, add core.lazy_load_plugins : False as an Apache Airflow configuration option. To learn more, refer to <u>Using configuration options to load plugins in</u> <u>2</u>.

What's next?

• Learn how to upload the requirements.txt file in this example to your Amazon S3 bucket in Installing Python dependencies.

- Learn how to upload the DAG code in this example to the dags folder in your Amazon S3 bucket in Adding or updating DAGs.
- Learn more about how to upload the plugins.zip file in this example to your Amazon S3 bucket in <u>Installing custom plugins</u>.

Changing a DAG's timezone on Amazon MWAA

Apache Airflow schedules your directed acyclic graph (DAG) in UTC+0 by default. The following steps show how you can change the timezone in which Amazon MWAA runs your DAGs with <u>Pendulum</u>. Optionally, this topic demonstrates how you can create a custom plugin to change the timezone for your environment's Apache Airflow logs.

Topics

- Version
- Prerequisites
- Permissions
- Create a plugin to change the timezone in Airflow logs
- Create a plugins.zip
- <u>Code sample</u>
- What's next?

Version

• You can use the code example on this page with **Apache Airflow v2** in Python 3.10.

Prerequisites

To use the sample code on this page, you'll need the following:

• An Amazon MWAA environment.

Permissions

• No additional permissions are required to use the code example on this page.

Create a plugin to change the timezone in Airflow logs

Apache Airflow will run the Python files in the plugins directory at start-up. With the following plugin, you can override the executor's timezone, which modifies the timezone in which Apache Airflow writes logs.

1. Create a directory named plugins for your custom plugin, and navigate to the directory. For example:

```
$ mkdir plugins
$ cd plugins
```

2. Copy the contents of the following code sample and save locally as dag-timezoneplugin.py in the plugins folder.

```
import time
import os
os.environ['TZ'] = 'America/Los_Angeles'
time.tzset()
```

3. In the plugins directory, create an empty Python file named __init__.py. Your plugins directory should be similar to the following:

plugins/ |-- __init__.py |-- dag-timezone-plugin.py

Create a plugins.zip

The following steps show how to create plugins.zip. The content of this example can be combined with other plugins and binaries into a single plugins.zip file.

1. In your command prompt, navigate to the plugins directory from the previous step. For example:

cd plugins

2. Zip the contents within your plugins directory.

zip -r ../plugins.zip ./

3. Upload plugins.zip to your S3 bucket

```
$ aws s3 cp plugins.zip s3://your-mwaa-bucket/
```

Code sample

To change the default timezone (UTC+0) in which the DAG runs, we'll use a library called Pendulum, a Python library for working with timezone-aware datetime.

1. In your command prompt, navigate to the directory where your DAGs are stored. For example:

```
$ cd dags
```

2. Copy the content of the following example and save as tz-aware-dag.py.

```
from airflow import DAG
from airflow.operators.bash_operator import BashOperator
from datetime import datetime, timedelta
# Import the Pendulum library.
import pendulum
# Instantiate Pendulum and set your timezone.
local_tz = pendulum.timezone("America/Los_Angeles")
with DAG(
    dag_id = "tz_test",
    schedule_interval="0 12 * * *",
    catchup=False,
    start_date=datetime(2022, 1, 1, tzinfo=local_tz)
) as dag:
    bash_operator_task = BashOperator(
        task_id="tz_aware_task",
        dag=dag,
        bash_command="date"
    )
```

3. Run the following AWS CLI command to copy the DAG to your environment's bucket, then trigger the DAG using the Apache Airflow UI.

```
$ aws s3 cp your-dag.py s3://your-environment-bucket/dags/
```

 If successful, you'll output similar to the following in the task logs for the tz_aware_task in the tz_test DAG:

```
[2022-08-01, 12:00:00 PDT] {{subprocess.py:74}} INF0 - Running command: ['bash', '-
c', 'date']
[2022-08-01, 12:00:00 PDT] {{subprocess.py:85}} INF0 - Output:
[2022-08-01, 12:00:00 PDT] {{subprocess.py:89}} INF0 - Mon Aug 1 12:00:00 PDT 2022
[2022-08-01, 12:00:00 PDT] {{subprocess.py:93}} INF0 - Command exited with return
code 0
[2022-08-01, 12:00:00 PDT] {{taskinstance.py:1280}} INF0 - Marking task as
SUCCESS. dag_id=tz_test, task_id=tz_aware_task, execution_date=20220801T190033,
start_date=20220801T190035, end_date=20220801T190035
[2022-08-01, 12:00:00 PDT] {{local_task_job.py:154}} INF0 - Task exited with return
code 0
[2022-08-01, 12:00:00 PDT] {{local_task_job.py:264}} INF0 - 0 downstream tasks
scheduled from follow-on schedule check
```

What's next?

• Learn more about how to upload the plugins.zip file in this example to your Amazon S3 bucket in Installing custom plugins.

Refreshing a CodeArtifact token

If you're using CodeArtifact to install Python dependencies, Amazon MWAA requires an active token. To allow Amazon MWAA to access a CodeArtifact repository at runtime, you can use a <u>startup script</u> and set the <u>PIP_EXTRA_INDEX_URL</u> with the token.

The following topic describes how you can create a startup script that uses the <u>get_authorization_token</u> CodeArtifact API operation to retrieve a fresh token every time your environment starts up, or updates.

Topics

Version

- Prerequisites
- Permissions
- Code sample
- What's next?

Version

• You can use the code example on this page with **Apache Airflow v2** in Python 3.10.

Prerequisites

To use the sample code on this page, you'll need the following:

- An Amazon MWAA environment.
- A CodeArtifact repository where you store dependencies for your environment.

Permissions

To refresh the CodeArtifact token and write the result to Amazon S3 Amazon MWAA must have the following permissions in the execution role.

 The codeartifact:GetAuthorizationToken action allows Amazon MWAA to retrieve a new token from CodeArtifact. The following policy grants permission for every CodeArtifact domain you create. You can further restrict access to your domains by modifying the resource value in the statement, and specifying only the domains that you want your environment to access.

```
{
    "Effect": "Allow",
    "Action": "codeartifact:GetAuthorizationToken",
    "Resource": "arn:aws:codeartifact:us-west-2:*:domain/*"
}
```

• The sts:GetServiceBearerToken action is required to call the CodeArtifact <u>GetAuthorizationToken</u> API operation. This operation returns a token that must be used when using a package manager such as pip with CodeArtifact. To use a package manager with a CodeArtifact repository, your environment's execution role role must allow sts:GetServiceBearerToken as shown in the following policy statement.

```
{
   "Sid": "AllowServiceBearerToken",
   "Effect": "Allow",
   "Action": "sts:GetServiceBearerToken",
   "Resource": "*"
}
```

Code sample

The following steps describe how you can create a start up script that updates the CodeArtifact token.

 Copy the contents of the following code sample and save locally as code_artifact_startup_script.sh.

```
#!/bin/sh
# Startup script for MWAA, refer to https://docs.aws.amazon.com/mwaa/latest/
userguide/using-startup-script.html
set -eu
# setup code artifact endpoint and token
# https://pip.pypa.io/en/stable/cli/pip_install/#cmdoption-0
# https://docs.aws.amazon.com/mwaa/latest/userguide/samples-code-artifact.html
DOMAIN="amazon"
DOMAIN_OWNER="112233445566"
REGION="us-west-2"
REPO_NAME="MyRepo"
echo "Getting token for CodeArtifact with args: --domain $DOMAIN --region $REGION
--domain-owner $DOMAIN_OWNER"
TOKEN=$(aws codeartifact get-authorization-token --domain $DOMAIN --region $REGION
 --domain-owner $DOMAIN_OWNER | jq -r '.authorizationToken')
echo "Setting Pip env var for '--index-url' to point to CodeArtifact"
export PIP_EXTRA_INDEX_URL="https://aws:$TOKEN@$DOMAIN-
$DOMAIN_OWNER.d.codeartifact.$REGION.amazonaws.com/pypi/$REPO_NAME/simple/"
echo "CodeArtifact startup setup complete"
```

2. Navigate to the folder where you saved the script. Use cp in a new prompt window to upload the script to your bucket. Replace *amzn-s3-demo-bucket* with your information.

\$ aws s3 cp code_artifact_startup_script.sh s3://amzn-s3-demo-bucket/ code_artifact_startup_script.sh

If successful, Amazon S3 outputs the URL path to the object:

```
upload: ./code_artifact_startup_script.sh to s3://amzn-s3-demo-bucket/
code_artifact_startup_script.sh
```

After you upload the script, your environment updates and runs the script at startup.

What's next?

- Learn how to use startup scripts to customize your environment in <u>the section called "Using a</u> startup script".
- Learn how to upload the DAG code in this example to the dags folder in your Amazon S3 bucket in <u>Adding or updating DAGs</u>.
- Learn more about how to upload the plugins.zip file in this example to your Amazon S3 bucket in <u>Installing custom plugins</u>.

Creating a custom plugin with Apache Hive and Hadoop

Amazon MWAA extracts the contents of a plugins.zip to /usr/local/airflow/plugins. This can be used to add binaries to your containers. In addition, Apache Airflow executes the contents of Python files in the plugins folder at *startup*—enabling you to set and modify environment variables. The following sample walks you through the steps to create a custom plugin using Apache Hive and Hadoop on an Amazon Managed Workflows for Apache Airflow environment and can be combined with other custom plugins and binaries.

Topics

- Version
- Prerequisites
- Permissions
- Requirements
- Download dependencies

- Custom plugin
- Plugins.zip
- Code sample
- <u>Airflow configuration options</u>
- What's next?

Version

- The sample code on this page can be used with Apache Airflow v1 in Python 3.7.
- You can use the code example on this page with **Apache Airflow v2** in Python 3.10.

Prerequisites

To use the sample code on this page, you'll need the following:

• An Amazon MWAA environment.

Permissions

• No additional permissions are required to use the code example on this page.

Requirements

To use the sample code on this page, add the following dependencies to your requirements.txt. To learn more, refer to Installing Python dependencies.

Apache Airflow v2

```
-c https://raw.githubusercontent.com/apache/airflow/constraints-2.0.2/
constraints-3.7.txt
apache-airflow-providers-amazon[apache.hive]
```

Apache Airflow v1

apache-airflow[hive]==1.10.12

Download dependencies

Amazon MWAA will extract the contents of plugins.zip into /usr/local/airflow/plugins on each Amazon MWAA scheduler and worker container. This is used to add binaries to your environment. The following steps describe how to assemble the files needed for the custom plugin.

1. In your command prompt, navigate to the directory where you would like to create your plugin. For example:

cd plugins

2. Download <u>Hadoop</u> from a <u>mirror</u>, for example:

wget https://downloads.apache.org/hadoop/common/hadoop-3.3.0/hadoop-3.3.0.tar.gz

3. Download Hive from a mirror, for example:

wget https://downloads.apache.org/hive/hive-3.1.2/apache-hive-3.1.2-bin.tar.gz

4. Create a directory. For example:

mkdir hive_plugin

5. Extract Hadoop.

tar -xvzf hadoop-3.3.0.tar.gz -C hive_plugin

6. Extract Hive.

tar -xvzf apache-hive-3.1.2-bin.tar.gz -C hive_plugin

Custom plugin

Apache Airflow will execute the contents of Python files in the plugins folder at startup. This is used to set and modify environment variables. The following steps describe the sample code for the custom plugin.

1. In your command prompt, navigate to the hive_plugin directory. For example:

```
cd hive_plugin
```

2. Copy the contents of the following code sample and save locally as hive_plugin.py in the hive_plugin directory.

```
from airflow.plugins_manager import AirflowPlugin
import os
os.environ["JAVA_HOME"]="/usr/lib/jvm/jre"
os.environ["HADOOP_HOME"]='/usr/local/airflow/plugins/hadoop-3.3.0/etc/hadoop'
os.environ["HADOOP_CONF_DIR"]='/usr/local/airflow/plugins/hadoop-3.3.0/etc/hadoop'
os.environ["HIVE_HOME"]='/usr/local/airflow/plugins/apache-hive-3.1.2-bin'
os.environ["PATH"] = os.getenv("PATH") + ":/usr/local/airflow/plugins/
hadoop-3.3.0:/usr/local/airflow/plugins/apache-hive-3.1.2-bin/bin:/usr/local/
airflow/plugins/apache-hive-3.1.2-bin/lib"
os.environ["CLASSPATH"] = os.getenv("CLASSPATH") + ":/usr/local/airflow/plugins/
apache-hive-3.1.2-bin/lib"
class EnvVarPlugin(AirflowPlugin):
    name = 'hive_plugin'
```

3. Cope the content of the following text and save locally as .airflowignore in the hive_plugin directory.

```
hadoop-3.3.0
apache-hive-3.1.2-bin
```

Plugins.zip

The following steps show how to create plugins.zip. The contents of this example can be combined with other plugins and binaries into a single plugins.zip file.

1. In your command prompt, navigate to the hive_plugin directory from the previous step. For example:

cd hive_plugin

2. Zip the contents within your plugins folder.

```
zip -r ../hive_plugin.zip ./
```

Code sample

The following steps describe how to create the DAG code that will test the custom plugin.

1. In your command prompt, navigate to the directory where your DAG code is stored. For example:

cd dags

2. Copy the contents of the following code sample and save locally as hive.py.

```
from airflow import DAG
from airflow.operators.bash_operator import BashOperator
from airflow.utils.dates import days_ago
with DAG(dag_id="hive_test_dag", schedule_interval=None, catchup=False,
    start_date=days_ago(1)) as dag:
    hive_test = BashOperator(
        task_id="hive_test",
        bash_command='hive --help'
    )
```

Airflow configuration options

If you're using Apache Airflow v2, add core.lazy_load_plugins : False as an Apache Airflow configuration option. To learn more, refer to <u>Using configuration options to load plugins in</u> <u>2</u>.

What's next?

• Learn how to upload the requirements.txt file in this example to your Amazon S3 bucket in Installing Python dependencies.

- Learn how to upload the DAG code in this example to the dags folder in your Amazon S3 bucket in Adding or updating DAGs.
- Learn more about how to upload the plugins.zip file in this example to your Amazon S3 bucket in Installing custom plugins.

Creating a custom plugin for Apache Airflow PythonVirtualenvOperator

The following sample shows how to patch the Apache Airflow PythonVirtualenvOperator with a custom plugin on Amazon Managed Workflows for Apache Airflow.

Topics

- Version
- Prerequisites
- Permissions
- Requirements
- Custom plugin sample code
- Plugins.zip
- Code sample
- <u>Airflow configuration options</u>
- What's next?

Version

- The sample code on this page can be used with **Apache Airflow v1** in <u>Python 3.7</u>.
- You can use the code example on this page with **Apache Airflow v2** in <u>Python 3.10</u>.

Prerequisites

To use the sample code on this page, you'll need the following:

• An Amazon MWAA environment.

Permissions

• No additional permissions are required to use the code example on this page.

Requirements

To use the sample code on this page, add the following dependencies to your requirements.txt. To learn more, refer to Installing Python dependencies.

virtualenv

Custom plugin sample code

Apache Airflow will execute the contents of Python files in the plugins folder at startup. This plugin will patch the built-in PythonVirtualenvOperator during that startup process to make it compatible with Amazon MWAA. The following steps show the sample code for the custom plugin.

Apache Airflow v2

.....

1. In your command prompt, navigate to the plugins directory above. For example:

cd plugins

 Copy the contents of the following code sample and save locally as virtual_python_plugin.py.

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```
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.....
from airflow.plugins_manager import AirflowPlugin
import airflow.utils.python_virtualenv
from typing import List
def _generate_virtualenv_cmd(tmp_dir: str, python_bin: str,
 system_site_packages: bool) -> List[str]:
    cmd = ['python3','/usr/local/airflow/.local/lib/python3.7/site-packages/
virtualenv', tmp_dir]
    if system_site_packages:
        cmd.append('--system-site-packages')
    if python_bin is not None:
        cmd.append(f'--python={python_bin}')
    return cmd
airflow.utils.python_virtualenv._generate_virtualenv_cmd=_generate_virtualenv_cmd
class VirtualPythonPlugin(AirflowPlugin):
    name = 'virtual_python_plugin'
```

Apache Airflow v1

1. In your command prompt, navigate to the plugins directory above. For example:

cd plugins

 Copy the contents of the following code sample and save locally as virtual_python_plugin.py.

```
from airflow.plugins_manager import AirflowPlugin
from airflow.operators.python_operator import PythonVirtualenvOperator

def _generate_virtualenv_cmd(self, tmp_dir):
    cmd = ['python3','/usr/local/airflow/.local/lib/python3.7/site-packages/
virtualenv', tmp_dir]
    if self.system_site_packages:
        cmd.append('--system-site-packages')
    if self.python_version is not None:
        cmd.append('--python=python{}'.format(self.python_version))
    return cmd
PythonVirtualenvOperator._generate_virtualenv_cmd=_generate_virtualenv_cmd
```

```
class EnvVarPlugin(AirflowPlugin):
    name = 'virtual_python_plugin'
```

Plugins.zip

The following steps show how to create the plugins.zip.

 In your command prompt, navigate to the directory containing virtual_python_plugin.py above. For example:

cd plugins

2. Zip the contents within your plugins folder.

zip plugins.zip virtual_python_plugin.py

Code sample

The following steps describe how to create the DAG code for the custom plugin.

Apache Airflow v2

1. In your command prompt, navigate to the directory where your DAG code is stored. For example:

```
cd dags
```

 Copy the contents of the following code sample and save locally as virtualenv_test.py.

```
"""
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```

```
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COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER
IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
.....
from airflow import DAG
from airflow.operators.python import PythonVirtualenvOperator
from airflow.utils.dates import days_ago
import os
os.environ["PATH"] = os.getenv("PATH") + ":/usr/local/airflow/.local/bin"
def virtualenv_fn():
    import boto3
    print("boto3 version ",boto3.__version__)
with DAG(dag_id="virtualenv_test", schedule_interval=None, catchup=False,
 start_date=days_ago(1)) as dag:
    virtualenv_task = PythonVirtualenvOperator(
        task_id="virtualenv_task",
        python_callable=virtualenv_fn,
        requirements=["boto3>=1.17.43"],
        system_site_packages=False,
        dag=dag,
    )
```

Apache Airflow v1

1. In your command prompt, navigate to the directory where your DAG code is stored. For example:

cd dags

 Copy the contents of the following code sample and save locally as virtualenv_test.py.

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```
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.....
from airflow import DAG
from airflow.operators.python_operator import PythonVirtualenvOperator
from airflow.utils.dates import days_ago
import os
os.environ["PATH"] = os.getenv("PATH") + ":/usr/local/airflow/.local/bin"
def virtualenv_fn():
    import boto3
    print("boto3 version ",boto3.__version__)
with DAG(dag_id="virtualenv_test", schedule_interval=None, catchup=False,
 start_date=days_ago(1)) as dag:
    virtualenv_task = PythonVirtualenvOperator(
        task_id="virtualenv_task",
        python_callable=virtualenv_fn,
        requirements=["boto3>=1.17.43"],
        system_site_packages=False,
        dag=dag,
    )
```

Airflow configuration options

If you're using Apache Airflow v2, add core.lazy_load_plugins : False as an Apache Airflow configuration option. To learn more, refer to <u>Using configuration options to load plugins in</u> 2.

What's next?

- Learn how to upload the requirements.txt file in this example to your Amazon S3 bucket in Installing Python dependencies.
- Learn how to upload the DAG code in this example to the dags folder in your Amazon S3 bucket in Adding or updating DAGs.
- Learn more about how to upload the plugins.zip file in this example to your Amazon S3 bucket in Installing custom plugins.

Invoking DAGs with a Lambda function

The following code example uses an <u>AWS Lambda</u> function to get an Apache Airflow CLI token and invoke a directed acyclic graph (DAG) in an Amazon MWAA environment.

Topics

- Version
- Prerequisites
- Permissions
- Dependencies
- <u>Code example</u>

Version

• You can use the code example on this page with **Apache Airflow v2** in <u>Python 3.10</u>.

Prerequisites

To use this code example, you must:

- Use the public network access mode for your Amazon MWAA environment.
- Have a Lambda function using the latest Python runtime.

(i) Note

If the Lambda function and your Amazon MWAA environment are in the same VPC, you can use this code on a private network. For this configuration, the Lambda function's execution role needs permission to call the Amazon Elastic Compute Cloud (Amazon EC2) **CreateNetworkInterface** API operation. You can provide this permission using the <u>AWSLambdaVPCAccessExecutionRole</u> AWS managed policy.

Permissions

To use the code example on this page, your Amazon MWAA environment's execution role needs access to perform the airflow:CreateCliToken action. You can provide this permission using the AmazonMWAAAirflowCliAccess AWS managed policy:

JSON

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
               "airflow:CreateCliToken"
        ],
            "Resource": "*"
        }
    ]
}
```

For more information, refer to Apache Airflow CLI policy: AmazonMWAAAirflowCliAccess.

Dependencies

 To use this code example with Apache Airflow v2, no additional dependencies are required. The code uses the <u>Apache Airflow v2 base install</u> on your environment.

Code example

- 1. Open the AWS Lambda console at https://console.aws.amazon.com/lambda/.
- 2. Choose your Lambda function from the Functions list.
- 3. On the function page, copy the following code and replace the following with the names of your resources:
 - YOUR_ENVIRONMENT_NAME The name of your Amazon MWAA environment.
 - YOUR_DAG_NAME The name of the DAG that you want to invoke.

```
import boto3
import http.client
import base64
import ast
mwaa_env_name = 'YOUR_ENVIRONMENT_NAME'
dag_name = 'YOUR_DAG_NAME'
mwaa_cli_command = 'dags trigger'
client = boto3.client('mwaa')
def lambda_handler(event, context):
    # get web token
   mwaa_cli_token = client.create_cli_token(
        Name=mwaa_env_name
    )
    conn = http.client.HTTPSConnection(mwaa_cli_token['WebServerHostname'])
    payload = mwaa_cli_command + " " + dag_name
    headers = {
      'Authorization': 'Bearer ' + mwaa_cli_token['CliToken'],
      'Content-Type': 'text/plain'
    }
    conn.request("POST", "/aws_mwaa/cli", payload, headers)
    res = conn.getresponse()
    data = res.read()
    dict_str = data.decode("UTF-8")
   mydata = ast.literal_eval(dict_str)
    return base64.b64decode(mydata['stdout'])
```

4. Choose Deploy.

- 5. Choose **Test** to invoke your function using the Lambda console.
- 6. To verify that your Lambda successfully invoked your DAG, use the Amazon MWAA console to navigate to your environment's Apache Airflow UI, then do the following:
 - a. On the **DAGs** page, locate your new target DAG in the list of DAGs.
 - b. Under **Last Run**, check the timestamp for the latest DAG run. This timestamp should closely match the latest timestamp for invoke_dag in your other environment.
 - c. Under **Recent Tasks**, check that the last run was successful.

Invoking DAGs in different Amazon MWAA environments

The following code example creates an Apache Airflow CLI token. The code then uses a directed acyclic graph (DAG) in one Amazon MWAA environment to invoke a DAG in a different Amazon MWAA environment.

Topics

- Version
- Prerequisites
- Permissions
- Dependencies
- Code example

Version

• You can use the code example on this page with **Apache Airflow v2** in Python 3.10.

Prerequisites

To use the code example on this page, you need the following:

- Two <u>Amazon MWAA environments</u> with **public network** web server access, including your current environment.
- A sample DAG uploaded to your target environment's Amazon Simple Storage Service (Amazon S3) bucket.

Permissions

To use the code example on this page, your environment's execution role must have permission to create an Apache Airflow CLI token. You can attach the AWS managed policy AmazonMWAAAirflowCliAccess to grant this permission.

JSON

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
               "airflow:CreateCliToken"
        ],
        "Resource": "*"
        }
    ]
}
```

For more information, refer to Apache Airflow CLI policy: AmazonMWAAAirflowCliAccess.

Dependencies

• To use this code example with Apache Airflow v2, no additional dependencies are required. The code uses the Apache Airflow v2 base install on your environment.

Code example

The following code example assumes that you're using a DAG in your current environment to invoke a DAG in another environment.

1. In your terminal, navigate to the directory where your DAG code is stored. For example:

cd dags

 Copy the content of the following code example and save it locally as invoke_dag.py. Replace the following values with your information.

- your-new-environment-name The name of the other environment where you want to invoke the DAG.
- your-target-dag-id The ID of the DAG in the other environment that you want to invoke.

```
from airflow.decorators import dag, task
import boto3
from datetime import datetime, timedelta
import os, requests
DAG_ID = os.path.basename(__file__).replace(".py", "")
@task()
def invoke_dag_task(**kwargs):
    client = boto3.client('mwaa')
    token = client.create_cli_token(Name='your-new-environment-name')
    url = f"https://{token['WebServerHostname']}/aws_mwaa/cli"
    body = 'dags trigger your-target-dag-id'
    headers = {
        'Authorization' : 'Bearer ' + token['CliToken'],
        'Content-Type': 'text/plain'
        }
    requests.post(url, data=body, headers=headers)
@dag(
    dag_id=DAG_ID,
    schedule_interval=None,
    start_date=datetime(2022, 1, 1),
    dagrun_timeout=timedelta(minutes=60),
    catchup=False
    )
def invoke_dag():
    t = invoke_dag_task()
invoke_dag_test = invoke_dag()
```

3. Run the following AWS CLI command to copy the DAG to your environment's bucket, then trigger the DAG using the Apache Airflow UI.

\$ aws s3 cp your-dag.py s3://your-environment-bucket/dags/

4. If the DAG runs successfully, you'll see output similar to the following in the task logs for invoke_dag_task.

```
[2022-01-01, 12:00:00 PDT] {{python.py:152}} INF0 - Done. Returned value was: None
[2022-01-01, 12:00:00 PDT] {{taskinstance.py:1280}} INF0 - Marking task as SUCCESS.
dag_id=invoke_dag, task_id=invoke_dag_task, execution_date=20220101T120000,
start_date=20220101T120000, end_date=20220101T120000
[2022-01-01, 12:00:00 PDT] {{local_task_job.py:154}} INF0 - Task exited with return
code 0
[2022-01-01, 12:00:00 PDT] {{local_task_job.py:264}} INF0 - 0 downstream tasks
scheduled from follow-on schedule check
```

To verify that your DAG was successfully invoked, navigate to the Apache Airflow UI for your new environment, then do the following:

- a. On the **DAGs** page, locate your new target DAG in the list of DAGs.
- b. Under **Last Run**, check the timestamp for the latest DAG run. This timestamp should closely match the latest timestamp for invoke_dag in your other environment.
- c. Under Recent Tasks, check that the last run was successful.

Using Amazon MWAA with Amazon RDS for Microsoft SQL Server

You can use Amazon Managed Workflows for Apache Airflow to connect to an <u>RDS for SQL Server</u>. The following sample code uses DAGs on an Amazon Managed Workflows for Apache Airflow environment to connect to and execute queries on an Amazon RDS for Microsoft SQL Server.

Topics

- Version
- Prerequisites
- Dependencies
- Apache Airflow v2 connection
- Code sample
- What's next?

Version

- The sample code on this page can be used with **Apache Airflow v1** in Python 3.7.
- You can use the code example on this page with **Apache Airflow v2** in Python 3.10.

Prerequisites

To use the sample code on this page, you'll need the following:

- An Amazon MWAA environment.
- Amazon MWAA and the RDS for SQL Server are running in the same Amazon VPC/
- VPC security groups of Amazon MWAA and the server are configured with the following connections:
 - An inbound rule for the port 1433 open for Amazon RDS in Amazon MWAA's security group
 - Or an outbound rule for the port of 1433 open from Amazon MWAA to RDS
- Apache Airflow Connection for RDS for SQL Server reflects the hostname, port, username and password from the Amazon RDS SQL server database created in previous process.

Dependencies

To use the sample code in this section, add the following dependency to your requirements.txt. To learn more, refer to Installing Python dependencies

Apache Airflow v2

```
apache-airflow-providers-microsoft-mssql==1.0.1
apache-airflow-providers-odbc==1.0.1
pymssql==2.2.1
```

Apache Airflow v1

```
apache-airflow[mssql]==1.10.12
```

Apache Airflow v2 connection

If you're using a connection in Apache Airflow v2, ensure the Airflow connection object includes the following key-value pairs:

- 1. Conn Id: mssql_default
- 2. Conn Type: Amazon Web Services
- 3. Host: YOUR_DB_HOST
- 4. Schema:
- 5. Login: admin
- 6. Password:
- 7. **Port:** 1433
- 8. Extra:

Code sample

1. In your command prompt, navigate to the directory where your DAG code is stored. For example:

cd dags

2. Copy the contents of the following code sample and save locally as sql-server.py.

....

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import pymssql

```
import logging
import sys
from airflow import DAG
from datetime import datetime
from airflow.operators.mssql_operator import MsSqlOperator
from airflow.operators.python_operator import PythonOperator
default_args = {
    'owner': 'aws',
    'depends_on_past': False,
    'start_date': datetime(2019, 2, 20),
    'provide_context': True
}
dag = DAG(
    'mssql_conn_example', default_args=default_args, schedule_interval=None)
drop_db = MsSql0perator(
  task_id="drop_db",
   sql="DROP DATABASE IF EXISTS testdb;",
  mssql_conn_id="mssql_default",
   autocommit=True,
   dag=dag
)
create_db = MsSql0perator(
  task_id="create_db",
   sql="create database testdb;",
  mssgl_conn_id="mssgl_default",
   autocommit=True,
   dag=dag
)
create_table = MsSql0perator(
   task_id="create_table",
   sql="CREATE TABLE testdb.dbo.pet (name VARCHAR(20), owner VARCHAR(20));",
  mssql_conn_id="mssql_default",
   autocommit=True,
   dag=dag
)
insert_into_table = MsSql0perator(
  task_id="insert_into_table",
   sql="INSERT INTO testdb.dbo.pet VALUES ('Olaf', 'Disney');",
```

```
mssql_conn_id="mssql_default",
  autocommit=True,
  dag=dag
)
def select_pet(**kwargs):
  try:
        conn = pymssql.connect(
            server='sampledb.<xxxxx>.<region>.rds.amazonaws.com',
            user='admin',
            password='<yoursupersecretpassword>',
            database='testdb'
        )
        # Create a cursor from the connection
        cursor = conn.cursor()
        cursor.execute("SELECT * from testdb.dbo.pet")
        row = cursor.fetchone()
        if row:
            print(row)
  except:
      logging.error("Error when creating pymssql database connection: %s",
sys.exc_info()[0])
select_query = PythonOperator(
    task_id='select_query',
    python_callable=select_pet,
    dag=dag,
)
drop_db >> create_db >> create_table >> insert_into_table >> select_query
```

What's next?

- Learn how to upload the requirements.txt file in this example to your Amazon S3 bucket in Installing Python dependencies.
- Learn how to upload the DAG code in this example to the dags folder in your Amazon S3 bucket in Adding or updating DAGs.
- Explore example scripts and other pymssql module examples.

• Learn more about executing SQL code in a specific Microsoft SQL database using the mssql_operator in the *Apache Airflow reference guide*.

Using Amazon MWAA with Amazon EMR

The following code sample demonstrates how to enable an integration using Amazon EMR and Amazon Managed Workflows for Apache Airflow.

Topics

- Version
- Code sample

Version

• The sample code on this page can be used with Apache Airflow v1 in Python 3.7.

Code sample

.....

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from airflow import DAG

from airflow.providers.amazon.aws.operators.emr import EmrAddStepsOperator
from airflow.providers.amazon.aws.sensors.emr import EmrStepSensor
from airflow.providers.amazon.aws.operators.emr import EmrCreateJobFlowOperator

```
User Guide
```

```
from airflow.utils.dates import days_ago
from datetime import timedelta
import os
DAG_ID = os.path.basename(__file__).replace(".py", "")
DEFAULT_ARGS = {
    'owner': 'airflow',
    'depends_on_past': False,
    'email': ['airflow@example.com'],
    'email_on_failure': False,
    'email_on_retry': False,
}
SPARK_STEPS = [
    {
        'Name': 'calculate_pi',
        'ActionOnFailure': 'CONTINUE',
        'HadoopJarStep': {
            'Jar': 'command-runner.jar',
            'Args': ['/usr/lib/spark/bin/run-example', 'SparkPi', '10'],
        },
    }
]
JOB_FLOW_OVERRIDES = {
    'Name': 'my-demo-cluster',
    'ReleaseLabel': 'emr-5.30.1',
    'Applications': [
        {
            'Name': 'Spark'
        },
    ],
    'Instances': {
        'InstanceGroups': [
            {
                'Name': "Master nodes",
                'Market': 'ON_DEMAND',
                'InstanceRole': 'MASTER',
                'InstanceType': 'm5.xlarge',
                'InstanceCount': 1,
            },
            {
```

```
'Name': "Slave nodes",
                   'Market': 'ON_DEMAND',
                   'InstanceRole': 'CORE',
                   'InstanceType': 'm5.xlarge',
                   'InstanceCount': 2,
               }
           ],
           'KeepJobFlowAliveWhenNoSteps': False,
           'TerminationProtected': False,
           'Ec2KeyName': 'mykeypair',
       },
       'VisibleToAllUsers': True,
       'JobFlowRole': 'EMR_EC2_DefaultRole',
       'ServiceRole': 'EMR_DefaultRole'
   }
  with DAG(
       dag_id=DAG_ID,
       default_args=DEFAULT_ARGS,
       dagrun_timeout=timedelta(hours=2),
       start_date=days_ago(1),
       schedule_interval='@once',
       tags=['emr'],
   ) as dag:
       cluster_creator = EmrCreateJobFlowOperator(
           task_id='create_job_flow',
           job_flow_overrides=JOB_FLOW_OVERRIDES
       )
       step_adder = EmrAddStepsOperator(
           task_id='add_steps',
           job_flow_id="{{ task_instance.xcom_pull(task_ids='create_job_flow',
key='return_value') }}",
           aws_conn_id='aws_default',
           steps=SPARK_STEPS,
       )
       step_checker = EmrStepSensor(
           task_id='watch_step',
           job_flow_id="{{ task_instance.xcom_pull('create_job_flow',
key='return_value') }}",
           step_id="{{ task_instance.xcom_pull(task_ids='add_steps',
key='return_value')[0] }}",
```

)

```
aws_conn_id='aws_default',
```

cluster_creator >> step_adder >> step_checker

Using Amazon MWAA with Amazon EKS

The following sample demonstrates how to use Amazon Managed Workflows for Apache Airflow with Amazon EKS.

Topics

- Version
- Prerequisites
- Create a public key for Amazon EC2
- Create the cluster
- <u>Create a mwaa namespace</u>
- <u>Create a role for the mwaa namespace</u>
- Create and attach an IAM role for the Amazon EKS cluster
- <u>Create the requirements.txt file</u>
- Create an identity mapping for Amazon EKS
- Create the kubeconfig
- <u>Create a DAG</u>
- Add the DAG and kube_config.yaml to the Amazon S3 bucket
- Enable and trigger the example

Version

- The sample code on this page can be used with **Apache Airflow v1** in Python 3.7.
- You can use the code example on this page with Apache Airflow v2 in Python 3.10.

Prerequisites

To use the example in this topic, you'll need the following:

- An Amazon MWAA environment.
- eksctl. To learn more, refer to Install eksctl.
- kubectl. To learn more, refer to <u>Install and Set Up kubectl</u>. In some case this is installed with eksctl.
- An EC2 key pair in the Region where you create your Amazon MWAA environment. To learn more, refer to Creating or importing a key pair.

🚺 Note

When you use an eksctl command, you can include a --profile to specify a profile other than the default.

Create a public key for Amazon EC2

Use the following command to create a public key from your private key pair.

ssh-keygen -y -f myprivatekey.pem > mypublickey.pub

To learn more, refer to Retrieving the public key for your key pair.

Create the cluster

Use the following command to create the cluster. If you want a custom name for the cluster or to create it in a different Region, replace the name and Region values. You must create the cluster in the same Region where you create the Amazon MWAA environment. Replace the values for the subnets to match the subnets in your Amazon VPC network that you use for Amazon MWAA. Replace the value for the ssh-public-key to match the key you use. You can use an existing key from Amazon EC2 that is in the same Region, or create a new key in the same Region where you create your Amazon MWAA environment.

```
eksctl create cluster \
--name mwaa-eks \
--region us-west-2 \
--version 1.18 \
--nodegroup-name linux-nodes \
```

It takes some time to complete creating the cluster. Once complete, you can verify that the cluster was created successfully and has the IAM OIDC Provider configured by using the following command:

```
eksctl utils associate-iam-oidc-provider \
--region us-west-2 \
--cluster mwaa-eks \
--approve
```

Create a mwaa namespace

After confirming that the cluster was successfully created, use the following command to create a namespace for the pods.

```
kubectl create namespace mwaa
```

Create a role for the mwaa namespace

After you create the namespace, create a role and role-binding for an Amazon MWAA user on EKS that can run pods in a the MWAA namespace. If you used a different name for the namespace, replace mwaa in -n *mwaa* with the name that you used.

```
cat << EOF | kubectl apply -f - -n mwaa
kind: Role
apiVersion: rbac.authorization.k8s.io/v1
metadata:
    name: mwaa-role
rules:
    _ apiGroups:
    _ ""</pre>
```

- "apps"
- "batch"
- "extensions"
- resources:
 - "jobs"
 - "pods"
 - "pods/attach"
 - "pods/exec"
 - "pods/log"
 - "pods/portforward"
 - "secrets"
 - "services"

verbs:

- "create"
- "delete"
- "describe"
- "get"
- "list"
- "patch"
- "update"

```
---
```

```
kind: RoleBinding
apiVersion: rbac.authorization.k8s.io/v1
metadata:
    name: mwaa-role-binding
subjects:
- kind: User
    name: mwaa-service
roleRef:
    kind: Role
    name: mwaa-role
    apiGroup: rbac.authorization.k8s.io
EOF
```

Confirm that the new role can access the Amazon EKS cluster by running the following command. Be sure to use the correct name if you did not use *mwaa*:

kubectl get pods -n mwaa --as mwaa-service

You should see a message returned that says:

No resources found in mwaa namespace.

Create and attach an IAM role for the Amazon EKS cluster

You must create an IAM role and then bind it to the Amazon EKS (k8s) cluster so that it can be used for authentication through IAM. The role is used only to log in to the cluster, and does not have any permissions for the console or API calls.

Create a new role for the Amazon MWAA environment using the steps in <u>Amazon MWAA execution</u> <u>role</u>. However, instead of creating and attaching the policies described in that topic, attach the following policy:

JSON

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "airflow:PublishMetrics",
            "Resource": "arn:aws:airflow:us-east-1:111122223333:environment/
${MWAA_ENV_NAME}"
        },
        {
            "Effect": "Deny",
            "Action": "s3:ListAllMyBuckets",
            "Resource": [
                "arn:aws:s3:::{MWAA_S3_BUCKET}",
                "arn:aws:s3:::{MWAA_S3_BUCKET}/*"
            ]
        },
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetObject*",
                "s3:GetBucket*",
                "s3:List*"
            ],
            "Resource": [
                "arn:aws:s3:::{MWAA_S3_BUCKET}",
                "arn:aws:s3:::{MWAA_S3_BUCKET}/*"
            1
        },
        ſ
```

```
"Effect": "Allow",
            "Action": [
                "logs:CreateLogStream",
                "logs:CreateLogGroup",
                "logs:PutLogEvents",
                "logs:GetLogEvents",
                "logs:GetLogRecord",
                "logs:GetLogGroupFields",
                "logs:GetQueryResults",
                "logs:DescribeLogGroups"
            ],
            "Resource": [
            "arn:aws:logs:us-east-1:111122223333:log-group:airflow-
${MWAA_ENV_NAME}-*"
            1
        },
        {
            "Effect": "Allow",
            "Action": "cloudwatch:PutMetricData",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "sqs:ChangeMessageVisibility",
                "sqs:DeleteMessage",
                "sqs:GetQueueAttributes",
                "sqs:GetQueueUrl",
                "sqs:ReceiveMessage",
                "sqs:SendMessage"
            ],
            "Resource": "arn:aws:sqs:us-east-1:*:airflow-celery-*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "kms:Decrypt",
                "kms:DescribeKey",
                "kms:GenerateDataKey*",
                "kms:Encrypt"
            ],
            "NotResource": "arn:aws:kms:*:111122223333:key/*",
            "Condition": {
                "StringLike": {
```

```
"kms:ViaService": [
                     "sqs.us-east-1.amazonaws.com"
                     1
                }
            }
        },
        {
            "Effect": "Allow",
            "Action": [
                 "eks:DescribeCluster"
            ],
            "Resource": "arn:aws:eks:us-east-1:111122223333:cluster/
${EKS_CLUSTER_NAME}"
        }
    ]
}
```

After you create role, edit your Amazon MWAA environment to use the role you created as the execution role for the environment. To change the role, edit the environment to use. You select the execution role under **Permissions**.

Known issues:

- There is a known issue with role ARNs with subpaths not being able to authenticate with Amazon EKS. The workaround for this is to create the service role manually rather than using the one created by Amazon MWAA itself. To learn more, refer to Roles with paths do not work when the path is included in their ARN in the aws-auth configmap
- If Amazon MWAA service listing is not available in IAM you need to choose an alternate service policy, such as Amazon EC2, and then update the role's trust policy to match the following:

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": [
          "airflow-env.amazonaws.com",
          "airflow.amazonaws.com"
```

```
User Guide
```

```
]
},
"Action": "sts:AssumeRole"
}
]
}
```

To learn more, refer to How to use trust policies with IAM roles.

Create the requirements.txt file

To use the sample code in this section, ensure you've added one of the following database options to your requirements.txt. To learn more, refer to Installing Python dependencies.

Apache Airflow v2

```
kubernetes
apache-airflow[cncf.kubernetes]==3.0.0
```

Apache Airflow v1

```
awscli
kubernetes==12.0.1
```

Create an identity mapping for Amazon EKS

Use the ARN for the role you created in the following command to create an identity mapping for Amazon EKS. Change the Region *us-east-1* to the Region where you created the environment. Replace the ARN for the role, and finally, replace *mwaa-execution-role* with your environment's execution role.

```
eksctl create iamidentitymapping \
--region us-east-1 \
--cluster mwaa-eks \
--arn arn:aws:iam::123456789012:role/mwaa-execution-role \
--username mwaa-service
```

Create the kubeconfig

Use the following command to create the kubeconfig:

```
aws eks update-kubeconfig \
--region us-west-2 \
--kubeconfig ./kube_config.yaml \
--name mwaa-eks \
--alias aws
```

If you used a specific profile when you ran update-kubeconfig you need to remove the env: section added to the kube_config.yaml file so that it works correctly with Amazon MWAA. To do so, delete the following from the file and then save it:

```
env:
- name: AWS_PROFILE
value: profile_name
```

Create a DAG

Use the following code example to create a Python file, such as mwaa_pod_example.py for the DAG.

Apache Airflow v2

```
.....
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COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER
IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
.....
from airflow import DAG
from datetime import datetime
```

```
from airflow.providers.cncf.kubernetes.operators.kubernetes_pod import
 KubernetesPodOperator
default_args = {
   'owner': 'aws',
   'depends_on_past': False,
   'start_date': datetime(2019, 2, 20),
   'provide_context': True
}
dag = DAG(
   'kubernetes_pod_example', default_args=default_args, schedule_interval=None)
#use a kube_config stored in s3 dags folder for now
kube_config_path = '/usr/local/airflow/dags/kube_config.yaml'
podRun = KubernetesPodOperator(
                       namespace="mwaa",
                       image="ubuntu:18.04",
                       cmds=["bash"],
                       arguments=["-c", "ls"],
                       labels={"foo": "bar"},
                       name="mwaa-pod-test",
                       task_id="pod-task",
                       get_logs=True,
                       dag=dag,
                       is_delete_operator_pod=False,
                       config_file=kube_config_path,
                       in_cluster=False,
                       cluster_context='aws'
                       )
```

Apache Airflow v1

.....

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```
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IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN
CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
.....
from airflow import DAG
from datetime import datetime
from airflow.contrib.operators.kubernetes_pod_operator import KubernetesPodOperator
default_args = {
   'owner': 'aws',
   'depends_on_past': False,
   'start_date': datetime(2019, 2, 20),
   'provide_context': True
}
dag = DAG(
   'kubernetes_pod_example', default_args=default_args, schedule_interval=None)
#use a kube_config stored in s3 dags folder for now
kube_config_path = '/usr/local/airflow/dags/kube_config.yaml'
podRun = KubernetesPodOperator(
                       namespace="mwaa",
                       image="ubuntu:18.04",
                       cmds=["bash"],
                       arguments=["-c", "ls"],
                       labels={"foo": "bar"},
                       name="mwaa-pod-test",
                       task_id="pod-task",
                       get_logs=True,
                       dag=dag,
                       is_delete_operator_pod=False,
                       config_file=kube_config_path,
                       in_cluster=False,
                       cluster_context='aws'
                       )
```

Add the DAG and kube_config.yaml to the Amazon S3 bucket

Put the DAG you created and the kube_config.yaml file into the Amazon S3 bucket for the Amazon MWAA environment. You can put files into your bucket using either the Amazon S3 console or the AWS Command Line Interface.

Enable and trigger the example

In Apache Airflow, enable the example and then trigger it.

After it runs and completes successfully, use the following command to verify the pod:

kubectl get pods -n mwaa

You should see output similar to the following:

```
NAME READY STATUS RESTARTS AGE
mwaa-pod-test-aa11bb22cc33444455556666677778888 0/1 Completed 0 2m23s
```

You can then verify the output of the pod with the following command. Replace the name value with the value returned from the previous command:

kubectl logs -n mwaa mwaa-pod-test-aa11bb22cc334444555566666777788888

Connecting to Amazon ECS using the ECSOperator

The topic describes how you can use the ECSOperator to connect to an Amazon Elastic Container Service (Amazon ECS) container from Amazon MWAA. In the following steps, you'll add the required permissions to your environment's execution role, use a AWS CloudFormation template to create an Amazon ECS Fargate cluster, and finally create and upload a DAG that connects to your new cluster.

Topics

- Version
- Prerequisites
- Permissions
- Create an Amazon ECS cluster
- Code sample

Version

• You can use the code example on this page with **Apache Airflow v2** in <u>Python 3.10</u>.

Prerequisites

To use the sample code on this page, you'll need the following:

• An Amazon MWAA environment.

Permissions

The execution role for your environment needs permission to run tasks in Amazon ECS. You can
either attach the <u>AmazonECS_FullAccess</u> AWS-managed policy to your execution role, or create
and attach the following policy to your execution role.

JSON

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "VisualEditor0",
            "Effect": "Allow",
            "Action": [
                "ecs:RunTask",
                "ecs:DescribeTasks"
            ],
            "Resource": "*"
        },
        {
            "Action": "iam:PassRole",
            "Effect": "Allow",
            "Resource": [
                "*"
            ],
            "Condition": {
                "StringLike": {
                     "iam:PassedToService": "ecs-tasks.amazonaws.com"
                }
            }
```

}

]

 In addition to adding the required premissions to run tasks in Amazon ECS, you must also modify the CloudWatch Logs policy statement in your Amazon MWAA execution role to allow access to the Amazon ECS task log group as shown in the following. The Amazon ECS log group is created by the AWS CloudFormation template in the section called "Create an Amazon ECS cluster".

```
{
    "Effect": "Allow",
    "Action": [
        "logs:CreateLogStream",
        "logs:CreateLogGroup",
        "logs:PutLogEvents",
        "logs:GetLogEvents",
        "logs:GetLogRecord",
        "logs:GetLogGroupFields",
        "logs:GetQueryResults"
    ],
    "Resource": [
        "arn:aws:logs:us-east-1:123456789012:log-group:airflow-environment-name-*",
        "arn:aws:logs:*:*:log-group:ecs-mwaa-group:*"
    ]
}
```

For more information about the Amazon MWAA execution role, and how to attach a policy, refer to <u>Execution role</u>.

Create an Amazon ECS cluster

Using the following AWS CloudFormation template, you will build an Amazon ECS Fargate cluster to use with your Amazon MWAA workflow. For more information, refer to <u>Creating a task definition</u> in the *Amazon Elastic Container Service Developer Guide*.

1. Create a JSON file with the following code and save it as ecs-mwaa-cfn.json.

```
"AWSTemplateFormatVersion": "2010-09-09",
```

{

```
"Description": "This template deploys an ECS Fargate cluster with an Amazon
Linux image as a test for MWAA.",
   "Parameters": {
       "VpcId": {
           "Type": "AWS::EC2::VPC::Id",
           "Description": "Select a VPC that allows instances access to ECR, as
used with MWAA."
       },
       "SubnetIds": {
           "Type": "List<AWS::EC2::Subnet::Id>",
           "Description": "Select at two private subnets in your selected VPC, as
used with MWAA."
       },
       "SecurityGroups": {
           "Type": "List<AWS::EC2::SecurityGroup::Id>",
           "Description": "Select at least one security group in your selected
VPC, as used with MWAA."
       }
   },
   "Resources": {
       "Cluster": {
           "Type": "AWS::ECS::Cluster",
           "Properties": {
               "ClusterName": {
                   "Fn::Sub": "${AWS::StackName}-cluster"
               }
           }
       },
       "LogGroup": {
           "Type": "AWS::Logs::LogGroup",
           "Properties": {
               "LogGroupName": {
                   "Ref": "AWS::StackName"
               },
               "RetentionInDays": 30
           }
       },
       "ExecutionRole": {
           "Type": "AWS::IAM::Role",
           "Properties": {
               "AssumeRolePolicyDocument": {
                   "Statement": [
                       {
                           "Effect": "Allow",
```

```
"Principal": {
                                 "Service": "ecs-tasks.amazonaws.com"
                            },
                             "Action": "sts:AssumeRole"
                        }
                    ]
                },
                "ManagedPolicyArns": [
                    "arn:aws:iam::aws:policy/service-role/
AmazonECSTaskExecutionRolePolicy"
                ]
            }
        },
        "TaskDefinition": {
            "Type": "AWS::ECS::TaskDefinition",
            "Properties": {
                "Family": {
                    "Fn::Sub": "${AWS::StackName}-task"
                },
                "Cpu": 2048,
                "Memory": 4096,
                "NetworkMode": "awsvpc",
                "ExecutionRoleArn": {
                    "Ref": "ExecutionRole"
                },
                "ContainerDefinitions": [
                    {
                        "Name": {
                             "Fn::Sub": "${AWS::StackName}-container"
                        },
                        "Image": "137112412989.dkr.ecr.us-east-1.amazonaws.com/
amazonlinux:latest",
                        "PortMappings": [
                             {
                                 "Protocol": "tcp",
                                 "ContainerPort": 8080,
                                 "HostPort": 8080
                             }
                        ],
                         "LogConfiguration": {
                             "LogDriver": "awslogs",
                             "Options": {
                                 "awslogs-region": {
                                     "Ref": "AWS::Region"
```

```
},
                             "awslogs-group": {
                                 "Ref": "LogGroup"
                             },
                             "awslogs-stream-prefix": "ecs"
                         }
                    }
                }
            ],
            "RequiresCompatibilities": [
                "FARGATE"
            ]
        }
    },
    "Service": {
        "Type": "AWS::ECS::Service",
        "Properties": {
            "ServiceName": {
                "Fn::Sub": "${AWS::StackName}-service"
            },
            "Cluster": {
                "Ref": "Cluster"
            },
            "TaskDefinition": {
                "Ref": "TaskDefinition"
            },
            "DesiredCount": 1,
            "LaunchType": "FARGATE",
            "PlatformVersion": "1.3.0",
            "NetworkConfiguration": {
                "AwsvpcConfiguration": {
                    "AssignPublicIp": "ENABLED",
                    "Subnets": {
                         "Ref": "SubnetIds"
                    },
                    "SecurityGroups": {
                         "Ref": "SecurityGroups"
                    }
                }
            }
        }
   }
}
```

}

In your command prompt, use the following AWS CLI command to create a new stack. You
must replace the values SecurityGroups and SubnetIds with values for your Amazon
MWAA environment's security groups and subnets.

```
$ aws cloudformation create-stack \
--stack-name my-ecs-stack --template-body file://ecs-mwaa-cfn.json \
--parameters ParameterKey=SecurityGroups,ParameterValue=your-mwaa-security-group \
ParameterKey=SubnetIds,ParameterValue=your-mwaa-subnet-1\\,your-mwaa-subnet-1 \
--capabilities CAPABILITY_IAM
```

Alternatively, you can use the following shell script. The script retrieves the required values for your environment's security groups, and subnets using the <u>get-environment</u> AWS CLI command, then creates the stack accordingly. To run the script, do the following.

a. Copy, and save the script as ecs-stack-helper.sh in the same directory as your AWS CloudFormation template.

```
#!/bin/bash
joinByString() {
  local separator="$1"
  shift
  local first="$1"
  shift
  printf "%s" "$first" "${@/#/$separator}"
}
response=$(aws mwaa get-environment --name $1)
securityGroupId=$(echo "$response" | jq -r
 '.Environment.NetworkConfiguration.SecurityGroupIds[]')
subnetIds=$(joinByString '\,' $(echo "$response" | jq -r
 '.Environment.NetworkConfiguration.SubnetIds[]'))
aws cloudformation create-stack --stack-name $2 --template-body file://ecs-
cfn.json ∖
--parameters ParameterKey=SecurityGroups,ParameterValue=$securityGroupId \
ParameterKey=SubnetIds,ParameterValue=$subnetIds \
--capabilities CAPABILITY_IAM
```

b. Run the script using the following commands. Replace environment-name and stackname with your information.

```
$ chmod +x ecs-stack-helper.sh
$ ./ecs-stack-helper.bash environment-name stack-name
```

If successful, you'll see the following output displaying your new AWS CloudFormation stack ID.

```
{
    "StackId": "arn:aws:cloudformation:us-west-2:123456789012:stack/my-ecs-
stack/123456e7-8ab9-01cd-b2fb-36cce63786c9"
}
```

After your AWS CloudFormation stack is completed and AWS has provisioned your Amazon ECS resources, you're ready to create and upload your DAG.

Code sample

1. Open a command prompt, and navigate to the directory where your DAG code is stored. For example:

cd dags

2. Copy the contents of the following code sample and save locally as mwaa-ecs-operator.py, then upload your new DAG to Amazon S3.

```
from http import client
from airflow import DAG
from airflow.providers.amazon.aws.operators.ecs import ECSOperator
from airflow.utils.dates import days_ago
import boto3
CLUSTER_NAME="mwaa-ecs-test-cluster" #Replace value for CLUSTER_NAME with your
information.
CONTAINER_NAME="mwaa-ecs-test-container" #Replace value for CONTAINER_NAME with
your information.
LAUNCH_TYPE="FARGATE"
```

```
with DAG(
    dag_id = "ecs_fargate_dag",
    schedule_interval=None,
    catchup=False,
    start_date=days_ago(1)
) as dag:
    client=boto3.client('ecs')
    services=client.list_services(cluster=CLUSTER_NAME,launchType=LAUNCH_TYPE)
 service=client.describe_services(cluster=CLUSTER_NAME,services=services['serviceArns'])
    ecs_operator_task = ECSOperator(
        task_id = "ecs_operator_task",
        dag=dag,
        cluster=CLUSTER_NAME,
        task_definition=service['services'][0]['taskDefinition'],
        launch_type=LAUNCH_TYPE,
        overrides={
            "containerOverrides":[
                {
                    "name":CONTAINER_NAME,
                    "command":["ls", "-l", "/"],
                },
            ],
        },
        network_configuration=service['services'][0]['networkConfiguration'],
        awslogs_group="mwaa-ecs-zero",
        awslogs_stream_prefix=f"ecs/{CONTAINER_NAME}",
    )
```

🚯 Note

In the example DAG, for awslogs_group, you might need to modify the log group with the name for your Amazon ECS task log group. The example assumes a log group named mwaa-ecs-zero. For awslogs_stream_prefix, use the Amazon ECS task log stream prefix. The example assumes a log stream prefix, ecs.

3. Run the following AWS CLI command to copy the DAG to your environment's bucket, then trigger the DAG using the Apache Airflow UI.

```
$ aws s3 cp your-dag.py s3://your-environment-bucket/dags/
```

 If successful, you'll see output similar to the following in the task logs for ecs_operator_task in the ecs_fargate_dag DAG:

```
[2022-01-01, 12:00:00 UTC] {{ecs.py:300}} INFO - Running ECS Task -
Task definition: arn:aws:ecs:us-west-2:123456789012:task-definition/mwaa-ecs-test-
task:1 - on cluster mwaa-ecs-test-cluster
[2022-01-01, 12:00:00 UTC] {{ecs-operator-test.py:302}} INFO - ECSOperator
overrides:
{'containerOverrides': [{'name': 'mwaa-ecs-test-container', 'command': ['ls', '-l',
 '/']}]
[2022-01-01, 12:00:00 UTC] {{ecs.py:379}} INFO - ECS task ID is:
e012340b5e1b43c6a757cf012c635935
[2022-01-01, 12:00:00 UTC] {{ecs.py:313}} INFO - Starting ECS Task Log Fetcher
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] total
52
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC]
             1 root root
                            7 Jun 13 18:51 bin -> usr/bin
lrwxrwxrwx
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] dr-xr-
       2 root root 4096 Apr 9 2019 boot
xr-x
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] drwxr-
       5 root root 340 Jul 19 17:54 dev
xr-x
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] drwxr-
      1 root root 4096 Jul 19 17:54 etc
xr-x
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] drwxr-
       2 root root 4096 Apr 9 2019 home
xr-x
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC]
             1 root root
                            7 Jun 13 18:51 lib -> usr/lib
lrwxrwxrwx
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC]
             1 root root
                            9 Jun 13 18:51 lib64 -> usr/lib64
lrwxrwxrwx
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] drwxr-
      2 root root 4096 Jun 13 18:51 local
xr-x
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] drwxr-
       2 root root 4096 Apr 9 2019 media
xr-x
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] drwxr-
       2 root root 4096 Apr 9 2019 mnt
xr-x
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] drwxr-
      2 root root 4096 Apr 9 2019 opt
xr-x
```

```
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] dr-xr-
xr-x 103 root root
                      0 Jul 19 17:54 proc
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] dr-xr-
        2 root root 4096 Apr 9 2019 root
x-\-\-
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] drwxr-
      2 root root 4096 Jun 13 18:52 run
xr-x
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC]
             1 root root
                            8 Jun 13 18:51 sbin -> usr/sbin
lrwxrwxrwx
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] drwxr-
      2 root root 4096 Apr 9 2019 srv
xr-x
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] dr-xr-
xr-x 13 root root
                     0 Jul 19 17:54 sys
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC]
             2 root root 4096 Jun 13 18:51 tmp
drwxrwxrwt
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] drwxr-
xr-x 13 root root 4096 Jun 13 18:51 usr
[2022-01-01, 12:00:00 UTC] {{ecs.py:119}} INFO - [2022-07-19, 17:54:03 UTC] drwxr-
xr-x 18 root root 4096 Jun 13 18:52 var
[2022-01-01, 12:00:00 UTC] {{ecs.py:328}} INFO - ECS Task has been successfully
 executed
```

Using dbt with Amazon MWAA

This topic demonstrates how you can use dbt and Postgres with Amazon MWAA. In the following steps, you'll add the required dependencies to your requirements.txt, and upload a sample dbt project to your environment's Amazon S3 bucket. Then, you'll use a sample DAG to verify that Amazon MWAA has installed the dependencies, and finally use the BashOperator to run the dbt project.

Topics

- Version
- Prerequisites
- Dependencies
- Upload a dbt project to Amazon S3
- Use a DAG to verify dbt dependency installation
- Use a DAG to run a dbt project

Version

• You can use the code example on this page with **Apache Airflow v2** in Python 3.10.

Prerequisites

Before you can complete the following steps, you'll need the following:

- An <u>Amazon MWAA environment</u> using Apache Airflow v2.2.2. This sample was written, and tested with v2.2.2. You might need to modify the sample to use with other Apache Airflow versions.
- A sample dbt project. To get started using dbt with Amazon MWAA, you can create a fork and clone the dbt starter project from the dbt-labs GitHub repository.

Dependencies

To use Amazon MWAA with dbt, add the following startup script to your environment. To learn more, refer to Using a startup script with Amazon MWAA.

```
#!/bin/bash
if [[ "${MWAA_AIRFLOW_COMPONENT}" != "worker" ]]
then
   exit 0
fi
echo "-----"
echo "Installing virtual Python env"
echo "-----"
pip3 install --upgrade pip
echo "Current Python version:"
python3 --version
echo "..."
sudo pip3 install --user virtualenv
sudo mkdir python3-virtualenv
cd python3-virtualenv
sudo python3 -m venv dbt-env
```

```
sudo chmod -R 777 *
echo "-----"
echo "Activating venv in"
$DBT_ENV_PATH
echo "-----"
source dbt-env/bin/activate
pip3 list
echo "-----"
echo "Installing libraries..."
echo "-----"
# do not use sudo, as it will install outside the venv
pip3 install dbt-redshift==1.6.1 dbt-postgres==1.6.1
echo "-----"
echo "Venv libraries..."
echo "-----"
pip3 list
dbt --version
echo "-----"
echo "Deactivating venv..."
echo "-----"
deactivate
```

In the following sections, you'll upload your dbt project directory to Amazon S3 and run a DAG that validates whether Amazon MWAA has successfully installed the required dbt dependencies.

Upload a dbt project to Amazon S3

To be able to use a dbt project with your Amazon MWAA environment, you can upload the entire project directory to your environment's dags folder. When the environment updates, Amazon MWAA downloads the dbt directory to the local usr/local/airflow/dags/ folder.

To upload a dbt project to Amazon S3

1. Navigate to the directory where you cloned the dbt starter project.

2. Run the following Amazon S3 AWS CLI command to recursively copy the content of the project to your environment's dags folder using the --recursive parameter. The command creates a sub-directory called dbt that you can use for all of your dbt projects. If the sub-directory already exists, the project files are copied into the existing directory, and a new directory is not created. The command also creates a sub-directory within the dbt directory for this specific starter project.

```
$ aws s3 cp dbt-starter-project s3://amzn-s3-demo-bucket/dags/dbt/dbt-starter-
project --recursive
```

You can use different names for project sub-directories to organize multiple dbt projects within the parent dbt directory.

Use a DAG to verify dbt dependency installation

The following DAG uses a BashOperator and a bash command to verify whether Amazon MWAA has successfully installed the dbt dependencies specified in requirements.txt.

```
from airflow import DAG
from airflow.operators.bash_operator import BashOperator
from airflow.utils.dates import days_ago
with DAG(dag_id="dbt-installation-test", schedule_interval=None, catchup=False,
    start_date=days_ago(1)) as dag:
    cli_command = BashOperator(
        task_id="bash_command",
        bash_command=""/usr/local/airflow/python3-virtualenv/dbt-env/bin/dbt --
version""
    )
```

Do the following to view task logs and verify that dbt and its dependencies have been installed.

- 1. Navigate to the Amazon MWAA console, then choose **Open Airflow UI** from the list of available environments.
- On the Apache Airflow UI, find the dbt-installation-test DAG from the list, then choose the date under the Last Run column to open the last successful task.
- 3. Using **Graph View**, choose the bash_command task to open the task instance details.

4. Choose **Log** to open the task logs, then verify that the logs successfully list the dbt version we specified in requirements.txt.

Use a DAG to run a dbt project

The following DAG uses a BashOperator to copy the dbt projects you uploaded to Amazon S3 from the local usr/local/airflow/dags/ directory to the write-accessible /tmp directory, then runs the dbt project. The bash commands assume a starter dbt project titled dbt-starter-project. Modify the directory name according to the name of your project directory.

```
from airflow import DAG
from airflow.operators.bash_operator import BashOperator
from airflow.utils.dates import days_ago
import os
DAG_ID = os.path.basename(__file__).replace(".py", "")
# assumes all files are in a subfolder of DAGs called dbt
with DAG(dag_id=DAG_ID, schedule_interval=None, catchup=False, start_date=days_ago(1))
 as dag:
    cli_command = BashOperator(
        task_id="bash_command",
        bash_command="source /usr/local/airflow/python3-virtualenv/dbt-env/bin/
activate;\
cp -R /usr/local/airflow/dags/dbt /tmp;\
echo 'listing project files:';\
ls -R /tmp;∖
cd /tmp/dbt/mwaa_dbt_test_project;\
/usr/local/airflow/python3-virtualenv/dbt-env/bin/dbt run --project-dir /tmp/dbt/
mwaa_dbt_test_project --profiles-dir ..;\
cat /tmp/dbt_logs/dbt.log;\
rm -rf /tmp/dbt/mwaa_dbt_test_project"
    )
```

AWS blogs and tutorials

• Working with Amazon EKS and Amazon MWAA for Apache Airflow v2.x

Best practices for Amazon Managed Workflows for Apache Airflow

This guide describes the best practices we recommend when using Amazon Managed Workflows for Apache Airflow.

Topics

- Performance tuning for Apache Airflow on Amazon MWAA
- Managing Python dependencies in requirements.txt

Performance tuning for Apache Airflow on Amazon MWAA

This topic describes how to tune the performance of an Amazon Managed Workflows for Apache Airflow environment using Using Apache Airflow configuration options on Amazon MWAA.

Contents

- Adding an Apache Airflow configuration option
- Apache Airflow scheduler
 - Parameters
 - Limits
- DAG folders
 - Parameters
- DAG files
 - Parameters
- Tasks
 - Parameters

Adding an Apache Airflow configuration option

The following procedure walks you through the steps of adding an Airflow configuration option to your environment.

1. Open the Environments page on the Amazon MWAA console.

- 2. Choose an environment.
- 3. Choose **Edit**.
- 4. Choose Next.
- 5. Choose Add custom configuration in the Airflow configuration options pane.
- 6. Choose a configuration from the dropdown list and enter a value, or type a custom configuration and enter a value.
- 7. Choose **Add custom configuration** for each configuration you want to add.
- 8. Choose Save.

To learn more, refer to Using Apache Airflow configuration options on Amazon MWAA.

Apache Airflow scheduler

The Apache Airflow scheduler is a core component of Apache Airflow. An issue with the scheduler can prevent DAGs from being parsed and tasks from being scheduled. For more information about Apache Airflow scheduler tuning, refer to <u>Fine-tuning your scheduler performance</u> in the Apache Airflow documentation website.

Parameters

This section describes the configuration options available for the Apache Airflow scheduler and their use cases.

Apache Airflow v2

Version	Configuration option	Default	Description	Use case
v2	<u>celery.sy</u> nc_parallelism	1	The number of processes the Celery Executor uses to sync task state.	You can use this option to prevent queue conflicts by limiting the processes the Celery Executor uses. By default,

Version	Configuration option	Default	Description	Use case
				a value is set to 1 to prevent errors in delivering task logs to CloudWatch Logs. Setting the value to 0 means using the maximum number of processes, but might cause errors when delivering task logs.

Version	Configuration option	Default	Description	Use case
	<pre>scheduler .idle_sleep_time</pre>	1	The number of seconds to wait between consecuti ve DAG file processing in the <i>Scheduler</i> "loop."	You can use this option to free up CPU usage on the Scheduler by increasing the time the Scheduler sleeps after it's finished retrieving DAG parsing results, finding and queuing tasks, and executing queued tasks in the Executor. Increasing this value consumes the number of Scheduler threads run on an environment in scheduler threads run on an environment in scheduler .parsing_ processes for Apache Airflow v2 and scheduler .max_thre ads for Apache Airflow

Version	Configuration option	Default	Description	Use case
				reduce the capacity of the <i>Schedulers</i> to parse DAGs, and increase the time it takes for DAGs to appear in the <i>Web server</i> .
ν2	<u>scheduler</u> .max_dagr <u>uns_to_cr</u> <u>eate_per_loop</u>	10	The maximum number of DAGs to create <i>DagRuns</i> for per <i>Scheduler</i> "loop."	You can use this option to free up resources for schedulin g tasks by decreasing the maximum number of <i>DagRuns</i> for the <i>Scheduler</i> "loop."

Version	Configuration option	Default	Description	Use case
ν2	scheduler .parsing_ processes	Set using the following formula: (2 * number of vCPUs) - 1 by default.	The number of threads the <i>Scheduler</i> can run in parallel to schedule DAGs.	You can use this option to free up resources by decreasin g the number of processes the <i>Scheduler</i> runs in parallel to parse DAGs. We recommend keeping this number low if DAG parsing is impacting task scheduling. You must specify a value that's less than the vCPU count on your environment. To learn more, refer to Limits.

Limits

This section describes the limits you should consider when adjusting the default parameters for the scheduler.

scheduler.parsing_processes, scheduler.max_threads

Two threads are allowed per vCPU for an environment class. At least one thread must be reserved for the scheduler for an environment class. If you notice a delay in tasks being scheduled, you may need to increase your <u>environment class</u>. For example, a large environment has a 4 vCPU Fargate container instance for its scheduler. This means that a maximum of 7 total

threads are available to use for other processes. That is, two threads multiplied four vCPUs, minus one for the scheduler itself. The value you specify in scheduler.max_threads and scheduler.parsing_processes must not exceed the number of threads available for an environment class (as shown, below:

- **mw1.small** Must not exceed 1 thread for other processes. The remaining thread is reserved for the *Scheduler*.
- mw1.medium Must not exceed 3 threads for other processes. The remaining thread is reserved for the Scheduler.
- **mw1.large** Must not exceed 7 threads for other processes. The remaining thread is reserved for the *Scheduler*.

DAG folders

The Apache Airflow *Scheduler* continuously scans the DAGs folder on your environment. Any contained plugins.zip files, or Python (.py) files containing "airflow" import statements. Any resulting Python DAG objects are then placed into a *DagBag* for that file to be processed by the *Scheduler* to determine what, if any, tasks need to be scheduled. Dag file parsing occurs regardless of whether the files contain any viable DAG objects.

Parameters

This section describes the configuration options available for the DAGs folder and their use cases.

Apache Airflow v2

Version	Configuration option	Default	Description	Use case
v2	<u>scheduler</u> .dag_dir_ list_interval	300 seconds	The number of seconds the DAGs folder should be scanned for new files.	You can use this option to free up resources by increasin g the number of seconds to parse the DAGs folder. We recommend

Version	Configuration option	Default	Description	Use case
				increasing this value if you're seeing long parsing times in total_par se_time metrics, which may be due to a large number of files in your DAGs folder.

Version	Configuration option	Default	Description	Use case
v2	scheduler .min_file _process_ interval	30 seconds	The number of seconds after which the scheduler parses a DAG and updates to the DAG are reflected.	You can use this option to free up resources by increasing the number of seconds that the scheduler waits before parsing a DAG. For example, if you specify a value of 30, the DAG file is parsed after every 30 seconds. We recommend keeping this number high to decrease the CPU usage on your environme nt.

DAG files

As part of the Apache Airflow scheduler loop, individual DAG files are parsed to extract DAG Python objects. In Apache Airflow v2 and above, the scheduler parses a maximum of number of parsing processes at the same time. The number of seconds specified in scheduler.min_file_process_interval must pass before the same file is parsed again.

Parameters

This section describes the configuration options available for Apache Airflow DAG files and their use cases.

Apache Airflow v2

Version	Configuration option	Default	Description	Use case
ν2	core.dag_ file_proc essor_timeout	50 seconds	The number of seconds before the <i>DagFilePr</i> <i>ocessor</i> times out processing a DAG file.	You can use this option to free up resources by increasin g the time it takes before the <i>DagFilePr</i> <i>ocessor</i> times out. We recommend increasing this value if you're seeing timeouts in your DAG processing logs that result in no viable DAGs being loaded.
v2	<u>core.dagb</u> <u>ag_import</u> _ <u>timeout</u>	30 seconds	The number of seconds before importing a Python file times out.	You can use this option to free up resources by increasin g the time it takes before the <i>Scheduler</i> times out while importing a

Version	Configuration option	Default	Description	Use case
				Python file to extract the DAG objects. This option is processed as part of the <i>Scheduler</i> "loop," and must contain a value lower than the value specified in core.dag_ file_proc essor_tim eout .

Version	Configuration option	Default	Description	Use case
ν2	<pre>core.min_ serialize d_dag_upd ate_interval</pre>	30	The minimum number of seconds after which serialize d DAGs in the database are updated.	You can use this option to free up resources by increasing the number of seconds after which serialize d DAGs in the database are updated. We recommend increasing this value if you have a large number of DAGs, or complex DAGs. Increasing this value reduces the load on the <i>Scheduler</i> and the database as DAGs are serialized.

Version	Configuration option	Default	Description	Use case
v2	<u>core.min_</u> <u>serialize</u> <u>d_dag_fet</u> <u>ch_interval</u>	10	The number of seconds a serialized DAG is re-fetched from the database when already loaded in the DagBag.	You can use this option to free up resources by increasin g the number of seconds a serialized DAG is re-fetched. The value must be higher than the value specified in core.min_ serialize d_dag_upd ate_inter val to reduce database "write" rates. Increasing this value reduces the load on the <i>Web server</i> and the database as DAGs are serialized.

Tasks

The Apache Airflow scheduler and workers are both involved in queuing and de-queuing tasks. The scheduler takes parsed tasks ready to schedule from a **None** status to a **Scheduled** status. The executor, also running on the scheduler container in Fargate, queues those tasks and sets their status to **Queued**. When the workers have capacity, it takes the task from the queue and sets the status to **Running**, which subsequently changes its status to **Success** or **Failed** based on whether the task succeeds or fails.

Parameters

This section describes the configuration options available for Apache Airflow tasks and their use cases.

The default configuration options that Amazon MWAA overrides are marked in *red*.

Apache Airflow v2

Version	Configuration option	Default	Description	Use case
ν2	<u>core.parallelism</u>	Dynamically set based on (maxWorkers * maxCelery Workers) / schedulers * 1.5.	The maximum number of task instances that can have a status of "Running."	You can use this option to free up resources by increasing the number of task instances that can run simultane ously. The value specified should be the number of available <i>Workers</i> "times" the <i>Workers</i> task density. We recommend changing this value only when you're seeing a large number of tasks stuck in the "Running"

Version	Configuration option	Default	Description	Use case
				or "Queued" state.
v2	<u>core.dag</u>		The number of task instances allowed to run concurrently for each DAG.	You can use this option to free up resources by increasing the number of task instances allowed to run concurrently. For example, if you have one hundred DAGs with ten parallel tasks, and you want all DAGs to run concurren tly, you can calculate the maximum parallelism as the number of available <i>Workers</i> "times" the <i>Workers</i> task density in celery.wo rker_conc urrency , divided by the number of DAGs (e.g. 100).

Version	Configuration option	Default	Description	Use case
v2	<u>core.exec</u> <u>ute_tasks</u> <u>_new_pyth</u> <u>on_interpreter</u>	True	Determine s whether Apache Airflow executes tasks by forking the parent process, or by creating a new Python process.	When set to True, Apache Airflow recognizes changes you make to your plugins as a new Python process so created to execute tasks.
v2	<u>celery.wo</u> <u>rker_conc</u> <u>urrency</u>	N/A	Amazon MWAA overrides the Airflow base install for this option to scale <i>Workers</i> as part of its autoscali ng component.	Any value specified for this option is ignored.

Version	Configuration option	Default	Description	Use case
ν2	<u>celery.wo</u> <u>rker_autoscale</u>	<pre>mw1.micro - 3,0 mw1.small - 5,0 mw1.medium - 10,0 mw1.large - 20,0 mw1.xlarge - 40,0 mw1.2xlarge - 80,0</pre>	The task concurrency for <i>Workers</i> .	You can use this option to free up resources by reducing the maximum, minimum task concurrency of <i>Workers</i> . <i>Workers</i> accept up to the maximum concurrent tasks configure d, regardless of whether there are sufficien t resources to do so. If tasks are scheduled without sufficient resources are scheduled without sufficient resources , the tasks immediate ly fail. We recommend changing this value for resource- intensive tasks by reducing the values to be less than

Version	Configuration option	Default	Description	Use case
				the defaults to allow more capacity per task.

Managing Python dependencies in requirements.txt

This topic describes how to install and manage Python dependencies in a requirements.txt file for an Amazon Managed Workflows for Apache Airflow environment.

Contents

- Testing DAGs using the Amazon MWAA CLI utility
- Installing Python dependencies using PyPi.org Requirements File Format
 - Option one: Python dependencies from the Python Package Index
 - Option two: Python wheels (.whl)
 - Using the plugins.zip file on an Amazon S3 bucket
 - Using a WHL file hosted on a URL
 - Creating a WHL files from a DAG
 - Option three: Python dependencies hosted on a private PyPi/PEP-503 Compliant Repo
- Enabling logs on the Amazon MWAA console
- Viewing logs on the CloudWatch Logs console
- Viewing errors in the Apache Airflow UI
 - Logging into Apache Airflow
- Example requirements.txt scenarios

Testing DAGs using the Amazon MWAA CLI utility

• The command line interface (CLI) utility replicates an Amazon Managed Workflows for Apache Airflow environment locally.

- The CLI builds a Docker container image locally that's similar to an Amazon MWAA production image. This allows you to run a local Apache Airflow environment to develop and test DAGs, custom plugins, and dependencies before deploying to Amazon MWAA.
- To run the CLI, refer to the <u>aws-mwaa-local-runner</u> on GitHub.

Installing Python dependencies using PyPi.org Requirements File Format

The following section describes the different ways to install Python dependencies according to the PyPi.org <u>Requirements File Format</u>.

Option one: Python dependencies from the Python Package Index

The following section describes how to specify Python dependencies from the <u>Python Package</u> <u>Index</u> in a requirements.txt file.

Apache Airflow v2

- 1. **Test locally**. Add additional libraries iteratively to find the right combination of packages and their versions, before creating a requirements.txt file. To run the Amazon MWAA CLI utility, refer to the aws-mwaa-local-runner on GitHub.
- 2. **Review the Apache Airflow package extras**. To view a list of the packages installed for Apache Airflow v2 on Amazon MWAA, refer to <u>Amazon MWAA local runner</u> requirements.txt on the GitHub website.
- 3. Add a constraints statement. Add the constraints file for your Apache Airflow v2 environment at the top of your requirements.txt file. Apache Airflow constraints files specify the provider versions available at the time of a Apache Airflow release.

Beginning with Apache Airflow v2.7.2, your requirements file must include a -constraint statement. If you do not provide a constraint, Amazon MWAA will specify one for you to ensure the packages listed in your requirements are compatible with the version of Apache Airflow you are using.

In the following example, replace *{environment-version}* with your environment's version number, and *{Python-version}* with the version of Python that's compatible with your environment.

User Guide

For information on the version of Python compatible with your Apache Airflow environment, refer to Apache Airflow Versions.

```
--constraint "https://raw.githubusercontent.com/apache/airflow/
constraints-{Airflow-version}/constraints-{Python-version}.txt"
```

If the constraints file determines that xyz==1.0 package is not compatible with other packages in your environment, pip3 install will fail in order to prevent incompatible libraries from being installed to your environment. If installation fails for any packages, you can view error logs for each Apache Airflow component (the scheduler, worker, and web server) in the corresponding log stream on CloudWatch Logs. For more information on log types, refer to the section called "Viewing Airflow logs".

4. **Apache Airflow packages**. Add the <u>package extras</u> and the version (==). This helps to prevent packages of the same name, but different version, from being installed on your environment.

```
apache-airflow[package-extra]==2.5.1
```

 Python libraries. Add the package name and the version (==) in your requirements.txt file. This helps to prevent a future breaking update from <u>PyPi.org</u> from being automatically applied.

library == version

Example Boto3 and psycopg2-binary

This example is provided for demonstration purposes. The boto and psycopg2-binary libraries are included with the Apache Airflow v2 base install and don't need to be specified in a requirements.txt file.

```
boto3==1.17.54
boto==2.49.0
botocore==1.20.54
psycopg2-binary==2.8.6
```

If a package is specified without a version, Amazon MWAA installs the latest version of the package from <u>PyPi.org</u>. This version may conflict with other packages in your requirements.txt.

Apache Airflow v1

- 1. **Test locally**. Add additional libraries iteratively to find the right combination of packages and their versions, before creating a requirements.txt file. To run the Amazon MWAA CLI utility, refer to the aws-mwaa-local-runner on GitHub.
- 2. **Review the Airflow package extras**. Review the list of packages available for Apache Airflow v1.10.12 at <u>https://raw.githubusercontent.com/apache/airflow/</u> constraints-1.10.12/constraints-3.7.txt.
- 3. Add the constraints file. Add the constraints file for Apache Airflow v1.10.12 to the top of your requirements.txt file. If the constraints file determines that xyz==1.0 package is not compatible with other packages on your environment, the pip3 install will fail to prevent incompatible libraries from being installed to your environment.

```
--constraint "https://raw.githubusercontent.com/apache/airflow/ constraints-1.10.12/constraints-3.7.txt"
```

4. **Apache Airflow v1.10.12 packages**. Add the <u>Airflow package extras</u> and the Apache Airflow v1.10.12 version (==). This helps to prevent packages of the same name, but different version, from being installed on your environment.

```
apache-airflow[package]==1.10.12
```

Example Secure Shell (SSH)

The following example requirements.txt file installs SSH for Apache Airflow v1.10.12.

```
apache-airflow[ssh]==1.10.12
```

5. **Python libraries**. Add the package name and the version (==) in your requirements.txt file. This helps to prevent a future breaking update from <u>PyPi.org</u> from being automatically applied.

library == version

Example Boto3

The following example requirements.txt file installs the Boto3 library for Apache Airflow v1.10.12.

boto3 == 1.17.4

If a package is specified without a version, Amazon MWAA installs the latest version of the package from <u>PyPi.org</u>. This version may conflict with other packages in your requirements.txt.

Option two: Python wheels (.whl)

A Python wheel is a package format designed to ship libraries with compiled artifacts. There are several benefits to wheel packages as a method to install dependencies in Amazon MWAA:

- **Faster installation** the WHL files are copied to the container as a single ZIP, and then installed locally, without having to download each one.
- **Fewer conflicts** You can determine version compatibility for your packages in advance. As a result, there is no need for pip to recursively work out compatible versions.
- More resilience With externally hosted libraries, downstream requirements can change, resulting in version incompatibility between containers on a Amazon MWAA environment. By not depending on an external source for dependencies, every container on has have the same libraries regardless of when the each container is instantiated.

We recommend the following methods to install Python dependencies from a Python wheel archive (.whl) in your requirements.txt.

Methods

- Using the plugins.zip file on an Amazon S3 bucket
- Using a WHL file hosted on a URL
- Creating a WHL files from a DAG

Using the plugins.zip file on an Amazon S3 bucket

The Apache Airflow scheduler, workers, and web server (for Apache Airflow v2.2.2 and later) look for custom plugins during startup on the AWS-managed Fargate container for your environment at /usr/local/airflow/plugins/*. This process begins prior to Amazon MWAA's pip3 install -r requirements.txt for Python dependencies and Apache Airflow service startup. A plugins.zip file be used for any files that you don't want continuously changed during environment execution, or that you may not want to grant access to users that write DAGs. For example, Python library wheel files, certificate PEM files, and configuration YAML files.

The following section describes how to install a wheel that's in the plugins.zip file on your Amazon S3 bucket.

 Download the necessary WHL files You can use <u>pip_download</u> with your existing requirements.txt on the Amazon MWAA <u>local-runner</u> or another <u>Amazon Linux 2</u> container to resolve and download the necessary Python wheel files.

```
$ pip3 download -r "$AIRFLOW_HOME/dags/requirements.txt" -d "$AIRFLOW_HOME/plugins"
$ cd "$AIRFLOW_HOME/plugins"
$ zip "$AIRFLOW_HOME/plugins.zip" *
```

Specify the path in your requirements.txt. Specify the plugins directory at the top of your requirements.txt using <u>--find-links</u> and instruct pip not to install from other sources using <u>--no-index</u>, as shown in the following

```
--find-links /usr/local/airflow/plugins
--no-index
```

Example wheel in requirements.txt

The following example assumes you've uploaded the wheel in a plugins.zip file at the root of your Amazon S3 bucket. For example:

```
--find-links /usr/local/airflow/plugins
--no-index
numpy
```

Amazon MWAA fetches the numpy-1.20.1-cp37-cp37m-manylinux1_x86_64.whl wheel from the plugins folder and installs it on your environment.

Using a WHL file hosted on a URL

The following section describes how to install a wheel that's hosted on a URL. The URL must either be publicly accessible, or accessible from within the custom Amazon VPC you specified for your Amazon MWAA environment.

• **Provide a URL**. Provide the URL to a wheel in your requirements.txt.

Example wheel archive on a public URL

The following example downloads a wheel from a public site.

```
--find-links https://files.pythonhosted.org/packages/
--no-index
```

Amazon MWAA fetches the wheel from the URL you specified and installs them on your environment.

Note

URLs are not accessible from private web servers installing requirements in Amazon MWAA v2.2.2 and later.

Creating a WHL files from a DAG

If you have a private web server using Apache Airflow v2.2.2 or later and you're unable to install requirements because your environment does not have access to external repositories, you can use the following DAG to take your existing Amazon MWAA requirements and package them on Amazon S3:

```
from airflow import DAG
from airflow.operators.bash_operator import BashOperator
from airflow.utils.dates import days_ago
S3_BUCKET = 'my-s3-bucket'
```

```
S3_KEY = 'backup/plugins_whl.zip'
with DAG(dag_id="create_whl_file", schedule_interval=None, catchup=False,
    start_date=days_ago(1)) as dag:
        cli_command = BashOperator(
            task_id="bash_command",
            bash_command=f"mkdir /tmp/whls;pip3 download -r /usr/local/airflow/
requirements/requirements.txt -d /tmp/whls;zip -j /tmp/plugins.zip /tmp/whls/*;aws s3
    cp /tmp/plugins.zip s3://amzn-s3-demo-bucket/{S3_KEY}"
    )
```

After running the DAG, use this new file as your Amazon MWAA plugins.zip, optionally, packaged with other plugins. Then, update your requirements.txt preceded by --find-links /usr/local/airflow/plugins and --no-index without adding --constraint.

This method allows you to use the same libraries offline.

Option three: Python dependencies hosted on a private PyPi/PEP-503 Compliant Repo

The following section describes how to install an Apache Airflow extra that's hosted on a private URL with authentication.

- 1. Add your user name and password as Apache Airflow configuration options. For example:
 - foo.user:YOUR_USER_NAME
 - foo.pass:YOUR_PASSWORD
- Create your requirements.txt file. Substitute the placeholders in the following example with your private URL, and the username and password you've added as <u>Apache Airflow</u> configuration options. For example:

```
--index-url https://${AIRFLOW__FO0__USER}:${AIRFLOW__FO0__PASS}@my.privatepypi.com
```

3. Add any additional libraries to your requirements.txt file. For example:

```
--index-url https://${AIRFLOW__FO0__USER}:${AIRFLOW__FO0__PASS}@my.privatepypi.com
my-private-package==1.2.3
```

Enabling logs on the Amazon MWAA console

The <u>execution role</u> for your Amazon MWAA environment needs permission to send logs to CloudWatch Logs. To update the permissions of an execution role, refer to <u>Amazon MWAA</u> execution role.

You can enable Apache Airflow logs at the INFO, WARNING, ERROR, or CRITICAL level. When you choose a log level, Amazon MWAA sends logs for that level and all higher levels of severity. For example, if you enable logs at the INFO level, Amazon MWAA sends INFO logs and WARNING, ERROR, and CRITICAL log levels to CloudWatch Logs. We recommend enabling Apache Airflow logs at the INFO level for the *Scheduler* to view logs received for the requirements.txt.



Airflow scheduler logs

Log level

Specify which types of task events to log

INFO Log info and higher-severity events

CRITICAL Log critical events only

ERROR

Log error and higher-severity events

WARNING

Log warning and higher-severity events

INFO

Log info and higher-severity events

Viewing logs on the CloudWatch Logs console

You can view Apache Airflow logs for the *Scheduler* scheduling your workflows and parsing your dags folder. The following steps describe how to open the log group for the *Scheduler* on the Amazon MWAA console, and view Apache Airflow logs on the CloudWatch Logs console.

To view logs for a requirements.txt

1. Open the Environments page on the Amazon MWAA console.

- 2. Choose an environment.
- 3. Choose the Airflow scheduler log group on the Monitoring pane.
- 4. Choose the requirements_install_ip log in Log streams.
- 5. You should see the list of packages that were installed on the environment at /usr/local/ airflow/.local/bin. For example:

```
Collecting appdirs==1.4.4 (from -r /usr/local/airflow/.local/bin (line 1))
Downloading https://files.pythonhosted.org/
packages/3b/00/2344469e2084fb28kjdsfiuyweb47389789vxbmnbjhsdgf5463acd6cf5e3db69324/
appdirs-1.4.4-py2.py3-none-any.whl
Collecting astroid==2.4.2 (from -r /usr/local/airflow/.local/bin (line 2))
```

6. Review the list of packages and whether any of these encountered an error during installation. If something went wrong, you may see an error similar to the following:

```
2021-03-05T14:34:42.731-07:00
No matching distribution found for LibraryName==1.0.0 (from -r /usr/local/
airflow/.local/bin (line 4))
No matching distribution found for LibraryName==1.0.0 (from -r /usr/local/
airflow/.local/bin (line 4))
```

Viewing errors in the Apache Airflow UI

You may also want to check your Apache Airflow UI to identify whether an error may be related to another issue. The most common error you may encounter with Apache Airflow on Amazon MWAA is:

```
Broken DAG: No module named x
```

If you see this error in your Apache Airflow UI, you're likely missing a required dependency in your requirements.txt file.

Logging into Apache Airflow

You need <u>Apache Airflow UI access policy: AmazonMWAAWebServerAccess</u> permissions for your AWS account in AWS Identity and Access Management (IAM) to view your Apache Airflow UI.

To access your Apache Airflow UI

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose **Open Airflow UI**.

Example requirements.txt scenarios

You can mix and match different formats in your requirements.txt. The following example uses a combination of the different ways to install extras.

Example Extras on PyPi.org and a public URL

You need to use the --index-url option when specifying packages from PyPi.org, in addition to packages on a public URL, such as custom PEP 503 compliant repo URLs.

```
aws-batch == 0.6
phoenix-letter >= 0.3
--index-url http://dist.repoze.org/zope2/2.10/simple
    zopelib
```

Monitoring and metrics for Amazon Managed Workflows for Apache Airflow

Monitoring is an important part of maintaining the reliability, availability, and performance of Amazon Managed Workflows for Apache Airflow and your AWS solution. We recommend collecting monitoring data from all parts of your AWS solution so that you can more easily debug a multipoint failure if one occurs. This topic describes what resources AWS provides for monitoring your Amazon MWAA environment and responding to potential events.

i Note

Apache Airflow metrics and logging are subject to standard Amazon CloudWatch pricing.

For more information about monitoring Apache Airflow, refer to <u>Logging & Monitoring</u> in the Apache Airflow documentation website.

Sections

- Monitoring overview on Amazon MWAA
- Viewing audit logs in AWS CloudTrail
- Viewing Airflow logs in Amazon CloudWatch
- Monitoring dashboards and alarms on Amazon MWAA
- Apache Airflow v2 environment metrics in CloudWatch
- Container, queue, and database metrics for Amazon MWAA

Monitoring overview on Amazon MWAA

This page describes the AWS services used to monitor an Amazon Managed Workflows for Apache Airflow environment.

Contents

- Amazon CloudWatch overview
- AWS CloudTrail overview

Amazon CloudWatch overview

CloudWatch is a metrics repository for AWS services that allows you to retrieve statistics based on the <u>metrics</u> and <u>dimensions</u> published by a service. You can use these metrics to configure <u>alarms</u>, calculate statistics and then present the data in a <u>dashboard</u> that helps you assess the health of your environment in the Amazon CloudWatch console.

Apache Airflow is already set-up to send <u>StatsD</u> metrics for an Amazon Managed Workflows for Apache Airflow environment to Amazon CloudWatch.

To learn more, refer to What is Amazon CloudWatch?.

AWS CloudTrail overview

CloudTrail is an auditing service that provides a record of actions taken by a user, role, or an AWS service in Amazon MWAA. Using the information collected by CloudTrail, you can determine the request that was made to Amazon MWAA, the IP address from which the request was made, who made the request, when it was made, and additional details available in audit logs.

To learn more, refer to What is AWS CloudTrail?.

Viewing audit logs in AWS CloudTrail

AWS CloudTrail is enabled on your AWS account when you create it. CloudTrail logs the activity taken by an IAM entity or an AWS service, such as Amazon Managed Workflows for Apache Airflow, which is recorded as a CloudTrail event. You can view, search, and download the past 90 days of event history in the CloudTrail console. CloudTrail captures all events on the Amazon MWAA console and all calls to Amazon MWAA APIs. It doesn't capture read-only actions, such as GetEnvironment, or the PublishMetrics action. This page describes how to use CloudTrail to monitor events for Amazon MWAA.

Contents

- Creating a trail in CloudTrail
- Viewing events with CloudTrail Event History
- Example trail for CreateEnvironment
- What's next?

Creating a trail in CloudTrail

You need to create a trail to view an ongoing record of events in your AWS account, including events for Amazon MWAA. A trail enables CloudTrail to deliver log files to an Amazon S3 bucket. If you do not create a trail, you can still view available event history in the CloudTrail console. For example, using the information collected by CloudTrail, you can determine the request that was made to Amazon MWAA, the IP address from which the request was made, who made the request, when it was made, and additional details. To learn more, refer to the <u>Creating a trail for your AWS account</u>.

Viewing events with CloudTrail Event History

You can troubleshoot operational and security incidents over the past 90 days in the CloudTrail console by viewing event history. For example, you can view events related to the creation, modification, or deletion of resources (such as IAM users or other AWS resources) in your AWS account on a per-region basis. To learn more, refer to the <u>Viewing Events with CloudTrail Event</u> <u>History</u>.

- 1. Open the <u>CloudTrail</u> console.
- 2. Choose **Event history**.
- 3. Select the events you want to view, and then choose **Compare event details**.

Example trail for CreateEnvironment

A trail is a configuration that enables delivery of events as log files to an Amazon S3 bucket that you specify.

CloudTrail log files contain one or more log entries. An event represents a single request from any source and includes information about the requested action, such as the date and time of the action, or request parameters. CloudTrail log files are not an ordered stack trace of the public API calls, and don't appear in any specific order. The following example is a log entry for the CreateEnvironment action that is denied due to lacking permissions. The values in AirflowConfigurationOptions have been redacted for privacy.

```
{
    "eventVersion": "1.05",
    "userIdentity": {
        "type": "AssumedRole",
```

```
"principalId": "00123456ABC7DEF8HIJK",
    "arn": "arn:aws:sts::012345678901:assumed-role/root/myuser",
    "accountId": "012345678901",
    "accessKeyId": "",
    "sessionContext": {
        "sessionIssuer": {
            "type": "Role",
            "principalId": "00123456ABC7DEF8HIJK",
            "arn": "arn:aws:iam::012345678901:role/user",
            "accountId": "012345678901",
            "userName": "user"
        },
        "webIdFederationData": {},
        "attributes": {
            "mfaAuthenticated": "false",
            "creationDate": "2020-10-07T15:51:52Z"
        }
    }
},
"eventTime": "2020-10-07T15:52:58Z",
"eventSource": "airflow.amazonaws.com",
"eventName": "CreateEnvironment",
"awsRegion": "us-west-2",
"sourceIPAddress": "205.251.233.178",
"userAgent": "PostmanRuntime/7.26.5",
"errorCode": "AccessDenied",
"requestParameters": {
    "SourceBucketArn": "arn:aws:s3:::my-bucket",
    "ExecutionRoleArn": "arn:aws:iam::012345678901:role/AirflowTaskRole",
    "AirflowConfigurationOptions": "***",
    "DagS3Path": "sample_dag.py",
    "NetworkConfiguration": {
        "SecurityGroupIds": [
            "sg-01234567890123456"
        ],
        "SubnetIds": [
            "subnet-01234567890123456",
            "subnet-65432112345665431"
        ]
    },
    "Name": "test-cloudtrail"
},
"responseElements": {
    "message": "Access denied."
```

```
stID",
```

```
"requestID": "RequestID",
"eventID": "EventID",
"readOnly": false,
"eventType": "AwsApiCall",
"recipientAccountId": "012345678901"
```

```
}
```

What's next?

},

- Learn how to configure other AWS services for the event data collected in CloudTrail logs in <u>CloudTrail Supported Services and Integrations</u>.
- Learn how to be notified when CloudTrail publishes new log files to an Amazon S3 bucket in <u>Configuring Amazon SNS Notifications for CloudTrail</u>.

Viewing Airflow logs in Amazon CloudWatch

Amazon MWAA can send Apache Airflow logs to Amazon CloudWatch. You can view logs for multiple environments from a single location to easily identify Apache Airflow task delays or workflow errors without the need for additional third-party tools. Apache Airflow logs need to be enabled on the Amazon Managed Workflows for Apache Airflow console to view Apache Airflow DAG processing, tasks, *Web server*, *Worker* logs in CloudWatch.

Contents

- Pricing
- Before you begin
- Log types
- Enabling Apache Airflow logs
- Viewing Apache Airflow logs
- Example scheduler logs
- What's next?

Pricing

• Standard CloudWatch Logs charges apply. For more information, refer to CloudWatch pricing.

• You must have a role that can view logs in CloudWatch. For more information, refer to <u>Accessing</u> an Amazon MWAA environment.

Log types

Amazon MWAA creates a log group for each Airflow logging option you enable, and pushes the logs to the CloudWatch Logs groups associated with an environment. Log groups are named in the following format: YourEnvironmentName-LogType. For example, if your environment's named Airflow-v202-Public, Apache Airflow task logs are sent to Airflow-v202-Public-Task.

Log type		Description
YourEnvironmentName- sing	DAGProces	The logs of the DAG processor manager (the part of the scheduler that processes DAG files).
YourEnvironmentName-	Scheduler	The logs the Airflow scheduler generates.
YourEnvironmentName-	Task	The task logs a DAG generates.
YourEnvironmentName-	WebServer	The logs the Airflow web interface generates.
YourEnvironmentName-	Worker	The logs generated as part of workflow and DAG execution.

Enabling Apache Airflow logs

You can enable Apache Airflow logs at the INFO, WARNING, ERROR, or CRITICAL level. When you choose a log level, Amazon MWAA sends logs for that level and all higher levels of severity. For example, if you enable logs at the INFO level, Amazon MWAA sends INFO logs and WARNING, ERROR, and CRITICAL log levels to CloudWatch Logs.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose Edit.
- 4. Choose Next.

- 5. Choose one or more of the following logging options:
 - a. Choose the **Airflow scheduler log group** on the **Monitoring** pane.
 - b. Choose the **Airflow web server log group** on the **Monitoring** pane.
 - c. Choose the **Airflow worker log group** on the **Monitoring** pane.
 - d. Choose the **Airflow DAG processing log group** on the **Monitoring** pane.
 - e. Choose the **Airflow task log group** on the **Monitoring** pane.
 - f. Choose the logging level in **Log level**.
- 6. Choose Next.
- 7. Choose Save.

Viewing Apache Airflow logs

The following section describes how to view Apache Airflow logs in the CloudWatch console.

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose a log group in the **Monitoring** pane.
- 4. Choose a log in **Log stream**.

Example scheduler logs

You can view Apache Airflow logs for the *Scheduler* scheduling your workflows and parsing your dags folder. The following steps describe how to open the log group for the *Scheduler* on the Amazon MWAA console, and view Apache Airflow logs on the CloudWatch Logs console.

To view logs for a requirements.txt

- 1. Open the Environments page on the Amazon MWAA console.
- 2. Choose an environment.
- 3. Choose the **Airflow scheduler log group** on the **Monitoring** pane.
- 4. Choose the requirements_install_ip log in Log streams.
- 5. You should see the list of packages that were installed on the environment at /usr/local/ airflow/.local/bin. For example:

Collecting appdirs==1.4.4 (from -r /usr/local/airflow/.local/bin (line 1)) Downloading https://files.pythonhosted.org/ packages/3b/00/2344469e2084fb28kjdsfiuyweb47389789vxbmnbjhsdgf5463acd6cf5e3db69324/ appdirs-1.4.4-py2.py3-none-any.whl Collecting astroid==2.4.2 (from -r /usr/local/airflow/.local/bin (line 2))

6. Review the list of packages and whether any of these encountered an error during installation. If something went wrong, you may see an error similar to the following:

```
2021-03-05T14:34:42.731-07:00
No matching distribution found for LibraryName==1.0.0 (from -r /usr/local/
airflow/.local/bin (line 4))
No matching distribution found for LibraryName==1.0.0 (from -r /usr/local/
airflow/.local/bin (line 4))
```

What's next?

- Learn how to configure a CloudWatch alarm in Using Amazon CloudWatch alarms.
- Learn how to create a CloudWatch dashboard in Using CloudWatch dashboards.

Monitoring dashboards and alarms on Amazon MWAA

You can create a custom dashboard in Amazon CloudWatch and add alarms for a particular metric to monitor the health status of an Amazon Managed Workflows for Apache Airflow environment. When an alarm is on a dashboard, it turns red when it is in the ALARM state, making it easier for you to monitor the health of an Amazon MWAA environment proactively.

Apache Airflow exposes metrics for a number of processes, including the number of DAG processes, DAG bag size, currently running tasks, task failures, and successes. When you create an environment, Airflow is configured to automatically send metrics for an Amazon MWAA environment to CloudWatch. This page describes how to create a health status dashboard for the Airflow metrics in CloudWatch for an Amazon MWAA environment.

Contents

- Metrics
- <u>Alarm states overview</u>

- Example custom dashboards and alarms
 - About these metrics
 - About the dashboard
 - Using AWS tutorials
 - Using AWS CloudFormation
- Deleting metrics and dashboards
- What's next?

Metrics

You can create a custom dashboard and alarm for any of the metrics available for your Apache Airflow version. Each metric corresponds to an Apache Airflow key performance indicator (KPI). To view a list of metrics, refer to:

<u>Apache Airflow v2 environment metrics in CloudWatch</u>

Alarm states overview

A metric alarm has the following possible states:

- OK The metric or expression is within the defined threshold.
- ALARM The metric or expression is outside of the defined threshold.
- INSUFFICIENT_DATA The alarm has just started, the metric is not available, or not enough data is available for the metric to determine the alarm state.

Example custom dashboards and alarms

You can build a custom monitoring dashboard that displays charts of selected metrics for your Amazon MWAA environment.

About these metrics

The following list describes each of the metrics created in the custom dashboard by the tutorial and template definitions in this section.

- *QueuedTasks* The number of tasks with queued state. Corresponds to the executor.queued_tasks Apache Airflow metric.
- *TasksPending* The number of tasks pending in executor. Corresponds to the scheduler.tasks.pending Apache Airflow metric.

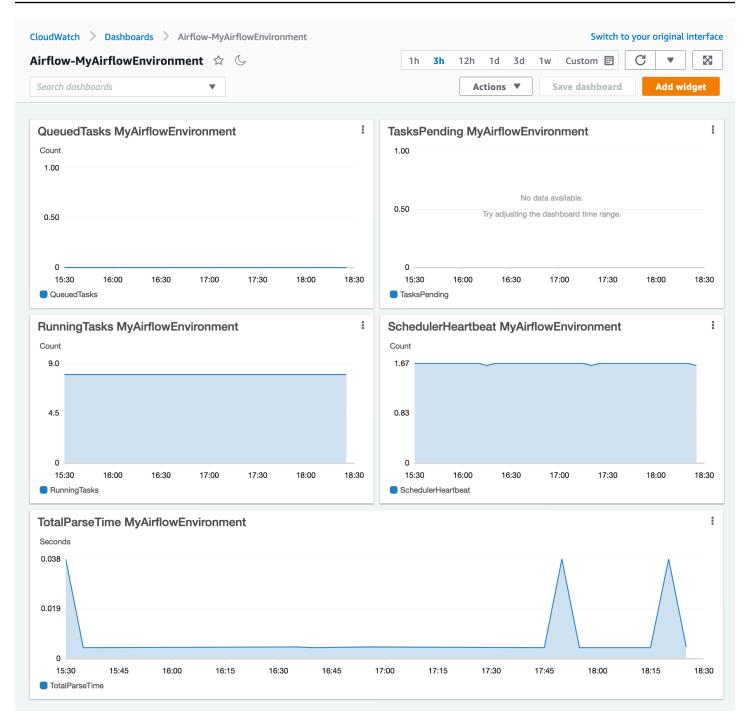
i Note

Does not apply to Apache Airflow v2.2 and above.

- *RunningTasks* The number of tasks running in executor. Corresponds to the executor.running_tasks Apache Airflow metric.
- SchedulerHeartbeat The number of check-ins Apache Airflow performs on the scheduler job.
 Corresponds to the scheduler_heartbeat Apache Airflow metrics.
- *TotalParseTime* The number of seconds taken to scan and import all DAG files once. Corresponds to the dag_processing.total_parse_time Apache Airflow metric.

About the dashboard

The following image shows the monitoring dashboard created by the tutorial and template definition in this section.



Using AWS tutorials

You can use the following AWS tutorial to automatically create a health status dashboard for any Amazon MWAA environments that are currently deployed. It also creates CloudWatch alarms for unhealthy workers and scheduler heartbeat failures across all Amazon MWAA environments.

CloudWatch Dashboard Automation for Amazon MWAA

Using AWS CloudFormation

You can use the AWS CloudFormation template definition in this section to create a monitoring dashboard in CloudWatch, then add alarms on the CloudWatch console to receive notifications when a metric surpasses a particular threshold. To create the stack using this template definition, refer to <u>Creating a stack on the AWS CloudFormation console</u>. To add an alarm to the dashboard, refer to <u>Using alarms</u>.

```
AWSTemplateFormatVersion: "2010-09-09"
Description: Creates MWAA Cloudwatch Dashboard
Parameters:
  DashboardName:
    Description: Enter the name of the CloudWatch Dashboard
    Type: String
  EnvironmentName:
    Description: Enter the name of the MWAA Environment
    Type: String
Resources:
  BasicDashboard:
    Type: AWS::CloudWatch::Dashboard
    Properties:
      DashboardName: !Ref DashboardName
      DashboardBody:
        Fn::Sub: '{
              "widgets": [
                  {
                       "type": "metric",
                       "x": 0,
                       "y": 0,
                       "width": 12,
                       "height": 6,
                       "properties": {
                           "view": "timeSeries",
                           "stacked": true,
                           "metrics": [
                               Ε
                                   "AmazonMWAA",
                                   "QueuedTasks",
                                   "Function",
                                   "Executor",
                                   "Environment",
                                   "${EnvironmentName}"
                               ]
```

```
],
        "region": "${AWS::Region}",
        "title": "QueuedTasks ${EnvironmentName}",
        "period": 300
    }
},
{
    "type": "metric",
    "x": 0,
    "y": 6,
    "width": 12,
    "height": 6,
    "properties": {
        "view": "timeSeries",
        "stacked": true,
        "metrics": [
             Ε
                 "AmazonMWAA",
                 "RunningTasks",
                 "Function",
                 "Executor",
                 "Environment",
                 "${EnvironmentName}"
            ]
        ],
        "region": "${AWS::Region}",
        "title": "RunningTasks ${EnvironmentName}",
        "period": 300
    }
},
{
    "type": "metric",
    "x": 12,
    "y": 6,
    "width": 12,
    "height": 6,
    "properties": {
        "view": "timeSeries",
        "stacked": true,
        "metrics": [
             Ε
                 "AmazonMWAA",
                 "SchedulerHeartbeat",
                 "Function",
```

```
"Scheduler",
                 "Environment",
                 "${EnvironmentName}"
            ]
        ],
        "region": "${AWS::Region}",
        "title": "SchedulerHeartbeat ${EnvironmentName}",
        "period": 300
    }
},
{
    "type": "metric",
    "x": 12,
    "y": 0,
    "width": 12,
    "height": 6,
    "properties": {
        "view": "timeSeries",
        "stacked": true,
        "metrics": [
            Γ
                 "AmazonMWAA",
                 "TasksPending",
                 "Function",
                 "Scheduler",
                 "Environment",
                 "${EnvironmentName}"
            ]
        ],
        "region": "${AWS::Region}",
        "title": "TasksPending ${EnvironmentName}",
        "period": 300
    }
},
{
    "type": "metric",
    "x": 0,
    "y": 12,
    "width": 24,
    "height": 6,
    "properties": {
        "view": "timeSeries",
        "stacked": true,
        "region": "${AWS::Region}",
```

```
"metrics": [
                     Ε
                         "AmazonMWAA",
                         "TotalParseTime",
                         "Function",
                         "DAG Processing",
                         "Environment",
                         "${EnvironmentName}"
                     ]
                 ],
                 "title": "TotalParseTime ${EnvironmentName}",
                 "period": 300
            }
        }
    ]
}'
```

Deleting metrics and dashboards

If you delete an Amazon MWAA environment, the corresponding dashboard is also deleted. CloudWatch metrics are stored for fifteen (15) months and can not be deleted. The CloudWatch console limits the search of metrics to two (2) weeks after a metric is last ingested to ensure that the most up to date instances are shown for your Amazon MWAA environment. To learn more, refer to <u>Amazon CloudWatch FAQs</u>.

What's next?

 Learn how to create a DAG that queries the Amazon Aurora PostgreSQL metadata database for your environment and publishes custom metrics to CloudWatch in <u>Using a DAG to write custom</u> <u>metrics in CloudWatch</u>.

Apache Airflow v2 environment metrics in CloudWatch

Apache Airflow v2 is already set-up to collect and send <u>StatsD</u> metrics for an Amazon Managed Workflows for Apache Airflow environment to Amazon CloudWatch. The complete list of metrics Apache Airflow sends is available on the <u>Metrics</u> page in the *Apache Airflow reference guide*. This page describes the Apache Airflow metrics available in CloudWatch, and how to access metrics in the CloudWatch console.

Contents

- Terms
- Dimensions
- Accessing metrics in the CloudWatch console
- Apache Airflow metrics available in CloudWatch
 - <u>Apache Airflow Counters</u>
 - <u>Apache Airflow Gauges</u>
 - Apache Airflow Timers
- Choosing which metrics are reported
- What's next?

Terms

Namespace

A namespace is a container for the CloudWatch metrics of an AWS service. For Amazon MWAA, the namespace is *AmazonMWAA*.

CloudWatch metrics

A CloudWatch metric represents a time-ordered set of data points that are specific to CloudWatch.

Apache Airflow metrics

The Metrics specific to Apache Airflow.

Dimension

A dimension is a name/value pair that is part of the identity of a metric.

Unit

A statistic has a unit of measure. For Amazon MWAA, units include *Count*, *Seconds*, and *Milliseconds*. For Amazon MWAA, units are set based on the units in the original Airflow metrics.

Dimensions

This section describes the CloudWatch *Dimensions* grouping for Apache Airflow metrics in CloudWatch.

Dimension	Description
DAG	Indicates a specific Apache Airflow DAG name.
DAG Filename	Indicates a specific Apache Airflow DAG file name.
Function	This dimension is used to improve the grouping of metrics in CloudWatch.
Job	Indicates an Apache Airflow <i>Job</i> run by the <i>Scheduler</i> . Always has a value of <i>Job</i> .
Operator	Indicates a specific Apache Airflow operator.
Pool	Indicates a specific Apache Airflow <i>worker</i> <i>pool</i> .
Task	Indicates a specific Apache Airflow task.
HostName	Indicates the hostname for a specific running Apache Airflow process.

Accessing metrics in the CloudWatch console

This section describes how to access performance metrics in CloudWatch for a specific DAG.

To view performance metrics for a dimension

- 1. Open the <u>Metrics page</u> on the CloudWatch console.
- 2. Use the AWS Region selector to select your region.
- 3. Choose the AmazonMWAA namespace.
- 4. In the **All metrics** tab, select a dimension. For example, *DAG, Environment*.
- 5. Choose a CloudWatch metric for a dimension. For example, *TaskInstanceSuccesses* or *TaskInstanceDuration*. Choose **Graph all search results**.
- 6. Choose the **Graphed metrics** tab to view performance statistics for Apache Airflow metrics, such as *DAG*, *Environment*, *Task*.

Apache Airflow metrics available in CloudWatch

This section describes the Apache Airflow metrics and dimensions sent to CloudWatch.

Apache Airflow Counters

The Apache Airflow metrics in this section contain data about Apache Airflow Counters.

CloudWatch metric	Apache Airflow metric	Unit	Dimension	
SLAMissed Note Available for Apache Airflow v2.4.3 and above.	sla_missed	Count	Function, Scheduler	
FailedSLACallback	sla_callb ack_notif ication_f ailure	Count	Function, Scheduler	

CloudWatch metric	Apache Airflow metric	Unit	Dimension	
(i) Note Available for Apache Airflow v2.4.3 and above.				
Updates	dataset.u pdates	Count	Function, Scheduler	
 Note Available for Apache Airflow v2.6.3 and above. 				
Orphaned	dataset.o rphaned	Count	Function, Scheduler	
 Note Available for Apache Airflow v2.6.3 and above. 				
FailedCeleryTaskExecution	celery.ex ecute_com	Count	Function, Celery	
 Note Available for Apache Airflow v2.4.3 and above. 	mand.failure			

CloudWatch metric	Apache Airflow metric	Unit	Dimension
FilePathQueueUpdateCount Note Available for Apache Airflow v2.6.3 and above.	dag_proce ssing.fil e_path_qu eue_updat e_count	Count	Function, Scheduler
CriticalSectionBusy	scheduler .critical _section_ busy	Count	Function, Scheduler
DagBagSize	dagbag_size	Count	Function, DAG Processing
DagCallbackExceptions	dag.callb ack_excep tions	Count	DAG, All
FailedSLAEmailAttempts	sla_email _notifica tion_failure	Count	Function, Scheduler
TaskInstanceFinished	ti.finish. {dag_id}. {task_id}. {state}	Count	DAG, {dag_id} Task, {task_id} State, {state}

CloudWatch metric	Apache Airflow metric	Unit	Dimension	
JobEnd	{job_name }_end	Count	Job, {job_name}	
JobHeartbeatFailure	{job_name }_heartbe at_failure	Count	Job, {job_name}	
JobStart	{job_name }_start	Count	Job, {job_name}	
ManagerStalls	dag_proce ssing.man ager_stalls	Count	Function, DAG Processing	
OperatorFailures	operator_ failures_ {operator _name}	Count	Operator, {operator _name}	
OperatorSuccesses	operator_ successes _{operato r_name}	Count	Operator, {operator _name}	
OtherCallbackCount	dag_proce ssing.oth	Count	Function, Scheduler	
(i) Note Available in Apache Airflow v2.6.3 and above.	er_callba ck_count			

CloudWatch metric	Apache Airflow metric	Unit	Dimension
Processes	dag_proce ssing.pro cesses	Count	Function, DAG Processing
SchedulerHeartbeat	scheduler _heartbeat	Count	Function, Scheduler
StartedTaskInstances	ti.start. {dag_id}. {task_id}	Count	DAG, All Task, All
SlaCallbackCount	dag_proce ssing.sla _callback _count i Note Available for Apache Airflow v2.6.3 and above.	Count	Function, Scheduler
TasksKilledExternally	scheduler .tasks.ki lled_exte rnally	Count	Function, Scheduler

CloudWatch metric	Apache Airflow metric	Unit	Dimension
TaskTimeoutError	celery.ta sk_timeou t_error	Count	Function, Celery
TaskInstanceCreate dUsingOperator	task_inst ance_crea ted-{oper ator_name}	Count	Operator, {operator _name}
TaskInstancePreviouslySucce eded	previousl y_succeeded	Count	DAG, All Task, All
TaskInstanceFailures	ti_failures	Count	DAG, All Task, All
TaskInstanceSuccesses	ti_successes	Count	DAG, All Task, All
TaskRemovedFromDAG	task_remo ved_from_ dag.{dag_id}	Count	DAG, {dag_id}
TaskRestoredToDAG	task_rest ored_to_dag. {dag_id}	Count	DAG, {dag_id}

CloudWatch metric	Apache Airflow metric	Unit	Dimension	
TriggersSucceeded Note Available for Apache Airflow v2.7.2 and above.	triggers. succeeded	Count	Function, Trigger	
TriggersFailed Note Available for Apache Airflow v2.7.2 and above.	triggers. failed	Count	Function, Trigger	
TriggersBlockedMainThread Note Available for Apache Airflow v2.7.2 and above.	triggers. blocked_m ain_thread	Count	Function, Trigger	
TriggerHeartbeat Note Available for Apache Airflow v2.8.1 and above.	triggerer _heartbeat	Count	Function, Triggerer	

CloudWatch metric	Apache Airflow metric	Unit	Dimension	
TaskInstanceCreate dUsingOperator	airflow.t ask_insta nce_creat ed_{operator _name} Note Available for Apache Airflow v2.7.2 and above.	Count	Operator, {operator _name}	
ZombiesKilled	zombies_k illed	Count	DAG, All Task, All	

Apache Airflow Gauges

The Apache Airflow metrics in this section contain data about <u>Apache Airflow Gauges</u>.

CloudWatch metric	Apache Airflow metric	Unit	Dimension
DAGFileRe freshError	dag_file_refresh_error	Count	Function, DAG Processing
ImportErrors	dag_processing.imp ort_errors	Count	Function, DAG Processing

CloudWatch metric	Apache Airflow metric	Unit	Dimension
Exception Failures	smart_sensor_opera tor.exception_failures	Count	Function, Smart Sensor Operator
ExecutedTasks	smart_sensor_opera tor.executed_tasks	Count	Function, Smart Sensor Operator
InfraFailures	smart_sensor_opera tor.infra_failures	Count	Function, Smart Sensor Operator
LoadedTasks	smart_sensor_opera tor.loaded_tasks	Count	Function, Smart Sensor Operator
TotalPars eTime	dag_processing.tot al_parse_time	Seconds	Function, DAG Processing
Triggered DagRuns i Note Available in Apache Airflow v2.6.3 and above.	dataset.triggered_ dagruns	Count	Function, Scheduler

CloudWatch metric	Apache Airflow metric	Unit	Dimension	
TriggersR unning Note Available in Apache Airflow v2.7.2 and above.	<pre>triggers. running.{hostname}</pre>	Count	Function, Trigger HostName, {hostname}	
PoolDefer redSlots Note Available in Apache Airflow v2.7.2 and above.	<pre>pool.deferred_slot s.{pool_name}</pre>	Count	Pool, {pool_name}	
DAGFilePr ocessingL astRunSec ondsAgo	dag_processing.las t_run.seconds_ago. {dag_filename}	Seconds	DAG Filename, {dag_file name}	
OpenSlots	executor.open_slots	Count	Function, Executor	

CloudWatch metric	Apache Airflow metric	Unit	Dimension
OrphanedT	scheduler.orphaned	Count	Function,
asksAdopted	_tasks.adopted		Scheduler
OrphanedT	scheduler.orphaned	Count	Function,
asksCleared	_tasks.cleared		Scheduler
PokedExce ptions	smart_sensor_opera tor.poked_exception	Count	Function, Smart Sensor Operator
PokedSuccess	smart_sensor_opera tor.poked_success	Count	Function, Smart Sensor Operator
PokedTasks	smart_sensor_opera tor.poked_tasks	Count	Function, Smart Sensor Operator
PoolFailures	pool.open_slots.{p ool_name}	Count	Pool, {pool_name}
PoolStarv	pool.starving_tasks.	Count	Pool,
ingTasks	{pool_name}		{pool_name}
PoolOpenSlots	pool.open_slots.{p ool_name}	Count	Pool, {pool_name}
PoolQueue	pool.queued_slots.	Count	Pool,
dSlots	{pool_name}		{pool_name}
PoolRunni	pool.running_slots.	Count	Pool,
ngSlots	{pool_name}		{pool_name}
Processor	dag_processing.pro	Count	Function, DAG
Timeouts	cessor_timeouts		Processing

CloudWatch metric	Apache Airflow metric	Unit	Dimension
QueuedTasks	executor.queued_tasks	Count	Function, Executor
RunningTasks	executor.running_tasks	Count	Function, Executor
TasksExec utable	scheduler.tasks.ex ecutable	Count	Function, Scheduler
TasksPendingImage: NoteDoesnotapplytoApacheAirflowv2.2andabove.	scheduler.tasks.pe nding	Count	Function, Scheduler
TasksRunning	scheduler.tasks.running	Count	Function, Scheduler
TasksStarving	scheduler.tasks.starving	Count	Function, Scheduler
TasksWith outDagRun	scheduler.tasks.wi thout_dagrun	Count	Function, Scheduler

CloudWatch metric	Apache Airflow metric	Unit	Dimension
DAGFilePr ocessingL astNumOfD bQueries i Note Available in Apache Airflow v2.10.1 and above.	dag_processing.las t_num_of_db_queries. {dag_filename}	Count	DAG Filename, {dag_file name}
PoolSched uledSlots Note Available in Apache Airflow v2.10.1 and above.	pool.scheduled_slots. {pool_name}	Count	Pool, {pool_name}

CloudWatch metric	Apache Airflow metric	Unit	Dimension
TaskCpuUsage Note Available in Apache Airflow v2.10.1 and above.	cpu.usage.{dag_id}. {task_id}	Percent	DAG, {dag_id} Task, {task_id}
TaskMemor yUsage Note Available in Apache Airflow v2.10.1 and above.	mem.usage.{dag_id}. {task_id}	Percent	DAG, {dag_id} Task, {task_id}

Apache Airflow Timers

The Apache Airflow metrics in this section contain data about Apache Airflow Timers.

CloudWatch metric	Apache Airflow metric	Unit	Dimension
CollectDBDags	collect_db_dags	Milliseconds	Function, DAG Processing
CriticalS ectionDuration	scheduler .critical_section_ duration	Milliseconds	Function, Scheduler
CriticalS ectionQue ryDuration Note Available for Apache Airflow v2.5.1 and above.	scheduler .critical_section_ query_duration	Milliseconds	Function, Scheduler
DAGDepend encyCheck	dagrun.de pendency-check. {dag_id}	Milliseconds	DAG, {dag_id}
DAGDurati onFailed	dagrun.du ration.failed. {dag_id}	Milliseconds	DAG, {dag_id}
DAGDurati onSuccess	dagrun.du ration.success. {dag_id}	Milliseconds	DAG, {dag_id}

CloudWatch metric	Apache Airflow metric	Unit	Dimension
DAGFilePr ocessingL astDuration	dag_proce ssing.las t_duration. {dag_filename}	Seconds	DAG Filename, {dag_filename}
DAGSchedu leDelay	dagrun.sc hedule_delay. {dag_id}	Milliseconds	DAG, {dag_id}
FirstTask SchedulingDelay	dagrun.{d ag_id}.fi rst_task_ schedulin g_delay	Milliseconds	DAG, {dag_id}
Scheduler LoopDuration Note Available for Apache Airflow v2.5.1 and above.	scheduler .schedule r_loop_duration	Milliseconds	Function, Scheduler
TaskInsta nceDuration	dag.{dag_id}. {task_id}.dura tion	Milliseconds	DAG, {dag_id} Task, {task_id}

CloudWatch metric	Apache Airflow metric	Unit	Dimension
TaskInsta nceQueued Duration	dag.{dag_id}.{ta .queued_d uration (i) Note Available for Apache Airflow v2.7.2 and above.	Milliseconds	DAG, {dag_id} Task, {task_id}
TaskInsta nceSchedu ledDuration Note Available for Apache Airflow v2.7.2 and above.	<pre>dag.{dag_id}.{ta .schedule d_duration</pre>	Milliseconds	DAG, {dag_id} Task, {task_id}

Choosing which metrics are reported

You can choose which Apache Airflow metrics are emitted to CloudWatch, or blocked by Apache Airflow, using the following Amazon MWAA <u>configuration options</u>:

- metrics.metrics_allow_list A list of comma-separated prefixes you can use to select which metrics are emitted to CloudWatch by your environment. Use this option if you want Apache Airflow to not send all available metrics and instead select a subset of elements. For example, scheduler, executor, dagrun.
- metrics.metrics_block_list A list of comma-separated prefixes to filter out metrics that start with the elements of the list. For example, scheduler, executor, dagrun.

If you configure both metrics.metrics_allow_list and metrics.metrics_block_list, Apache Airflow ignores metrics.metrics_block_list. If you configure metrics.metrics_block_list but not metrics.metrics_allow_list, Apache Airflow filters out the elements you specify in metrics.metrics_block_list.

🚯 Note

The metrics.metrics_allow_list and metrics.metrics_block_list configuration options only apply to Apache Airflow v2.6.3 and above. For previous version of Apache Airflow use metrics.statsd_allow_list and metrics.statsd_block_list instead.

What's next?

• Explore the Amazon MWAA API operation used to publish environment health metrics at PublishMetrics.

Container, queue, and database metrics for Amazon MWAA

In addition to Apache Airflow metrics, you can monitor the underlying components of your Amazon Managed Workflows for Apache Airflow environments using CloudWatch, which collects raw data and processes data into readable, near real-time metrics. With these environment metrics, you will have greater visibility into key performance indicators to help you appropriately size your environments and debug issues with your workflows. These metrics apply to all supported Apache Airflow versions on Amazon MWAA.

Amazon MWAA will provide CPU and memory utilization for each Amazon Elastic Container Service (Amazon ECS) container and Amazon Aurora PostgreSQL instance, and Amazon Simple Queue

Service (Amazon SQS) metrics for the number of messages and the age of the oldest message, Amazon Relational Database Service (Amazon RDS) metrics for database connections, disk queue depth, write operations, latency, and throughput, and Amazon RDS Proxy metrics. These metrics also include the number of base workers, additional workers, schedulers, and web servers.

These statistics are kept for 15 months, so that you can access historical information and gain a better perspective on why a schedule is failing, and troubleshoot underlying issues. You can also set alarms that watch for certain thresholds, and send notifications or take actions when those thresholds are met. For more information, refer to the <u>Amazon CloudWatch User Guide</u>.

Topics

- Terms
- Dimensions
- Accessing metrics in the CloudWatch console
- List of metrics

Terms

Namespace

A namespace is a container for the CloudWatch metrics of an AWS service. For Amazon MWAA, the namespace is AWS/MWAA.

CloudWatch metrics

A CloudWatch metric represents a time-ordered set of data points that are specific to CloudWatch.

Dimension

A dimension is a name/value pair that is part of the identity of a metric.

Unit

A statistic has a unit of measure. For Amazon MWAA, units include Count.

Dimensions

This section describes the CloudWatch dimensions grouping for Amazon MWAA metrics in CloudWatch.

Dimension	Description
Cluster	Metrics for the minimum three Amazon ECS container that an Amazon MWAA environme nt uses to run Apache Airflow components: scheduler, worker, and web server.
Queue	Metrics for the Amazon SQS queues that decouple the scheduler from workers. When workers read the messages, they are considere d in-flight and not available for other workers. Messages become available for other workers to read if they are not deleted before the 12 hours visibility timeout.
Database	Metrics the Aurora clusters used by Amazon MWAA. This includes metrics for the primary database instance and a read replica to support the read operations. Amazon MWAA publishes database metrics for both READER and WRITER instances.

Accessing metrics in the CloudWatch console

This section describes how to access your Amazon MWAA metrics in CloudWatch.

To view performance metrics for a dimension

- 1. Open the Metrics page on the CloudWatch console.
- 2. Use the AWS Region selector to select your region.
- 3. Choose the **AWS/MWAA** namespace.
- 4. In the **All metrics** tab, choose a dimension. For example, **Cluster**.
- 5. Choose a CloudWatch metric for a dimension. For example, *NumSchedulers* or *CPUUtilization*. Then, choose **Graph all search results**.
- 6. Choose the **Graphed metrics** tab to view performance metrics.

List of metrics

The following tables list the cluster, queue, and database service metrics for Amazon MWAA. To view descriptions for metrics directly emitted from Amazon ECS, Amazon SQS, or Amazon RDS, choose the respective documentation link.

Topics

- <u>Cluster metrics</u>
- Database metrics
- Queue metrics
- <u>Application Load Balancer metrics</u>

Cluster metrics

The following metrics apply to each scheduler, base worker, additional worker, and web server. For more information and descriptions of each cluster metric, refer to <u>Available metrics and</u> <u>dimensions</u> in the *Amazon ECS Developer Guide*.

Namespace	Metric	Unit
AWS/MWAA	CPUUtilization	Percent
AWS/MWAA	MemoryUtilization	Percent

Evaluating the number of additional worker and web server containers

You can use the component metrics provided under the **Cluster** dimension, as described in the following procedure, to assess how many additional workers, or web servers, an environment is using at a given point in time. You can do this by graphing either the **CPUUtilization** or the **MemoryUtilization** metric and setting the statistic type to **Sample Count**. The resulting value is the total number of RUNNING tasks for the AdditionalWorker component. Understanding the number of additional worker instances utilized by your environment can help you gauge how your environment scales and allow you to optimize the number of additional workers.

Workers

To evaluate the number of additional workers using the AWS Management Console

- 1. Choose the **AWS/MWAA** namespace.
- 2. In the All metrics tab, choose the Cluster dimension.
- 3. Under the **Cluster** dimension, for the **AdditionalWorker**, choose either the **CPUUtilization** or the **MemoryUtilization** metric.
- 4. On the **Graphed metrics** tab, set **Period** to **1 Minute** and **Statistic** to **Sample Count**.

Web servers

To evaluate the number of additional web servers using the AWS Management Console

- 1. Choose the **AWS/MWAA** namespace.
- 2. In the **All metrics** tab, choose the **Cluster** dimension.
- 3. Under the **Cluster** dimension, for the **AdditionalWebservers**, choose either the **CPUUtilization** or the **MemoryUtilization** metric.
- 4. On the **Graphed metrics** tab, set **Period** to **1 Minute** and **Statistic** to **Sample Count**.

For more information, refer to <u>Service RUNNING task count</u> in the *Amazon Elastic Container Service Developer Guide*.

Database metrics

The following metrics apply to each database instance associated with the Amazon MWAA environment.

Namespace	Metric	Unit
AWS/MWAA	CPUUtilization	Percent
AWS/MWAA	DatabaseConnections	Count
AWS/MWAA	DiskQueueDepth	Count
AWS/MWAA	FreeableMemory	Bytes

Namespace	Metric	Unit
AWS/MWAA	VolumeWriteIOPS	Count per five minutes
AWS/MWAA	WriteIOPS	Count per second
AWS/MWAA	WriteLatency	Seconds
AWS/MWAA	WriteThroughput	Bytes per second

Queue metrics

For more information on units and descriptions for the following queue metrics, refer to <u>Available</u> <u>CloudWatch metrics for Amazon SQS</u> in the *Amazon Simple Queue Service Developer Guide*.

Namespace	Metric	Unit
AWS/MWAA	ApproximateAgeOfOl destTask	Seconds
AWS/MWAA	RunningTasks	Count
AWS/MWAA	QueuedTasks	Count

Application Load Balancer metrics

Application Load Balancer metrics apply to the web servers running in your environment. Amazon MWAA uses these metrics to for scaling your web servers based on the amount of traffic. For more information on units and descriptions for the following load balancer metrics, refer to <u>CloudWatch</u> <u>metrics for your Application Load Balancer</u> in the *Application Load Balancers User Guide*.

Namespace	Metric	Unit
AWS/MWAA	ActiveConnectionCount	Count

Security in Amazon Managed Workflows for Apache Airflow

Cloud security at AWS is the highest priority. As an AWS customer, you benefit from a data center and network architecture that is built to meet the requirements of the most security-sensitive organizations.

Security is a shared responsibility between AWS and you (the customer). The <u>shared responsibility</u> <u>model</u> describes this as security *of* the cloud and security *in* the cloud:

- Security of the cloud AWS is responsible for protecting the infrastructure that runs AWS services in the AWS Cloud. AWS also provides you with services that you can use securely. Third-party auditors regularly test and verify the effectiveness of our security as part of the <u>AWS</u> <u>Compliance Programs</u>. To learn about the compliance programs that apply to Amazon MWAA, refer to <u>AWS Services in Scope by Compliance Program</u>.
- Security in the cloud Your responsibility is determined by the AWS service that you use. You are also responsible for other factors including the sensitivity of your data, your company's requirements, and applicable laws and regulations.

This documentation helps you understand how to apply the shared responsibility model when using Amazon Managed Workflows for Apache Airflow. It shows you how to configure Amazon MWAA to meet your security and compliance objectives. You also learn how to use other AWS services that help you to monitor and secure your Amazon MWAA resources.

In this section:

- Data Protection in Amazon Managed Workflows for Apache Airflow
- <u>AWS Identity and Access Management</u>
- <u>Compliance Validation for Amazon Managed Workflows for Apache Airflow</u>
- <u>Resilience in Amazon Managed Workflows for Apache Airflow</u>
- Infrastructure Security in Amazon MWAA
- Configuration and Vulnerability Analysis in Amazon MWAA
- Security best practices on Amazon MWAA

Data Protection in Amazon Managed Workflows for Apache Airflow

The AWS <u>shared responsibility model</u> applies to data protection in Amazon Managed Workflows for Apache Airflow. As described in this model, AWS is responsible for protecting the global infrastructure that runs all of the AWS Cloud. You are responsible for maintaining control over your content that is hosted on this infrastructure. This content includes the security configuration and management tasks for the AWS services that you use. For more information about data privacy, refer to the <u>Data Privacy FAQ</u>. For information about data protection in Europe, refer to the <u>AWS</u> <u>Shared Responsibility Model and GDPR</u> blog post on the *AWS Security Blog*.

For data protection purposes, we recommend that you protect AWS account credentials and set up individual user accounts with AWS Identity and Access Management (IAM). That way each user is given only the permissions necessary to fulfill their job duties. We also recommend that you secure your data in the following ways:

- Use multi-factor authentication (MFA) with each account.
- Use SSL/TLS to communicate with AWS resources. We recommend TLS 1.2 or later.
- Set up API and user activity logging with AWS CloudTrail.
- Use AWS encryption solutions, along with all default security controls within AWS services.
- Use advanced managed security services such as Amazon Macie, which assists in discovering and securing personal data that is stored in Amazon S3.

We strongly recommend that you never put confidential or sensitive information, such as your customers' email addresses, into tags or free-form fields such as a **Name** field. This includes when you work with Amazon MWAA or other AWS services using the console, API, AWS CLI, or AWS SDKs. Any data that you enter into tags or free-form fields used for names may be used for billing or diagnostic logs. If you provide a URL to an external server, we strongly recommend that you do not include credentials information in the URL to validate your request to that server.

Encryption on Amazon MWAA

The following topics describe how Amazon MWAA protects your data at rest, and in transit. Use this information to learn how Amazon MWAA integrates with AWS KMS to encrypt data at rest, and how data is encrypted using Transport Layer Security (TLS) protocol in transit.

Topics

- Encryption at rest
- Encryption in transit

Encryption at rest

On Amazon MWAA, data at rest is data that the service saves to persistent media.

You can use an <u>AWS owned key</u> for data at rest encryption, or optionally provide a <u>Customer</u> <u>managed key</u> for additional encryption when you create an environment. If you choose to use a customer managed KMS key, it must be in the same account as the other AWS resources and services you are using with your environment.

To use a customer managed KMS key, you must attach the required policy statement for CloudWatch access to your key policy. When you use a customer managed KMS key for your environment, Amazon MWAA attaches four <u>grants</u> on your behalf. For more information on the grants Amazon MWAA attaches to a customer managed KMS key, refer to <u>Customer managed keys</u> for data encryption.

If you do not specify a customer managed KMS key, by default, Amazon MWAA uses an AWS owned KMS key for to encrypt and decrypt your data. We recommend using an AWS owned KMS key to manage data encryption on Amazon MWAA.

🚺 Note

You pay for the storage and use of AWS owned, or customer managed KMS keys on Amazon MWAA. For more information, refer to <u>AWS KMS Pricing</u>.

Encryption artifacts

You specify the encryption artifacts used for at rest encryption by specifying an <u>AWS owned key</u> or <u>Customer managed key</u> when you create your Amazon MWAA environment. Amazon MWAA adds the grants needed to your specified key.

Amazon S3 – Amazon S3 data is encrypted at the object-level using Server-Side Encryption (SSE). Amazon S3 encryption and decryption takes place on the Amazon S3 bucket where your DAG code and supporting files are stored. Objects are encrypted when they are uploaded to Amazon S3 and decrypted when they are downloaded to your Amazon MWAA environment. By default, if you are using a customer managed KMS key, Amazon MWAA uses it to read and decrypt the data on your Amazon S3 bucket.

CloudWatch Logs – If you are using an AWS owned KMS key, Apache Airflow logs sent to CloudWatch Logs are encrypted using SSE with CloudWatch Logs's AWS owned KMS key. If you are using a customer managed KMS key, you must add a <u>key policy</u> to your KMS key to allow CloudWatch Logs to use your key.

Amazon SQS – Amazon MWAA creates one Amazon SQS queue for your environment. Amazon MWAA handles encrypting data passed to and from the queue using SSE with either an AWS owned KMS key, or a customer managed KMS key that you specify. You must add Amazon SQS permissions to your execution role regardless of whether you are using an AWS owned or customer managed KMS key.

Aurora PostgreSQL – Amazon MWAA creates one PostgreSQL cluster for your environment. Aurora PostgreSQL encrypts the content with either an AWS owned or customer managed KMS key using SSE. If you are using a customer managed KMS key, Amazon RDS adds at least two grants to the key: one for the cluster and one for the database instance. Amazon RDS might create additional grants if you choose to use your customer managed KMS key on multiple environments. For more information, refer to Data protection in Amazon RDS.

Encryption in transit

Data in transit is referred to as data that may be intercepted as it travels the network.

Transport Layer Security (TLS) encrypts the Amazon MWAA objects in transit between your environment's Apache Airflow components and other AWS services that integrate with Amazon MWAA. such as Amazon S3. For more information about Amazon S3 encryption, refer to <u>Protecting</u> data using encryption.

Using customer managed keys for encryption

You can optionally provide a <u>Customer managed key</u> for data encryption on your environment. You must create the customer managed KMS key in the same Region as your Amazon MWAA environment instance and your Amazon S3 bucket where you store resources for your workflows. If the customer managed KMS key that you specify is in a different account from the one you use to configure an environment, you must specify the key using its ARN for cross-account access. For more information about creating keys, refer to <u>Creating Keys</u> in the *AWS Key Management Service Developer Guide*.

What's supported

AWS KMS feature	Supported
An <u>AWS KMS key ID or ARN</u> .	Yes
An <u>AWS KMS key alias</u> .	No
An <u>AWS KMS multi-region</u> <u>key</u> .	No

Using Grants for Encryption

This topic describes the grants Amazon MWAA attaches to a customer managed KMS key on your behalf to encrypt and decrypt your data.

How it works

There are two resource-based access control mechanisms supported by AWS KMS for customer managed KMS key: a key policy and grant.

A key policy is used when the permission is mostly static and used in synchronous service mode. A grant is used when more dynamic and granular permissions are required, such as when a service needs to define different access permissions for itself or other accounts.

Amazon MWAA uses and attaches four grant policies to your customer managed KMS key. This is due to the granular permissions required for an environment to encrypt data at rest from CloudWatch Logs, Amazon SQS queue, Aurora PostgreSQL database database, Secrets Manager secrets, Amazon S3 bucket and DynamoDB tables.

When you create an Amazon MWAA environment and specify a customer managed KMS key, Amazon MWAA attaches the grant policies to your customer managed KMS key. These policies allow Amazon MWAA in airflow.us-east-1}.amazonaws.com to use your customer managed KMS key to encrypt resources on your behalf that are owned by Amazon MWAA.

Amazon MWAA creates, and attaches, additional grants to a specified KMS key on your behalf. This includes policies to retire a grant if you delete your environment, to use your customer managed KMS key for Client-Side Encryption (CSE), and for the AWS Fargate execution role that needs to access secrets protected by your customer managed key in Secrets Manager.

Grant policies

Amazon MWAA adds the following <u>resource based policy</u> grants on your behalf to a customer managed KMS key. These policies allow the grantee and the principal (Amazon MWAA) to perform actions defined in the policy.

Grant 1: used to create data plane resources

```
{
    "Name": "mwaa-grant-for-env-mgmt-role-environment name",
    "GranteePrincipal": "airflow.us-east-1.amazonaws.com",
    "RetiringPrincipal": "airflow.us-east-1.amazonaws.com",
    "Operations": [
        "kms:Encrypt",
        "kms:Decrypt",
        "kms:ReEncrypt*",
        "kms:GenerateDataKey*",
        "kms:CreateGrant",
        "kms:DescribeKey",
        "kms:RetireGrant"
    ]
}
```

Grant 2: used for ControllerLambdaExecutionRole access

```
{
    "Name": "mwaa-grant-for-lambda-exec-environment name",
    "GranteePrincipal": "airflow.us-east-1.amazonaws.com",
    "RetiringPrincipal": "airflow.us-east-1.amazonaws.com",
    "Operations": [
        "kms:Encrypt",
        "kms:Decrypt",
        "kms:ReEncrypt*",
        "kms:GenerateDataKey*",
        "kms:DescribeKey",
        "kms:RetireGrant"
    ]
}
```

```
{
    "Name": " mwaa-grant-for-cfn-mgmt-environment name",
    "GranteePrincipal": "airflow.us-east-1.amazonaws.com",
    "RetiringPrincipal": "airflow.us-east-1.amazonaws.com",
    "Operations": [
        "kms:Encrypt",
        "kms:Decrypt",
        "kms:ReEncrypt*",
        "kms:GenerateDataKey*",
        "kms:DescribeKey"
    ]
}
```

Grant 4: used for Fargate execution role to access backend secrets

```
{
    "Name": "mwaa-fargate-access-for-environment name",
    "GranteePrincipal": "airflow.us-east-1.amazonaws.com",
    "RetiringPrincipal": "airflow.us-east-1.amazonaws.com",
    "Operations": [
        "kms:Encrypt",
        "kms:Decrypt",
        "kms:ReEncrypt*",
        "kms:GenerateDataKey*",
        "kms:DescribeKey",
        "kms:RetireGrant"
    ]
}
```

Attaching key policies to a customer managed key

If you choose to use your own customer managed KMS key with Amazon MWAA, you must attach the following policy to the key to allow Amazon MWAA to use it to encrypt your data.

If the customer managed KMS key you used for your Amazon MWAA environment is not already configured to work with CloudWatch, you must update the <u>key policy</u> to allow for encrypted CloudWatch Logs. For more information, refer to the <u>Encrypt log data in CloudWatch using AWS</u> Key Management Service service.

The following example represents a key policy for CloudWatch Logs. Substitute the sample values provided for the region.

```
{
          "Effect": "Allow",
          "Principal": {
          "Service": "logs.us-east-1.amazonaws.com"
        },
        "Action": [
          "kms:Encrypt*",
          "kms:Decrypt*",
          "kms:ReEncrypt*",
          "kms:GenerateDataKey*",
          "kms:Describe*"
        ],
        "Resource": "*",
        "Condition": {
          "ArnLike": {
            "kms:EncryptionContext:aws:logs:arn": "arn:aws:logs:us-east-1:*:*"
            }
          }
        }
```

AWS Identity and Access Management

AWS Identity and Access Management (IAM) is an AWS service that helps an administrator securely control access to AWS resources. IAM administrators control who can be authenticated (signed in) and authorized (have permissions) to use Amazon Managed Workflows for Apache Airflow resources. IAM is an AWS service that you can use with no additional charge.

This topic provides a basic overview of how Amazon MWAA uses AWS Identity and Access Management (IAM). To learn about managing access to Amazon MWAA, refer to <u>Managing access</u> to an Amazon MWAA environment.

Contents

- <u>Audience</u>
- Authenticating With Identities
- Managing Access Using Policies
- Allowing users to view their own permissions

- Troubleshooting Amazon Managed Workflows for Apache Airflow identity and access
- How Amazon MWAA works with IAM

Audience

How you use AWS Identity and Access Management (IAM) differs, depending on the work that you do in Amazon MWAA.

Service user – If you use the Amazon MWAA service to do your job, then your administrator provides you with the credentials and permissions that you need. As you use more Amazon MWAA features to do your work, you might need additional permissions. Understanding how access is managed can help you request the right permissions from your administrator. If you cannot access a feature in Amazon MWAA, see <u>Troubleshooting Amazon Managed Workflows for Apache Airflow</u> identity and access.

Service administrator – If you're in charge of Amazon MWAA resources at your company, you probably have full access to Amazon MWAA. It's your job to determine which Amazon MWAA features and resources your service users should access. You must then submit requests to your IAM administrator to change the permissions of your service users. Review the information on this page to understand the basic concepts of IAM. To learn more about how your company can use IAM with Amazon MWAA, see How Amazon MWAA works with IAM.

IAM administrator – If you're an IAM administrator, you might want to learn details about how you can write policies to manage access to Amazon MWAA. To view example Amazon MWAA identity-based policies that you can use in IAM, see <u>Amazon MWAA identity-based policy examples</u>.

Authenticating With Identities

Authentication is how you sign in to AWS using your identity credentials. You must be *authenticated* (signed in to AWS) as the AWS account root user, as an IAM user, or by assuming an IAM role.

You can sign in to AWS as a federated identity by using credentials provided through an identity source. AWS IAM Identity Center (IAM Identity Center) users, your company's single sign-on authentication, and your Google or Facebook credentials are examples of federated identities. When you sign in as a federated identity, your administrator previously set up identity federation using IAM roles. When you access AWS by using federation, you are indirectly assuming a role.

User Guide

Depending on the type of user you are, you can sign in to the AWS Management Console or the AWS access portal. For more information about signing in to AWS, see <u>How to sign in to your AWS</u> account in the AWS Sign-In User Guide.

If you access AWS programmatically, AWS provides a software development kit (SDK) and a command line interface (CLI) to cryptographically sign your requests by using your credentials. If you don't use AWS tools, you must sign requests yourself. For more information about using the recommended method to sign requests yourself, see <u>AWS Signature Version 4 for API requests</u> in the *IAM User Guide*.

Regardless of the authentication method that you use, you might be required to provide additional security information. For example, AWS recommends that you use multi-factor authentication (MFA) to increase the security of your account. To learn more, see <u>Multi-factor authentication</u> in the AWS IAM Identity Center User Guide and <u>AWS Multi-factor authentication in IAM</u> in the IAM User Guide.

AWS account root user

When you create an AWS account, you begin with one sign-in identity that has complete access to all AWS services and resources in the account. This identity is called the AWS account *root user* and is accessed by signing in with the email address and password that you used to create the account. We strongly recommend that you don't use the root user for your everyday tasks. Safeguard your root user credentials and use them to perform the tasks that only the root user can perform. For the complete list of tasks that require you to sign in as the root user, see <u>Tasks that require root</u> <u>user credentials</u> in the *IAM User Guide*.

IAM Users and Groups

An <u>IAM user</u> is an identity within your AWS account that has specific permissions for a single person or application. Where possible, we recommend relying on temporary credentials instead of creating IAM users who have long-term credentials such as passwords and access keys. However, if you have specific use cases that require long-term credentials with IAM users, we recommend that you rotate access keys. For more information, see <u>Rotate access keys regularly for use cases that require long-</u> <u>term credentials</u> in the *IAM User Guide*.

An <u>IAM group</u> is an identity that specifies a collection of IAM users. You can't sign in as a group. You can use groups to specify permissions for multiple users at a time. Groups make permissions easier to manage for large sets of users. For example, you could have a group named *IAMAdmins* and give that group permissions to administer IAM resources.

Users are different from roles. A user is uniquely associated with one person or application, but a role is intended to be assumable by anyone who needs it. Users have permanent long-term credentials, but roles provide temporary credentials. To learn more, see <u>Use cases for IAM users</u> in the *IAM User Guide*.

IAM Roles

An <u>IAM role</u> is an identity within your AWS account that has specific permissions. It is similar to an IAM user, but is not associated with a specific person. To temporarily assume an IAM role in the AWS Management Console, you can <u>switch from a user to an IAM role (console)</u>. You can assume a role by calling an AWS CLI or AWS API operation or by using a custom URL. For more information about methods for using roles, see <u>Methods to assume a role</u> in the *IAM User Guide*.

IAM roles with temporary credentials are useful in the following situations:

- Federated user access To assign permissions to a federated identity, you create a role and define permissions for the role. When a federated identity authenticates, the identity is associated with the role and is granted the permissions that are defined by the role. For information about roles for federation, see <u>Create a role for a third-party identity provider</u> (federation) in the *IAM User Guide*. If you use IAM Identity Center, you configure a permission set. To control what your identities can access after they authenticate, IAM Identity Center correlates the permission set to a role in IAM. For information about permissions sets, see <u>Permission sets</u> in the *AWS IAM Identity Center User Guide*.
- **Temporary IAM user permissions** An IAM user or role can assume an IAM role to temporarily take on different permissions for a specific task.
- Cross-account access You can use an IAM role to allow someone (a trusted principal) in a different account to access resources in your account. Roles are the primary way to grant crossaccount access. However, with some AWS services, you can attach a policy directly to a resource (instead of using a role as a proxy). To learn the difference between roles and resource-based policies for cross-account access, see Cross account resource access in IAM in the IAM User Guide.
- **Cross-service access** Some AWS services use features in other AWS services. For example, when you make a call in a service, it's common for that service to run applications in Amazon EC2 or store objects in Amazon S3. A service might do this using the calling principal's permissions, using a service role, or using a service-linked role.
 - Forward access sessions (FAS) When you use an IAM user or role to perform actions in AWS, you are considered a principal. When you use some services, you might perform an action that then initiates another action in a different service. FAS uses the permissions of the

principal calling an AWS service, combined with the requesting AWS service to make requests to downstream services. FAS requests are only made when a service receives a request that requires interactions with other AWS services or resources to complete. In this case, you must have permissions to perform both actions. For policy details when making FAS requests, see Forward access sessions.

- Service role A service role is an <u>IAM role</u> that a service assumes to perform actions on your behalf. An IAM administrator can create, modify, and delete a service role from within IAM. For more information, see <u>Create a role to delegate permissions to an AWS service</u> in the *IAM User Guide*.
- Service-linked role A service-linked role is a type of service role that is linked to an AWS service. The service can assume the role to perform an action on your behalf. Service-linked roles appear in your AWS account and are owned by the service. An IAM administrator can view, but not edit the permissions for service-linked roles.
- Applications running on Amazon EC2 You can use an IAM role to manage temporary credentials for applications that are running on an EC2 instance and making AWS CLI or AWS API requests. This is preferable to storing access keys within the EC2 instance. To assign an AWS role to an EC2 instance and make it available to all of its applications, you create an instance profile that is attached to the instance. An instance profile contains the role and enables programs that are running on the EC2 instance to get temporary credentials. For more information, see <u>Use an IAM role to grant permissions to applications running on Amazon EC2 instances</u> in the *IAM User Guide*.

Managing Access Using Policies

You control access in AWS by creating policies and attaching them to AWS identities or resources. A policy is an object in AWS that, when associated with an identity or resource, defines their permissions. AWS evaluates these policies when a principal (user, root user, or role session) makes a request. Permissions in the policies determine whether the request is allowed or denied. Most policies are stored in AWS as JSON documents. For more information about the structure and contents of JSON policy documents, see <u>Overview of JSON policies</u> in the *IAM User Guide*.

Administrators can use AWS JSON policies to specify who has access to what. That is, which **principal** can perform **actions** on what **resources**, and under what **conditions**.

By default, users and roles have no permissions. To grant users permission to perform actions on the resources that they need, an IAM administrator can create IAM policies. The administrator can then add the IAM policies to roles, and users can assume the roles.

IAM policies define permissions for an action regardless of the method that you use to perform the operation. For example, suppose that you have a policy that allows the iam:GetRole action. A user with that policy can get role information from the AWS Management Console, the AWS CLI, or the AWS API.

Identity-Based Policies

Identity-based policies are JSON permissions policy documents that you can attach to an identity, such as an IAM user, group of users, or role. These policies control what actions users and roles can perform, on which resources, and under what conditions. To learn how to create an identity-based policy, see <u>Define custom IAM permissions with customer managed policies</u> in the *IAM User Guide*.

Identity-based policies can be further categorized as *inline policies* or *managed policies*. Inline policies are embedded directly into a single user, group, or role. Managed policies are standalone policies that you can attach to multiple users, groups, and roles in your AWS account. Managed policies include AWS managed policies and customer managed policies. To learn how to choose between a managed policy or an inline policy, see <u>Choose between managed policies and inline policies</u> in the *IAM User Guide*.

Resource-Based Policies

Resource-based policies are JSON policy documents that you attach to a resource. Examples of resource-based policies are IAM *role trust policies* and Amazon S3 *bucket policies*. In services that support resource-based policies, service administrators can use them to control access to a specific resource. For the resource where the policy is attached, the policy defines what actions a specified principal can perform on that resource and under what conditions. You must <u>specify a principal</u> in a resource-based policy. Principals can include accounts, users, roles, federated users, or AWS services.

Resource-based policies are inline policies that are located in that service. You can't use AWS managed policies from IAM in a resource-based policy.

Access Control Lists (ACLs)

Access control lists (ACLs) control which principals (account members, users, or roles) have permissions to access a resource. ACLs are similar to resource-based policies, although they do not use the JSON policy document format. Amazon S3, AWS WAF, and Amazon VPC are examples of services that support ACLs. To learn more about ACLs, see <u>Access control list (ACL) overview</u> in the *Amazon Simple Storage Service Developer Guide*.

Other Policy Types

AWS supports additional, less-common policy types. These policy types can set the maximum permissions granted to you by the more common policy types.

- Permissions boundaries A permissions boundary is an advanced feature in which you set the maximum permissions that an identity-based policy can grant to an IAM entity (IAM user or role). You can set a permissions boundary for an entity. The resulting permissions are the intersection of an entity's identity-based policies and its permissions boundaries. Resource-based policies that specify the user or role in the Principal field are not limited by the permissions boundary. An explicit deny in any of these policies overrides the allow. For more information about permissions boundaries, see <u>Permissions boundaries for IAM entities</u> in the *IAM User Guide*.
- Service control policies (SCPs) SCPs are JSON policies that specify the maximum permissions for an organization or organizational unit (OU) in AWS Organizations. AWS Organizations is a service for grouping and centrally managing multiple AWS accounts that your business owns. If you enable all features in an organization, then you can apply service control policies (SCPs) to any or all of your accounts. The SCP limits permissions for entities in member accounts, including each AWS account root user. For more information about Organizations and SCPs, see <u>Service</u> <u>control policies</u> in the AWS Organizations User Guide.
- Resource control policies (RCPs) RCPs are JSON policies that you can use to set the maximum available permissions for resources in your accounts without updating the IAM policies attached to each resource that you own. The RCP limits permissions for resources in member accounts and can impact the effective permissions for identities, including the AWS account root user, regardless of whether they belong to your organization. For more information about Organizations and RCPs, including a list of AWS services that support RCPs, see <u>Resource control policies (RCPs)</u> in the AWS Organizations User Guide.
- Session policies Session policies are advanced policies that you pass as a parameter when you
 programmatically create a temporary session for a role or federated user. The resulting session's
 permissions are the intersection of the user or role's identity-based policies and the session
 policies. Permissions can also come from a resource-based policy. An explicit deny in any of these
 policies overrides the allow. For more information, see <u>Session policies</u> in the *IAM User Guide*.

Multiple Policy Types

When multiple types of policies apply to a request, the resulting permissions are more complicated to understand. To learn how AWS determines whether to allow a request when multiple policy types are involved, see Policy evaluation logic in the *IAM User Guide*.

Allowing users to view their own permissions

This example shows how you might create a policy that allows IAM users to view the inline and managed policies that are attached to their user identity. This policy includes permissions to complete this action on the console or programmatically using the AWS CLI or AWS API.

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "ViewOwnUserInfo",
            "Effect": "Allow",
            "Action": [
                "iam:GetUserPolicy",
                "iam:ListGroupsForUser",
                "iam:ListAttachedUserPolicies",
                "iam:ListUserPolicies",
                "iam:GetUser"
            ],
            "Resource": ["arn:aws:iam::*:user/${aws:username}"]
        },
        {
            "Sid": "NavigateInConsole",
            "Effect": "Allow",
            "Action": [
                "iam:GetGroupPolicy",
                "iam:GetPolicyVersion",
                "iam:GetPolicy",
                "iam:ListAttachedGroupPolicies",
                "iam:ListGroupPolicies",
                "iam:ListPolicyVersions",
                "iam:ListPolicies",
                "iam:ListUsers"
            ],
            "Resource": "*"
        }
```

]

Troubleshooting Amazon Managed Workflows for Apache Airflow identity and access

Use the following information to help you diagnose and fix common issues that you might encounter when working with Amazon MWAA and IAM.

I am not authorized to perform an action in Amazon MWAA

If the AWS Management Console tells you that you're not authorized to perform an action, then you must contact your administrator for assistance. Your administrator is the person that provided you with your user name and password.

I am not authorized to perform iam:PassRole

If you receive an error that you're not authorized to perform the iam: PassRole action, your policies must be updated to allow you to pass a role to Amazon MWAA.

Some AWS services allow you to pass an existing role to that service instead of creating a new service role or service-linked role. To do this, you must have permissions to pass the role to the service.

The following example error occurs when an IAM user named marymajor tries to use the console to perform an action in Amazon MWAA. However, the action requires the service to have permissions that are granted by a service role. Mary does not have permissions to pass the role to the service.

```
User: arn:aws:iam::123456789012:user/marymajor is not authorized to perform: iam:PassRole
```

In this case, Mary's policies must be updated to allow her to perform the iam: PassRole action.

If you need help, contact your AWS administrator. Your administrator is the person who provided you with your sign-in credentials.

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I want to allow people outside of my AWS account to access my Amazon MWAA resources

You can create a role that users in other accounts or people outside of your organization can use to access your resources. You can specify who is trusted to assume the role. For services that support resource-based policies or access control lists (ACLs), you can use those policies to grant people access to your resources.

To learn more, consult the following:

- To learn whether Amazon MWAA supports these features, see <u>How Amazon MWAA works with</u> <u>IAM</u>.
- To learn how to provide access to your resources across AWS accounts that you own, see Providing access to an IAM user in another AWS account that you own in the IAM User Guide.
- To learn how to provide access to your resources to third-party AWS accounts, see <u>Providing</u> access to AWS accounts owned by third parties in the *IAM User Guide*.
- To learn how to provide access through identity federation, see <u>Providing access to externally</u> <u>authenticated users (identity federation)</u> in the *IAM User Guide*.
- To learn the difference between using roles and resource-based policies for cross-account access, see <u>Cross account resource access in IAM</u> in the *IAM User Guide*.

How Amazon MWAA works with IAM

Amazon MWAA uses IAM identity-based policies to grant permissions to Amazon MWAA actions and resources. For recommended examples of custom IAM policies you can use to control access to your Amazon MWAA resources, refer to <u>the section called "Accessing an Amazon MWAA</u> <u>environment"</u>.

To get a high-level view of how Amazon MWAA and other AWS services work with IAM, refer to AWS Services That Work with IAM in the IAM User Guide.

Amazon MWAA identity-based policies

With IAM identity-based policies, you can specify allowed or denied actions and resources, as well as the conditions under which actions are allowed or denied. Amazon MWAA supports specific actions, resources, and condition keys. The following steps show how you can create a new JSON policy using the IAM console. This policy provides read-only access to your Amazon MWAA resources.

To use the JSON policy editor to create a policy

- 1. Sign in to the AWS Management Console and open the IAM console at https://console.aws.amazon.com/iam/.
- 2. In the navigation pane on the left, choose **Policies**.

If this is your first time choosing **Policies**, the **Welcome to Managed Policies** page appears. Choose **Get Started**.

- 3. At the top of the page, choose **Create policy**.
- 4. In the **Policy editor** section, choose the **JSON** option.
- 5. Enter the following JSON policy document:

```
{
    "Version": "2012-10-17",
    "Statement": [
    {
        "Effect": "Allow",
        "Action": [
            "airflow:ListEnvironments",
            "airflow:GetEnvironment",
            "airflow:ListTagsForResource"
        ],
        "Resource": "*"
    }
]
```

6. Choose Next.

i Note

You can switch between the **Visual** and **JSON** editor options anytime. However, if you make changes or choose **Next** in the **Visual** editor, IAM might restructure your policy to optimize it for the visual editor. For more information, see <u>Policy restructuring</u> in the *IAM User Guide*.

- 7. On the **Review and create** page, enter a **Policy name** and a **Description** (optional) for the policy that you are creating. Review **Permissions defined in this policy** to see the permissions that are granted by your policy.
- 8. Choose **Create policy** to save your new policy.

To learn about all of the elements that you use in a JSON policy, refer to <u>IAM JSON Policy Elements</u> <u>Reference</u> in the *IAM User Guide*.

Actions

Administrators can use AWS JSON policies to specify who has access to what. That is, which **principal** can perform **actions** on what **resources**, and under what **conditions**.

The Action element of a JSON policy describes the actions that you can use to allow or deny access in a policy. Policy actions usually have the same name as the associated AWS API operation. There are some exceptions, such as *permission-only actions* that don't have a matching API operation. There are also some operations that require multiple actions in a policy. These additional actions are called *dependent actions*.

Include actions in a policy to grant permissions to perform the associated operation.

Policy statements must include either an Action element or a NotAction element. The Action element lists the actions allowed by the policy. The NotAction element lists the actions that are not allowed.

The actions defined for Amazon MWAA reflect tasks that you can perform using Amazon MWAA. Policy actions in Detective have the following prefix: airflow:.

You can also use wildcards (*) to specify multiple actions. Instead of listing these actions separately, you can grant access to all actions that end with the word, for example, environment.

To get a list of Amazon MWAA actions, refer to <u>Actions Defined by Amazon Managed Workflows for</u> <u>Apache Airflow</u> in the *IAM User Guide*.

Amazon MWAA identity-based policy examples

To view the Amazon MWAA policies, refer to Managing access to an Amazon MWAA environment.

By default, IAM users and roles don't have permission to create or modify Amazon MWAA resources. They also can't perform tasks using the AWS Management Console, AWS CLI, or AWS API.

An IAM administrator must create IAM policies that grant users and roles permission to perform specific API operations on the specified resources they need. The administrator then attaches those policies to the IAM users or groups that require those permissions.

<u> Important</u>

We recommend using IAM roles and temporary credentials to provide access to your Amazon MWAA resources. Avoiding attaching permission poicies directly to your IAM users.

To learn how to create an IAM identity-based policy using these example JSON policy documents, refer to <u>Creating Policies on the JSON Tab</u> in the *IAM User Guide*.

Topics

- Policy best practices
- Using the Amazon MWAA console
- Allowing users to view their own permissions

Policy best practices

Identity-based policies determine whether someone can create, access, or delete Amazon MWAA resources in your account. These actions can incur costs for your AWS account. When you create or edit identity-based policies, follow these guidelines and recommendations:

- Get started with AWS managed policies and move toward least-privilege permissions To get started granting permissions to your users and workloads, use the AWS managed policies that grant permissions for many common use cases. They are available in your AWS account. We recommend that you reduce permissions further by defining AWS customer managed policies that are specific to your use cases. For more information, see <u>AWS managed policies</u> or <u>AWS</u> managed policies for job functions in the *IAM User Guide*.
- **Apply least-privilege permissions** When you set permissions with IAM policies, grant only the permissions required to perform a task. You do this by defining the actions that can be taken on specific resources under specific conditions, also known as *least-privilege permissions*. For more information about using IAM to apply permissions, see <u>Policies and permissions in IAM</u> in the *IAM User Guide*.
- Use conditions in IAM policies to further restrict access You can add a condition to your policies to limit access to actions and resources. For example, you can write a policy condition to

specify that all requests must be sent using SSL. You can also use conditions to grant access to service actions if they are used through a specific AWS service, such as AWS CloudFormation. For more information, see IAM JSON policy elements: Condition in the *IAM User Guide*.

- Use IAM Access Analyzer to validate your IAM policies to ensure secure and functional permissions – IAM Access Analyzer validates new and existing policies so that the policies adhere to the IAM policy language (JSON) and IAM best practices. IAM Access Analyzer provides more than 100 policy checks and actionable recommendations to help you author secure and functional policies. For more information, see <u>Validate policies with IAM Access Analyzer</u> in the *IAM User Guide*.
- Require multi-factor authentication (MFA) If you have a scenario that requires IAM users or a root user in your AWS account, turn on MFA for additional security. To require MFA when API operations are called, add MFA conditions to your policies. For more information, see <u>Secure API</u> access with MFA in the IAM User Guide.

For more information about best practices in IAM, see <u>Security best practices in IAM</u> in the *IAM User Guide*.

Using the Amazon MWAA console

To use the Amazon MWAA console, the user or role must have access to the relevant actions, which match corresponding actions in the API.

To view the Amazon MWAA policies, refer to Managing access to an Amazon MWAA environment.

Allowing users to view their own permissions

This example shows how you might create a policy that allows IAM users to view the inline and managed policies that are attached to their user identity. This policy includes permissions to complete this action on the console or programmatically using the AWS CLI or AWS API.

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "ViewOwnUserInfo",
            "Effect": "Allow",
            "Action": [
            "iam:GetUserPolicy",
            "iam:ListGroupsForUser",
            "iam:ListGroupsForUser",
            "iam:ListGroupsForUser",
            "iam:ListGroupsForUser",
            "iam:ListGroupsForUser",
            "iam:ListGroupsForUser",
            "Statement": "Statement: "Statement": "Statement": "Statement": "Statement": "Statement: "Statement": "Statement: "Statement": "Statement: "Statement": "Statement: "S
```

```
"iam:ListAttachedUserPolicies",
                "iam:ListUserPolicies",
                "iam:GetUser"
            ],
            "Resource": ["arn:aws:iam::*:user/${aws:username}"]
        },
        {
            "Sid": "NavigateInConsole",
            "Effect": "Allow",
            "Action": [
                "iam:GetGroupPolicy",
                "iam:GetPolicyVersion",
                "iam:GetPolicy",
                "iam:ListAttachedGroupPolicies",
                "iam:ListGroupPolicies",
                "iam:ListPolicyVersions",
                "iam:ListPolicies",
                "iam:ListUsers"
            ],
            "Resource": "*"
        }
    ]
}
```

Compliance Validation for Amazon Managed Workflows for Apache Airflow

To learn whether an AWS service is within the scope of specific compliance programs, see <u>AWS</u> <u>services in Scope by Compliance Program</u> and choose the compliance program that you are interested in. For general information, see <u>AWS Compliance Programs</u>.

You can download third-party audit reports using AWS Artifact. For more information, see <u>Downloading Reports in AWS Artifact</u>.

Your compliance responsibility when using AWS services is determined by the sensitivity of your data, your company's compliance objectives, and applicable laws and regulations. AWS provides the following resources to help with compliance:

 <u>Security Compliance & Governance</u> – These solution implementation guides discuss architectural considerations and provide steps for deploying security and compliance features.

- <u>HIPAA Eligible Services Reference</u> Lists HIPAA eligible services. Not all AWS services are HIPAA eligible.
- <u>AWS Compliance Resources</u> This collection of workbooks and guides might apply to your industry and location.
- <u>AWS Customer Compliance Guides</u> Understand the shared responsibility model through the lens of compliance. The guides summarize the best practices for securing AWS services and map the guidance to security controls across multiple frameworks (including National Institute of Standards and Technology (NIST), Payment Card Industry Security Standards Council (PCI), and International Organization for Standardization (ISO)).
- <u>Evaluating Resources with Rules</u> in the *AWS Config Developer Guide* The AWS Config service assesses how well your resource configurations comply with internal practices, industry guidelines, and regulations.
- <u>AWS Security Hub</u> This AWS service provides a comprehensive view of your security state within AWS. Security Hub uses security controls to evaluate your AWS resources and to check your compliance against security industry standards and best practices. For a list of supported services and controls, see <u>Security Hub controls reference</u>.
- <u>Amazon GuardDuty</u> This AWS service detects potential threats to your AWS accounts, workloads, containers, and data by monitoring your environment for suspicious and malicious activities. GuardDuty can help you address various compliance requirements, like PCI DSS, by meeting intrusion detection requirements mandated by certain compliance frameworks.
- <u>AWS Audit Manager</u> This AWS service helps you continuously audit your AWS usage to simplify how you manage risk and compliance with regulations and industry standards.

Resilience in Amazon Managed Workflows for Apache Airflow

The AWS global infrastructure is built around AWS Regions and Availability Zones. Regions provide multiple physically separated and isolated Availability Zones, which are connected through low-latency, high-throughput, and highly redundant networking. With Availability Zones, you can design and operate applications and databases that automatically fail over between zones without interruption. Availability Zones are more highly available, fault tolerant, and scalable than traditional single or multiple data center infrastructures.

For more information about AWS Regions and Availability Zones, refer to <u>AWS Global</u> <u>Infrastructure</u>.

Infrastructure Security in Amazon MWAA

As a managed service, Amazon Managed Workflows for Apache Airflow is protected by AWS global network security. For information about AWS security services and how AWS protects infrastructure, see <u>AWS Cloud Security</u>. To design your AWS environment using the best practices for infrastructure security, see <u>Infrastructure Protection</u> in *Security Pillar AWS Well-Architected Framework*.

You use AWS published API calls to access Amazon MWAA through the network. Clients must support the following:

- Transport Layer Security (TLS). We require TLS 1.2 and recommend TLS 1.3.
- Cipher suites with perfect forward secrecy (PFS) such as DHE (Ephemeral Diffie-Hellman) or ECDHE (Elliptic Curve Ephemeral Diffie-Hellman). Most modern systems such as Java 7 and later support these modes.

Additionally, requests must be signed by using an access key ID and a secret access key that is associated with an IAM principal. Or you can use the <u>AWS Security Token Service</u> (AWS STS) to generate temporary security credentials to sign requests.

Configuration and Vulnerability Analysis in Amazon MWAA

Configuration and IT controls are a shared responsibility between AWS and you, our customer.

Amazon Managed Workflows for Apache Airflow periodically patches and upgrades Apache Airflow on your environments. You should ensure that the appropriate access policies are used for your VPCs.

For more details, refer to the following resources:

- Compliance Validation for Amazon Managed Workflows for Apache Airflow
- Shared Responsibility Model
- Amazon Web Services: Overview of Security Processes
- Infrastructure Security in Amazon MWAA
- Security best practices on Amazon MWAA

Security best practices on Amazon MWAA

Amazon MWAA provides a number of security features to consider as you develop and implement your own security policies. The following best practices are general guidelines and don't represent a complete security solution. Because these best practices might not be appropriate or sufficient for your environment, treat them as helpful considerations rather than prescriptions.

- Use least-permissive permission policies. Grant permissions to only the resources or actions that users need to perform tasks.
- Use AWS CloudTrail to monitor user activity in your account.
- Ensure that the Amazon S3 bucket policy and object ACLs grant permissions to the users from the associated Amazon MWAA environment to put objects into the bucket. This ensures that users with permissions to add workflows to the bucket also have permissions to run the workflows in Airflow.
- Use the Amazon S3 buckets associated with Amazon MWAA environments. Your Amazon S3 bucket can be any name. Do not store other objects in the bucket, or use the bucket with another service.

Security best practices in Apache Airflow

Apache Airflow is not multi-tenant. While there are <u>access control measures</u> to limit some features to specific users, which <u>Amazon MWAA implements</u>, DAG creators do have the ability to write DAGs that can change Apache Airflow user privileges and interact with the underlying metadatabase.

We recommend the following steps when working with Apache Airflow on Amazon MWAA to ensure your environment's metadatabase and DAGs are secure.

- Use separate environments for separate teams with DAG writing access, or the ability to add files to your Amazon S3 /dags folder, assuming anything accessible by the <u>Amazon MWAA</u> <u>Execution Role</u> or <u>Apache Airflow connections</u> will also be accessible to users who can write to the environment.
- Do not provide direct Amazon S3 DAGs folder access. Instead, use CI/CD tools to write DAGs to Amazon S3, with a validation step ensuring that the DAG code meets your team's security guidelines.

- Prevent user access to your environment's Amazon S3 bucket. Instead, use a DAG factory that generates DAGs based on a YAML, JSON, or other definition file stored in a separate location from your Amazon MWAA Amazon S3 bucket where you store DAGs.
- Store secrets in <u>Secrets Manager</u>. While this will not prevent users who can write DAGs from reading secrets, it will prevent them from modifying the secrets that your environment uses.

Detecting changes to Apache Airflow user privileges

You can use CloudWatch Logs Insights to detect occurences of DAGs changing Apache Airflow user privileges. To do so, you can use an EventBridge scheduled rule, a Lambda function, and CloudWatch Logs Insights to deliver notifications to CloudWatch metrics whenever one of your DAGs changes Apache Airflow user privileges.

Prerequisites

To complete the following steps, you will need the following:

• An Amazon MWAA environment with all Apache Airflow log types enabled at the INFO log level. For more information, refer to the section called "Viewing Airflow logs".

To configure notifications for changes to Apache Airflow user privileges

 <u>Create a Lambda function</u> that runs the following CloudWatch Logs Insights query string against the five Amazon MWAA environment log groups (DAGProcessing, Scheduler, Task, WebServer, and Worker).

fields @log, @timestamp, @message | filter @message like "add-role" | stats count()
 by @log

2. <u>Create an EventBridge rule that runs on a schedule</u>, with the Lambda function you created in the previous step as the rule's target. Configure your schedule using a cron or rate expression to run at regular intervals.

Apache Airflow versions on Amazon Managed Workflows for Apache Airflow

This topic describes the Apache Airflow versions Amazon Managed Workflows for Apache Airflow supports, and best-practices for upgrading to the latest version.

Topics

- <u>About Amazon MWAA versions</u>
- Latest version
- Apache Airflow versions
- <u>Apache Airflow components</u>
- Upgrading the Apache Airflow version
- Downgrading the Apache Airflow version
- <u>Apache Airflow deprecated versions</u>
- <u>Apache Airflow version support and FAQ</u>

About Amazon MWAA versions

Amazon MWAA builds container images that bundle Apache Airflow releases with other common binaries and Python libraries. The image uses the Apache Airflow base install for the version you specify. When you create an environment, you specify an image version to use. Once an environment is created, it keeps using the specified image version until you upgrade it to a later version.

Latest version

Amazon MWAA supports more than one Apache Airflow version. If you do not specify an image version when you create an environment, Amazon MWAA creates an environment using the latest supported version of Apache Airflow.

Apache Airflow versions

The following Apache Airflow versions are supported on Amazon Managed Workflows for Apache Airflow.

(i) Note

- Effective December 30, 2025, Amazon MWAA will end support for Apache Airflow versions v2.4.3, v2.5.1, and v2.6.3. For more information, refer to <u>Apache Airflow version</u> <u>support and FAQ</u>.
- Beginning with Apache Airflow v2.2.2, Amazon MWAA supports installing Python requirements, provider packages, and custom plugins directly on the Apache Airflow web server.
- Beginning with Apache Airflow v2.7.2, your requirements file must include a -constraint statement. If you do not provide a constraint, Amazon MWAA will specify
 one for you to ensure the packages listed in your requirements are compatible with the
 version of Apache Airflow you are using.

For more information on setting up constraints in your requirements file, refer to Installing Python dependencies.

Apache Airflow version	Apache Airflow release date	Amazon MWAA availability date	Apache Airflow constraints	Python version
<u>v2.10.3</u>	<u>November 4,</u> 2024	December 18, 2024	<u>v2.10.3</u> constraints file	<u>Python 3.11</u>
<u>v2.10.1</u>	<u>September 5,</u> 2024	September 26, 2024	v2.10.1 constraints file	<u>Python 3.11</u>
<u>v2.9.2</u>	<u>June 10, 2024</u>	July 9, 2024	v2.9.2 constrain ts file	<u>Python 3.11</u>
<u>v2.8.1</u>	<u>January 19,</u> 2024	February 23, 2024	v2.8.1 constrain ts file	<u>Python 3.11</u>
<u>v2.7.2</u>	<u>October 12,</u> 2023	November 6, 2023	v2.7.2 constrain ts file	Python 3.11

For more information about migrating your self-managed Apache Airflow deployments, or migrating an existing Amazon MWAA environment, including instructions for backing up your metadata database, refer to the Amazon MWAA Migration Guide.

Apache Airflow components

This section describes the number of Apache Airflow schedulers and workers available for each Apache Airflow version on Amazon MWAA, and provides a list of key Apache Airflow features, indicating the version that supports each feature.

Schedulers

Apache Airflow version	Scheduler (default)	Scheduler (min)	Scheduler (max)
Apache Airflow v2 and above	2	2	5

Workers

Airflow version	Workers (min)	Workers (max)	Workers (default)	
Apache Airflow v2	1	25	10	

Upgrading the Apache Airflow version

Amazon MWAA supports minor version upgrades. This means you can upgrade your environment from version x.1.z to x.2.z, but not to a new major version, for example, from 1.y.z to 2.y.z.

For more information, and detailed instructions on updating your workflow resources, and upgrading the environment to a new version, refer to <u>the section called "Changing the version"</u>.

Downgrading the Apache Airflow version

Amazon MWAA supports minor version downgrades to an earlier version that is still supported at the time of downgrade. This means you can downgrade your environment from version x.2.z to x.1.z, but not to a previous major version, for example, from 2.y.z to 1.y.z.

For more information, and detailed instructions on updating your workflow resources, and upgrading the environment to a new version, refer to <u>the section called "Changing the version"</u>.

Apache Airflow deprecated versions

The following table lists the deprecated versions of Apache Airflow in Amazon MWAA, along with initial release and end-of-support dates for each version. For more information about migrating to a newer version, refer to the <u>Amazon MWAA Migration Guide</u>.

Apache Airflow version	Apache Airflow release date	Amazon MWAA availabil ity date	Amazon MWAA end-of- support date
v1.10.12	August 25, 2020	November 24, 2020	February 21, 2024
v2.0.2	April 19, 2021	May 25, 2021	April 29, 2024
v2.2.2	November 15, 2021	January 27,2022	June 27, 2024
v2.4.3	November 14, 2022	January 05, 2023	December 30, 2025
v2.5.1	January 20, 2023	April 11, 2023	December 30, 2025
v2.6.3	July 10, 2023	August 09, 2023	December 30, 2025

Apache Airflow version support and FAQ

In accordance with the Apache Airflow community <u>release process and version policy</u>, Amazon MWAA is committed to supporting at least three minor versions of Apache Airflow at any given time. We will announce the end of support date of a given Apache Airflow minor version at least 180 days before the end of support date.

Frequently asked questions

Q: How long does Amazon MWAA support an Apache Airflow version?

A: Amazon MWAA supports an Apache Airflow patch version for a minimum of 12 months after first being available.

Q: Am I notified when support is ending for an Apache Airflow version on Amazon MWAA?

A: Yes. If any Amazon MWAA environments in your account run the version nearing the end of support, Amazon MWAA sends out a notice through the AWS Health Dashboard with the end of support date.

Q: What happens on the end of support date?

A: On the end of support date, you can no longer use a deprecated version to create new Amazon MWAA environments. You can continue to access your existing Amazon MWAA environments that run the associated, deprecated version of Apache Airflow at your own risk. To upgrade to a newer version of Apache Airflow on Amazon MWAA, refer to the <u>Amazon MWAA Migration Guide</u>.

🛕 Important

You are responsible for keeping your Amazon MWAA versions current. AWS urges all customers to upgrade their Amazon MWAA environments to the latest version in order to benefit from the most current security, privacy, and availability safeguards. If you operate your environment on an unsupported version or software past the deprecation date, referred to as the *legacy version*, you face a greater likelihood of security, privacy, and operational risks, including downtime events. By operating your Amazon MWAA environment on a legacy version, you confirm that you understand and knowingly assume these risks, and you agree to complete your upgrade to the latest version as soon as possible. Continued operation of your environment on a legacy version is subject to the agreement governing your use of the AWS services.

Legacy versions are not considered generally available, and AWS no longer provides support for the legacy version. As a result, AWS may place limits on the access to or use of any legacy version at any time, if AWS determines that the legacy version poses a security or liability risk, or a risk of harm, to the services, AWS, its Affiliates, or any other third party. Your decision to continue running Your workloads on a legacy version might result in Your content becoming unavailable, corrupted, or unrecoverable. Environments running on a legacy version are subject to Service Level Agreement (SLA) exceptions. Environments, and related software, running on a legacy version might contain bugs, errors, defects, and harmful components. Accordingly, and notwithstanding any information to the contrary in the agreement, or the terms of service, AWS provides the legacy version *as is*.

For more information about AWS's shared responsibility model, refer to <u>Shared</u> responsibility in the AWS Well-Architected Framework.

Amazon Managed Workflows for Apache Airflow service endpoints and quotas

Amazon Managed Workflows for Apache Airflow has the following service quotas and endpoints. Service quotas, also referred to as limits, are the maximum number of service resources or operations for your AWS account.

Contents

- Service endpoints
- Service quotas
- Increasing quotas

Service endpoints

To view a list of endpoints for Amazon MWAA, refer to <u>Amazon Managed Workflows for Apache</u> Airflow endpoints and quotas.

Service quotas

Quota name	Description	Default quota	Adjustable
Environments	The maximum number of Amazon MWAA environme nts per account per Region.	10	Yes
Workers per environment	The maximum number of workers per Amazon MWAA environment.	25	Yes
Web servers per environment	The maximum number of web	5	Yes

Increasing quotas

You can request an increase to an adjustable quota by submitting a <u>quota increase request</u>.

Amazon MWAA frequently asked questions

This page describes common questions you may encounter when using Amazon Managed Workflows for Apache Airflow.

Contents

- Supported versions
 - What does Amazon MWAA support for Apache Airflow v2?
 - Why are older versions of Apache Airflow not supported?
 - What Python version should I use?
- Use cases
 - Can I use Amazon MWAA with Amazon SageMaker Unified Studio?
 - When should I use AWS Step Functions vs. Amazon MWAA?
- Environment specifications
 - How much task storage is available to each environment?
 - What is the default operating system used for Amazon MWAA environments?
 - Can I use a custom image for my Amazon MWAA environment?
 - Is Amazon MWAA HIPAA compliant?
 - Does Amazon MWAA support Spot Instances?
 - Does Amazon MWAA support a custom domain?
 - Can I SSH into my environment?
 - Why is a self-referencing rule required on the VPC security group?
 - Can I hide environments from different groups in IAM?
 - Can I store temporary data on the Apache Airflow Worker?
 - Can I specify more than 25 Apache Airflow Workers?
 - Does Amazon MWAA support shared Amazon VPCs or shared subnets?
 - <u>Can I create or integrate custom Amazon SQS queues to manage task execution and workflow</u> orchestration in Apache Airflow?
- Metrics
 - What metrics are used to determine whether to scale Workers?
 - Can I create custom metrics in CloudWatch?

- DAGs, Operators, Connections, and other questions
 - Can I use the PythonVirtualenvOperator?
 - How long does it take Amazon MWAA to recognize a new DAG file?
 - Why is my DAG file not picked up by Apache Airflow?
 - Can I remove a plugins.zip or requirements.txt from an environment?
 - Why don't I see my plugins in the Apache Airflow v2.0.2 Admin Plugins menu?
 - Can I use AWS Database Migration Service (DMS) Operators?
 - When I access the Airflow REST API using the AWS credentials, can I increase the throttling limit to more than 10 transactions per second (TPS)?

Supported versions

What does Amazon MWAA support for Apache Airflow v2?

To learn what Amazon MWAA supports, refer to <u>Apache Airflow versions on Amazon Managed</u> Workflows for Apache Airflow.

Why are older versions of Apache Airflow not supported?

We are only supporting the latest (as of launch) Apache Airflow version Apache Airflow v1.10.12 due to security concerns with older versions.

What Python version should I use?

The following Apache Airflow versions are supported on Amazon Managed Workflows for Apache Airflow.

i Note

- Effective December 30, 2025, Amazon MWAA will end support for Apache Airflow versions v2.4.3, v2.5.1, and v2.6.3. For more information, refer to <u>Apache Airflow version</u> <u>support and FAQ</u>.
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Beginning with Apache Airflow v2.7.2, your requirements file must include a -constraint statement. If you do not provide a constraint, Amazon MWAA will specify
one for you to ensure the packages listed in your requirements are compatible with the
version of Apache Airflow you are using.

For more information on setting up constraints in your requirements file, refer to Installing Python dependencies.

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<u>v2.7.2</u>	<u>October 12,</u> 2023	November 6, 2023	v2.7.2 constrain ts file	Python 3.11

For more information about migrating your self-managed Apache Airflow deployments, or migrating an existing Amazon MWAA environment, including instructions for backing up your metadata database, refer to the <u>Amazon MWAA Migration Guide</u>.

Use cases

Can I use Amazon MWAA with Amazon SageMaker Unified Studio?

Yes. With an Amazon SageMaker Unified Studio workflow, you can set up and run a series of tasks in Amazon SageMaker Unified Studio. Amazon SageMaker Unified Studio workflows use Apache

Airflow to model data processing procedures and orchestrate your Amazon SageMaker Unified Studio code artifacts. For more information, refer to the <u>Workflows</u> section. To learn more about Amazon SageMaker, refer to What is Amazon SageMaker?

When should I use AWS Step Functions vs. Amazon MWAA?

- 1. You can use Step Functions to process individual customer orders, since Step Functions can scale to meet demand for one order or one million orders.
- 2. If you're running an overnight workflow that processes the previous day's orders, you can use Step Functions or Amazon MWAA. Amazon MWAA allows you an open source option to abstract the workflow from the AWS resources you're using.

Environment specifications

How much task storage is available to each environment?

The task storage is limited to 20 GB, and is specified by <u>Amazon ECS Fargate 1.4</u>. The amount of RAM is determined by the environment class you specify. For more information about environment classes, refer to <u>Configuring the Amazon MWAA environment class</u>.

What is the default operating system used for Amazon MWAA environments?

Amazon MWAA environments are created on instances running Amazon Linux 2 for versions 2.6 and older, and on instances running Amazon Linux 2023 for versions 2.7 and newer.

Can I use a custom image for my Amazon MWAA environment?

Custom images are not supported. Amazon MWAA uses images that are built on Amazon Linux AMI. Amazon MWAA installs the additional requirements by running pip3 -r install for the requirements specified in the requirements.txt file you add to the Amazon S3 bucket for the environment.

Is Amazon MWAA HIPAA compliant?

Amazon MWAA is <u>Health Insurance Portability and Accountability Act (HIPAA)</u> eligible. If you have a HIPAA Business Associate Addendum (BAA) in place with AWS, you can use Amazon MWAA for

workflows handling Protected Health Information (PHI) on environments created on, or after, November 14th, 2022.

Does Amazon MWAA support Spot Instances?

Amazon MWAA does not currently support on-demand Amazon EC2 Spot Instance types for Apache Airflow. However, an Amazon MWAA environment can trigger Spot Instances on, for example, Amazon EMR and Amazon EC2.

Does Amazon MWAA support a custom domain?

To be able to use a custom domain for your Amazon MWAA hostname, do one of the following:

- For Amazon MWAA deployments with public web server access, you can use Amazon CloudFront with Lambda@Edge to direct traffic to your environment, and map a custom domain name to CloudFront. For more information and an example of setting up a custom domain for a public environment, refer to the <u>Amazon MWAA custom domain for public web server</u> sample in the Amazon MWAA examples GitHub repository.
- For Amazon MWAA deployments with private web server access, refer to <u>the section called</u> <u>"Setting up a custom domain"</u>.

Can I SSH into my environment?

While SSH is not supported on a Amazon MWAA environment, it's possible to use a DAG to run bash commands using the BashOperator. For example:

```
from airflow import DAG
from airflow.operators.bash_operator import BashOperator
from airflow.utils.dates import days_ago
with DAG(dag_id="any_bash_command_dag", schedule_interval=None, catchup=False,
    start_date=days_ago(1)) as dag:
        cli_command = BashOperator(
            task_id="bash_command",
            bash_command="{{ dag_run.conf['command'] }}"
    )
```

To trigger the DAG in the Apache Airflow UI, use:

{ "command" : "your bash command"}

Why is a self-referencing rule required on the VPC security group?

By creating a self-referencing rule, you're restricting the source to the same security group in the VPC, and it's not open to all networks. To learn more, refer to <u>the section called "Security in your</u> <u>VPC"</u>.

Can I hide environments from different groups in IAM?

You can limit access by specifying an environment name in AWS Identity and Access Management, however, visibility filtering isn't available in the AWS console—if a user can see one environment, they can see all environments.

Can I store temporary data on the Apache Airflow Worker?

Your Apache Airflow Operators can store temporary data on the *Workers*. Apache Airflow *Workers* can access temporary files in the /tmp on the Fargate containers for your environment.

i Note

Total task storage is limited to 20 GB, according to <u>Amazon ECS Fargate 1.4</u>. There's no guarantee that subsequent tasks will run on the same Fargate container instance, which might use a different /tmp folder.

Can I specify more than 25 Apache Airflow Workers?

Yes. Although you can specify up to 25 Apache Airflow workers on the Amazon MWAA console, you can configure up to 50 on an environment by requesting a quota increase. For more information, refer to <u>Requesting a quota increase</u>.

Does Amazon MWAA support shared Amazon VPCs or shared subnets?

Amazon MWAA does not support shared Amazon VPCs or shared subnets. The Amazon VPC you select when you create an environment should be owned by the account that is attempting to create the environment. However, you can route traffic from an Amazon VPC in the Amazon MWAA account to a shared VPC. For more information and an example of routing traffic to a shared Amazon VPC, refer to <u>Centralized outbound routing to the internet</u> in the *Amazon VPC Transit Gateways Guide*.

Can I create or integrate custom Amazon SQS queues to manage task execution and workflow orchestration in Apache Airflow?

No, you cannot create, modify, or use custom Amazon SQS queues within Amazon MWAA. This is because Amazon MWAA automatically provisions and manages its own Amazon SQS queue for each Amazon MWAA environment.

Metrics

What metrics are used to determine whether to scale Workers?

Amazon MWAA monitors the **QueuedTasks** and **RunningTasks** in CloudWatch to determine whether to scale Apache Airflow *Workers* on your environment. To learn more, refer to <u>Monitoring</u> <u>and metrics</u>.

Can I create custom metrics in CloudWatch?

Not on the CloudWatch console. However, you can create a DAG that writes custom metrics in CloudWatch. For more information, refer to <u>the section called "Using a DAG to write custom</u> <u>metrics"</u>.

DAGs, Operators, Connections, and other questions

Can I use the PythonVirtualenvOperator?

The PythonVirtualenvOperator is not explicitly supported on Amazon MWAA, but you can create a custom plugin that uses the PythonVirtualenvOperator. For sample code, refer to <u>the</u> <u>section called "Custom plugin to patch PythonVirtualenvOperator"</u>.

How long does it take Amazon MWAA to recognize a new DAG file?

DAGs are periodically synchronized from the Amazon S3 bucket to your environment. If you add a new DAG file, it takes about 300 seconds for Amazon MWAA to start *using* the new file. If you update an existing DAG, it takes Amazon MWAA about 30 seconds to recognize your updates.

These values, 300 seconds for new DAGs, and 30 seconds for updates to existing DAGs, correspond to Apache Airflow configuration options <u>dag_dir_list_interval</u>, and <u>min_file_process_interval</u> respectively.

Why is my DAG file not picked up by Apache Airflow?

The following are possible solutions for this issue:

- 1. Check that your execution role has sufficient permissions to your Amazon S3 bucket. To learn more, refer to Amazon MWAA execution role.
- 2. Check that the Amazon S3 bucket has *Block Public Access* configured, and *Versioning* enabled. To learn more, refer to Create an Amazon S3 bucket for Amazon MWAA.
- 3. Verify the DAG file itself. For example, be sure that each DAG has a unique DAG ID.

Can I remove a plugins.zip or requirements.txt from an environment?

Currently, there is no way to remove a plugins.zip or requirements.txt from an environment once they've been added, but we're working on the issue. In the interim, a workaround is to point to an empty text or zip file, respectively. To learn more, refer to <u>Deleting files on Amazon S3</u>.

Why don't I see my plugins in the Apache Airflow v2.0.2 Admin Plugins menu?

For security reasons, the Apache Airflow Web server on Amazon MWAA has limited network egress, and does not install plugins nor Python dependencies directly on the Apache Airflow *web server* for version 2.0.2 environments. The plugin that's shown allows Amazon MWAA to authenticate your Apache Airflow users in AWS Identity and Access Management (IAM).

To be able to install plugins and Python dependencies directly on the web server, we recommend creating a new environemnt with Apache Airflow v2.2 and above. Amazon MWAA installs Python dependencies and and custom plugins directly on the web server for Apache Airflow v2.2 and above.

Can I use AWS Database Migration Service (DMS) Operators?

Amazon MWAA supports <u>DMS Operators</u>. However, this operator cannot be used to perform actions on the Amazon Aurora PostgreSQL metadata database associated with an Amazon MWAA environment.

When I access the Airflow REST API using the AWS credentials, can I increase the throttling limit to more than 10 transactions per second (TPS)?

Yes, you can. To increase the throttling limit, please contact <u>AWS Customer Support</u>.

Troubleshooting Amazon Managed Workflows for Apache Airflow

This chapter describes common issues and errors you may encounter when using Apache Airflow on Amazon Managed Workflows for Apache Airflow and recommended steps to resolve these errors.

Contents

- Troubleshooting: DAGs, Operators, Connections, and other issues in Apache Airflow v2
 - <u>Connections</u>
 - I can't connect to Secrets Manager
 - How do I configure secretsmanager:ResourceTag/<tag-key> secrets manager conditions or a resource restriction in my execution role policy?
 - I can't connect to Snowflake
 - I can't see my connection in the Airflow UI
 - Web server
 - I see a 5xx error accessing the web server
 - I see a 'The scheduler does not appear to be running' error
 - Tasks
 - I see my tasks stuck or not completing
 - <u>CLI</u>
 - I see a '503' error when triggering a DAG in the CLI
 - Why does the dags backfill Apache Airflow CLI command fail? Is there a workaround?
 - Operators
 - I received a PermissionError: [Errno 13] Permission denied error using the S3Transform operator
- Troubleshooting: DAGs, Operators, Connections, and other issues in Apache Airflow v1
- <u>Updating requirements.txt</u>
 - Adding apache-airflow-providers-amazon causes my environment to fail
- Broken DAG
 - I received a 'Broken DAG' error when using Amazon DynamoDB operators

- I received 'Broken DAG: No module named psycopg2' error
- I received a 'Broken DAG' error when using the Slack operators
- I received various errors installing Google/GCP/BigQuery
- I received 'Broken DAG: No module named Cython' error
- Operators
 - I received an error using the BigQuery operator
- <u>Connections</u>
 - I can't connect to Snowflake
 - I can't connect to Secrets Manager
 - I can't connect to my MySQL server on '<DB-identifier-name>.clusterid.<region>.rds.amazonaws.com'
- Web server
 - I'm using the BigQueryOperator and it's causing my web server to crash
 - I see a 5xx error accessing the web server
 - I see a 'The scheduler does not appear to be running' error
- Tasks
 - I see my tasks stuck or not completing
- <u>CLI</u>
 - I see a '503' error when triggering a DAG in the CLI
- Troubleshooting: Creating and updating an Amazon MWAA environment
 - Updating requirements.txt
 - I specified a new version of my requirements.txt and it's taking more than 20 minutes to update my environment
 - Plugins
 - Does Amazon MWAA support implementing custom UI?
 - I am able to implement custom UI changes on the Amazon MWAA local runner via plugins, yet when I try to do the same on Amazon MWAA, I do not see my changes nor any errors. Why is this happening?
 - Create bucket
 - I can't select the option for S3 Block Public Access settings
 - Create environment

- I tried to create an environment and it's stuck in the "Creating" state
- I tried to create an environment but it shows the status as "Create failed"
- I tried to select a VPC and received a "Network Failure" error
- I tried to create an environment and received a service, partition, or resource "must be passed" error
- I tried to create an environment and it shows the status as "Available" but when I try to access the Airflow UI an "Empty Reply from Server" or "502 Bad Gateway" error is shown
- I tried to create an environment and my user name is a bunch of random character names
- Update environment
 - I tried changing the environment class but the update failed
- Access environment
 - I can't access the Apache Airflow UI
- Troubleshooting: CloudWatch Logs and CloudTrail errors
 - Logs
 - I can't see my task logs, or I received a 'Reading remote log from Cloudwatch log_group' error
 - Tasks are failing without any logs
 - I see a 'ResourceAlreadyExistsException' error in CloudTrail
 - I see an 'Invalid request' error in CloudTrail
 - <u>I see a 'Cannot locate a 64-bit Oracle Client library: "libclntsh.so: cannot open shared</u> object file: No such file or directory' in Apache Airflow logs
 - I see psycopg2 'server closed the connection unexpectedly' in my Scheduler logs
 - I see 'Executor reports task instance %s finished (%s) although the task says its %s' in my DAG processing logs
 - I see 'Could not read remote logs from log_group: airflow-*{*environmentName}-Task log_stream:* {*DAG_ID}/*{*TASK_ID}/*{*time}/*{*n}.log.' in my task logs

Troubleshooting: DAGs, Operators, Connections, and other issues in Apache Airflow v2

The topics on this page describe resolutions to Apache Airflow v2 Python dependencies, custom plugins, DAGs, Operators, Connections, tasks, and *Web server* issues you may encounter on an Amazon Managed Workflows for Apache Airflow environment.

Contents

- Connections
 - I can't connect to Secrets Manager
 - How do I configure secretsmanager:ResourceTag/<tag-key> secrets manager conditions or a resource restriction in my execution role policy?
 - I can't connect to Snowflake
 - I can't see my connection in the Airflow UI
- Web server
 - I see a 5xx error accessing the web server
 - I see a 'The scheduler does not appear to be running' error
- Tasks
 - I see my tasks stuck or not completing
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 - I see a '503' error when triggering a DAG in the CLI
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Connections

The following topic describes the errors you may receive when using an Apache Airflow connection, or using another AWS database.

I can't connect to Secrets Manager

- 1. Learn how to create secret keys for your Apache Airflow connection and variables in <u>the</u> section called "Configuring Secrets Manager".
- 2. Learn how to use the secret key for an Apache Airflow variable (test-variable) in Using a secret key in AWS Secrets Manager for an Apache Airflow variable.
- 3. Learn how to use the secret key for an Apache Airflow connection (myconn) in <u>Using a secret</u> key in AWS Secrets Manager for an Apache Airflow connection.

How do I configure secretsmanager:ResourceTag/<tag-key> secrets manager conditions or a resource restriction in my execution role policy?

1 Note

Applies to Apache Airflow version 2.0 and earlier.

Currently, you cannot limit access to Secrets Manager secrets by using condition keys or other resource restrictions in your environment's execution role, due to a known issue in Apache Airflow.

I can't connect to Snowflake

We recommend the following steps:

- Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> runner on GitHub.
- 2. Add the following entries to the requirements.txt for your environment.

apache-airflow-providers-snowflake==1.3.0

3. Add the following imports to your DAG:

from airflow.providers.snowflake.operators.snowflake import SnowflakeOperator

Ensure the Apache Airflow connection object includes the following key-value pairs:

- 1. Conn Id: snowflake_conn
- 2. Conn Type: Snowflake

- 3. Host: <my account>.<my region if not us-west-2>.snowflakecomputing.com
- 4. Schema: <my schema>
- 5. Login: <my user name>
- 6. **Password:** ********
- 7. Port: <port, if any>
- 8. Extra:

```
{
    "account": "<my account>",
    "warehouse": "<my warehouse>",
    "database": "<my database>",
    "region": "<my region if not using us-west-2 otherwise omit this line>"
}
```

For example:

```
>>> import json
>>> from airflow.models.connection import Connection
>>> myconn = Connection(
       conn_id='snowflake_conn',
. . .
       conn_type='Snowflake',
. . .
       host='123456789012.us-east-1.snowflakecomputing.com',
. . .
       schema='YOUR_SCHEMA'
. . .
       login='YOUR_USERNAME',
. . .
       password='YOUR_PASSWORD',
. . .
       port='YOUR_PORT'
. . .
       extra=json.dumps(dict(account='123456789012', warehouse='YOUR_WAREHOUSE',
. . .
database='YOUR_DB_OPTION', region='us-east-1')),
...)
```

I can't see my connection in the Airflow UI

Apache Airflow provides connection templates in the Apache Airflow UI. It uses this to generate the connection URI string, regardless of the connection type. If a connection template is not available in the Apache Airflow UI, an alternate connection template can be used to generate a connection URI string, such as using the HTTP connection template.

- 1. View the connection types Amazon MWAA's providing in the Apache Airflow UI at <u>Apache</u> Airflow provider packages installed on Amazon MWAA environments.
- 2. View the commands to create an Apache Airflow connection in the CLI at <u>Apache Airflow CLI</u> <u>command reference</u>.
- 3. Learn how to use connection templates in the Apache Airflow UI interchangeably for connection types that aren't available in the Apache Airflow UI on Amazon MWAA at <u>Overview</u> of connection types.

Web server

The following topic describes the errors you may receive for your Apache Airflow *Web server* on Amazon MWAA.

I see a 5xx error accessing the web server

We recommend the following steps:

- Check Apache Airflow configuration options. Verify that the key-value pairs you specified as an Apache Airflow configuration option, such as AWS Secrets Manager, were configured correctly. To learn more, refer to the section called "I can't connect to Secrets Manager".
- 2. Check the requirements.txt. Verify the Airflow "extras" package and other libraries listed in your requirements.txt are compatible with your Apache Airflow version.
- 3. Explore ways to specify Python dependencies in a requirements.txt file, refer to <u>Managing</u> <u>Python dependencies in requirements.txt</u>.

I see a 'The scheduler does not appear to be running' error

If the scheduler doesn't appear to be running, or the last "heart beat" was received several hours ago, your DAGs may not appear in Apache Airflow, and new tasks will not be scheduled.

We recommend the following steps:

1. Confirm that your VPC security group allows inbound access to port 5432. This port is needed to connect to the Amazon Aurora PostgreSQL metadata database for your environment. After this rule is added, give Amazon MWAA a few minutes, and the error should disappear. To learn more, refer to the section called "Security in your VPC".

🚯 Note

- The Aurora PostgreSQL metadatabase is part of the <u>Amazon MWAA service</u> architecture and is not visible in your AWS account.
- Database-related errors are usually a symptom of scheduler failure and not the root cause.
- If the scheduler is not running, it might be due to a number of factors such as <u>dependency</u> <u>installation failures</u>, or an <u>overloaded scheduler</u>. Confirm that your DAGs, plugins, and requirements are working correctly by viewing the corresponding log groups in CloudWatch Logs. To learn more, refer to <u>Monitoring and metrics</u>.

Tasks

The following topic describes the errors you may receive for Apache Airflow tasks in an environment.

I see my tasks stuck or not completing

If your Apache Airflow tasks are "stuck" or not completing, we recommend the following steps:

- 1. There may be a large number of DAGs defined. Reduce the number of DAGs and perform an update of the environment (such as changing a log level) to force a reset.
 - Airflow parses DAGs whether they are enabled or not. If you're using greater than 50% of your environment's capacity you may start overwhelming the Apache Airflow Scheduler.
 This leads to large Total Parse Time in CloudWatch Metrics or long DAG processing times in CloudWatch Logs. There are other ways to optimize Apache Airflow configurations which are outside the scope of this guide.
 - b. To learn more about the best practices we recommend to tune the performance of your environment, refer to the section called "Performance tuning for Apache Airflow".
- 2. There may be a large number of tasks in the queue. This often appears as a large—and growing—number of tasks in the "None" state, or as a large number in *Queued Tasks* and/or *Tasks Pending* in CloudWatch. This can occur for the following reasons:

- a. If there are more tasks to run than the environment has the capacity to run, and/or a large number of tasks that were queued before autoscaling has time to detect the tasks and deploy additional *Workers*.
- b. If there are more tasks to run than an environment has the capacity to run, we recommend **reducing** the number of tasks that your DAGs run concurrently, and/or increasing the minimum Apache Airflow *Workers*.
- c. If there are a large number of tasks that were queued before autoscaling has had time to detect and deploy additional workers, we recommend **staggering** task deployment and/or increasing the minimum Apache Airflow *Workers*.
- d. You can use the <u>update-environment</u> command in the AWS Command Line Interface (AWS CLI) to change the minimum or maximum number of *Workers* that run on your environment.

aws mwaa update-environment --name MyEnvironmentName --min-workers 2 --max-workers 10

- e. To learn more about the best practices we recommend to tune the performance of your environment, refer to the section called "Performance tuning for Apache Airflow".
- 3. If your tasks are stuck in the "running" state, you can also clear the tasks or mark them as succeeded or failed. This allows the autoscaling component for your environment to scale down the number of workers running on your environment. The following image shows an example of a stranded task.



• Choose the circle for the stranded task, and then select **Clear** (as shown). This allows Amazon MWAA to scale down workers; otherwise, Amazon MWAA can't determine which DAGs are enabled or disabled, and can't scale down, if there are still queued tasks.

List Task Instance			
Search -			
Actions	<		
Clear			
Set state to 'failed'			
Set state to 'up_for_retry' K Id			
Set state to 'running' Set state to 'success'			
queued	movie- list-dag	create_athena_ra	
queued	movie- list-dag	create_athena_n	

4. Learn more about the Apache Airflow task lifecycle at <u>Concepts</u> in the *Apache Airflow reference guide*.

CLI

The following topic describes the errors you may receive when running Airflow CLI commands in the AWS Command Line Interface.

I see a '503' error when triggering a DAG in the CLI

The Airflow CLI runs on the Apache Airflow *Web server*, which has limited concurrency. Typically a maximum of 4 CLI commands can run simultaneously.

Why does the dags backfill Apache Airflow CLI command fail? Is there a workaround?

🚯 Note

The following applies only to Apache Airflow v2.0.2 environments.

The backfill command, like other Apache Airflow CLI commands, parses all DAGs locally before any DAGs are processed, regardless of which DAG the CLI operation applies to. In Amazon MWAA environments using Apache Airflow v2.0.2, because plugins and requirements are not yet installed on the web server by the time the CLI command runs, the parsing operation fails, and the backfill operation is not invoked. If you did not have any requirements nor plugins in your environment, the backfill operation would succeed.

In order to be able to run the backfill CLI command, we recommend invoking it in a bash operator. In a bash operator, backfill is initiated from the worker, allowing the DAGs to parse successfully as all necessary requirements and plguins are available and installed. The following example shows how you can create a DAG with a BashOperator to run backfill.

```
from airflow import DAG
from airflow.operators.bash_operator import BashOperator
from airflow.utils.dates import days_ago
with DAG(dag_id="backfill_dag", schedule_interval=None, catchup=False,
   start_date=days_ago(1)) as dag:
        cli_command = BashOperator(
            task_id="bash_command",
            bash_command="airflow dags backfill my_dag_id"
        )
```

Operators

The following topic describes the errors you may receive when using Operators.

I received a PermissionError: [Errno 13] Permission denied error using the S3Transform operator

We recommend the following steps if you're trying to run a shell script with the S3Transform operator and you're receiving a PermissionError: [Errno 13] Permission denied

error. The following steps assume you have an existing plugins.zip file. If you're creating a *new* plugins.zip, refer to Installing custom plugins.

- 1. Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> runner on GitHub.
- 2. Create your "transform" script.

```
#!/bin/bash
cp $1 $2
```

3. (optional) macOS and Linux users may need to run the following command to ensure the script is executable.

chmod 777 transform_test.sh

4. Add the script to your plugins.zip.

zip plugins.zip transform_test.sh

- 5. Follow the steps in <u>Upload the plugins.zip to Amazon S3</u>.
- 6. Follow the steps in Specifying the plugins.zip version on the Amazon MWAA console.
- 7. Create the following DAG.

```
from airflow import DAG
from airflow.providers.amazon.aws.operators.s3_file_transform import
S3FileTransformOperator
from airflow.utils.dates import days_ago
import os
DAG_ID = os.path.basename(__file__).replace(".py", "")
with DAG (dag_id=DAG_ID, schedule_interval=None, catchup=False,
    start_date=days_ago(1)) as dag:
    file_transform = S3FileTransformOperator(
        task_id='file_transform',
        transform_script='/usr/local/airflow/plugins/transform_test.sh',
        source_s3_key='s3://amzn-s3-demo-bucket/files/output.txt'
    )
```

8. Follow the steps in Uploading DAG code to Amazon S3.

Troubleshooting: DAGs, Operators, Connections, and other issues in Apache Airflow v1

The topics on this page contains resolutions to Apache Airflow v1.10.12 Python dependencies, custom plugins, DAGs, Operators, Connections, tasks, and *Web server* issues you may encounter on an Amazon Managed Workflows for Apache Airflow environment.

Contents

- Updating requirements.txt
 - Adding apache-airflow-providers-amazon causes my environment to fail
- Broken DAG
 - I received a 'Broken DAG' error when using Amazon DynamoDB operators
 - I received 'Broken DAG: No module named psycopg2' error
 - I received a 'Broken DAG' error when using the Slack operators
 - I received various errors installing Google/GCP/BigQuery
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- Operators
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 - I'm using the BigQueryOperator and it's causing my web server to crash
 - I see a 5xx error accessing the web server
 - I see a 'The scheduler does not appear to be running' error
- <u>Tasks</u>
 - I see my tasks stuck or not completing
- <u>CLI</u>

Updating requirements.txt

The following topic describes the errors you may receive when updating your requirements.txt.

Adding apache-airflow-providers-amazon causes my environment to fail

apache-airflow-providers-**xyz** is only compatible with Apache Airflow v2. apacheairflow-backport-providers-**xyz** is compatible with Apache Airflow 1.10.12.

Broken DAG

The following topic describes the errors you may receive when running DAGs.

I received a 'Broken DAG' error when using Amazon DynamoDB operators

We recommend the following steps:

- 1. Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> runner on GitHub.
- 2. Add the following package to your requirements.txt.

boto

3. Explore ways to specify Python dependencies in a requirements.txt file, refer to <u>Managing</u> Python dependencies in requirements.txt.

I received 'Broken DAG: No module named psycopg2' error

We recommend the following steps:

- 1. Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> runner on GitHub.
- Add the following to your requirements.txt with your Apache Airflow version. For example:

```
apache-airflow[postgres]==1.10.12
```

3. Explore ways to specify Python dependencies in a requirements.txt file, refer to <u>Managing</u> Python dependencies in requirements.txt.

I received a 'Broken DAG' error when using the Slack operators

We recommend the following steps:

- 1. Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> runner on GitHub.
- 2. Add the following package to your requirements.txt and specify your Apache Airflow version. For example:

```
apache-airflow[slack]==1.10.12
```

 Explore ways to specify Python dependencies in a requirements.txt file, refer to <u>Managing</u> Python dependencies in requirements.txt.

I received various errors installing Google/GCP/BigQuery

Amazon MWAA uses Amazon Linux which requires a specific version of Cython and cryptograpy libraries. We recommend the following steps:

- 1. Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> runner on GitHub.
- 2. Add the following package to your requirements.txt.

```
grpcio==1.27.2
cython==0.29.21
pandas-gbq==0.13.3
cryptography==3.3.2
apache-airflow-backport-providers-amazon[google]
```

3. If you're not using backport providers, you can use:

```
grpcio==1.27.2
cython==0.29.21
pandas-gbq==0.13.3
cryptography==3.3.2
apache-airflow[gcp]==1.10.12
```

4. Explore ways to specify Python dependencies in a requirements.txt file, refer to <u>Managing</u> Python dependencies in requirements.txt.

I received 'Broken DAG: No module named Cython' error

Amazon MWAA uses Amazon Linux which requires a specific version of Cython. We recommend the following steps:

- 1. Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> runner on GitHub.
- 2. Add the following package to your requirements.txt.

```
cython==0.29.21
```

3. Cython libraries have various required pip dependency versions. For example, using awswrangler==2.4.0 requires pyarrow<3.1.0,>=2.0.0, so pip3 tries to install pyarrow==3.0.0 which causes a Broken DAG error. We recommend specifying the oldest acceptible version explicity. For example, if you specify the minimum value pyarrow==2.0.0 before awswrangler==2.4.0 then the error goes away, and the requirements.txt installs correctly. The final requirements should look like this:

cython==0.29.21
pyarrow==2.0.0
awswrangler==2.4.0

4. Explore ways to specify Python dependencies in a requirements.txt file, refer to <u>Managing</u> <u>Python dependencies in requirements.txt</u>.

Operators

The following topic describes the errors you may receive when using Operators.

I received an error using the BigQuery operator

Amazon MWAA does not support operators with UI extensions. We recommend the following steps:

- Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> <u>runner</u> on GitHub.
- A workaround is to override the extension by adding a line in the DAG to set <operator name>.operator_extra_links = None after importing the problem operators. For example:

```
from airflow.contrib.operators.bigquery_operator import BigQueryOperator
BigQueryOperator.operator_extra_links = None
```

3. You can use this approach for all DAGs by adding the above to a plugin. For an example, refer to the section called "Custom plugin to patch PythonVirtualenvOperator ".

Connections

The following topic describes the errors you may receive when using an Apache Airflow connection, or using another AWS database.

I can't connect to Snowflake

We recommend the following steps:

- 1. Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> runner on GitHub.
- 2. Add the following entries to the requirements.txt for your environment.

```
asn1crypto == 0.24.0
snowflake-connector-python == 1.7.2
```

3. Add the following imports to your DAG:

```
from airflow.contrib.hooks.snowflake_hook import SnowflakeHook
from airflow.contrib.operators.snowflake_operator import SnowflakeOperator
```

Ensure the Apache Airflow connection object includes the following key-value pairs:

- 1. Conn Id: snowflake_conn
- 2. Conn Type: Snowflake
- 3. Host: <my account>.<my region if not us-west-2>.snowflakecomputing.com
- 4. Schema: <my schema>
- 5. Login: <my user name>
- 6. **Password:** ********
- 7. Port: <port, if any>

8. Extra:

```
{
    "account": "<my account>",
    "warehouse": "<my warehouse>",
    "database": "<my database>",
    "region": "<my region if not using us-west-2 otherwise omit this line>"
}
```

For example:

```
>>> import json
>>> from airflow.models.connection import Connection
>>> myconn = Connection(
       conn_id='snowflake_conn',
. . .
       conn_type='Snowflake',
. . .
       host='123456789012.us-east-1.snowflakecomputing.com',
. . .
       schema='YOUR_SCHEMA'
. . .
       login='YOUR_USERNAME',
. . .
       password='YOUR_PASSWORD',
. . .
       port='YOUR_PORT'
. . .
       extra=json.dumps(dict(account='123456789012', warehouse='YOUR_WAREHOUSE',
. . .
database='YOUR_DB_OPTION', region='us-east-1')),
...)
```

I can't connect to Secrets Manager

- Learn how to create secret keys for your Apache Airflow connection and variables in <u>the</u> section called "Configuring Secrets Manager".
- 2. Learn how to use the secret key for an Apache Airflow variable (test-variable) in Using a secret key in AWS Secrets Manager for an Apache Airflow variable.
- 3. Learn how to use the secret key for an Apache Airflow connection (myconn) in <u>Using a secret</u> key in AWS Secrets Manager for an Apache Airflow connection.

I can't connect to my MySQL server on '<DB-identifier-name>.clusterid.<region>.rds.amazonaws.com'

Amazon MWAA's security group and the RDS security group need an ingress rule to allow traffic to and from one another. We recommend the following steps:

- 1. Modify the RDS security group to allow all traffic from Amazon MWAA's VPC security group.
- 2. Modify Amazon MWAA's VPC security group to allow all traffic from the RDS security group.
- 3. Rerun your tasks again and verify whether the SQL query succeeded by checking Apache Airflow logs in CloudWatch Logs.

Web server

The following topic describes the errors you may receive for your Apache Airflow *Web server* on Amazon MWAA.

I'm using the BigQueryOperator and it's causing my web server to crash

We recommend the following steps:

 Apache Airflow operators such as the BigQueryOperator and QuboleOperator that contain operator_extra_links could cause your Apache Airflow web server to crash. These operators attempt to load code to your web server, which is not permitted for security reasons. We recommend patching the operators in your DAG by adding the following code after your import statements:

```
BigQueryOperator.operator_extra_links = None
```

2. Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> runner on GitHub.

I see a 5xx error accessing the web server

We recommend the following steps:

 Check Apache Airflow configuration options. Verify that the key-value pairs you specified as an Apache Airflow configuration option, such as AWS Secrets Manager, were configured correctly. To learn more, refer to the section called "I can't connect to Secrets Manager".

- 2. Check the requirements.txt. Verify the Airflow "extras" package and other libraries listed in your requirements.txt are compatible with your Apache Airflow version.
- 3. Explore ways to specify Python dependencies in a requirements.txt file, refer to <u>Managing</u> <u>Python dependencies in requirements.txt</u>.

I see a 'The scheduler does not appear to be running' error

If the scheduler doesn't appear to be running, or the last "heart beat" was received several hours ago, your DAGs may not appear in Apache Airflow, and new tasks will not be scheduled.

We recommend the following steps:

1. Confirm that your VPC security group allows inbound access to port 5432. This port is needed to connect to the Amazon Aurora PostgreSQL metadata database for your environment. After this rule is added, give Amazon MWAA a few minutes, and the error should disappear. To learn more, refer to the section called "Security in your VPC".

i Note

- The Aurora PostgreSQL metadatabase is part of the <u>Amazon MWAA service</u> architecture and is not visible in your AWS account.
- Database-related errors are usually a symptom of scheduler failure and not the root cause.
- If the scheduler is not running, it might be due to a number of factors such as <u>dependency</u> <u>installation failures</u>, or an <u>overloaded scheduler</u>. Confirm that your DAGs, plugins, and requirements are working correctly by viewing the corresponding log groups in CloudWatch Logs. To learn more, refer to <u>Monitoring and metrics</u>.

Tasks

The following topic describes the errors you may receive for Apache Airflow tasks in an environment.

I see my tasks stuck or not completing

If your Apache Airflow tasks are "stuck" or not completing, we recommend the following steps:

- 1. There may be a large number of DAGs defined. Reduce the number of DAGs and perform an update of the environment (such as changing a log level) to force a reset.
 - Airflow parses DAGs whether they are enabled or not. If you're using greater than 50% of your environment's capacity you may start overwhelming the Apache Airflow *Scheduler*. This leads to large *Total Parse Time* in CloudWatch Metrics or long DAG processing times in CloudWatch Logs. There are other ways to optimize Apache Airflow configurations which are outside the scope of this guide.
 - b. To learn more about the best practices we recommend to tune the performance of your environment, refer to the section called "Performance tuning for Apache Airflow".
- There may be a large number of tasks in the queue. This often appears as a large—and growing—number of tasks in the "None" state, or as a large number in *Queued Tasks* and/or *Tasks Pending* in CloudWatch. This can occur for the following reasons:
 - a. If there are more tasks to run than the environment has the capacity to run, and/or a large number of tasks that were queued before autoscaling has time to detect the tasks and deploy additional *Workers*.
 - b. If there are more tasks to run than an environment has the capacity to run, we recommend **reducing** the number of tasks that your DAGs run concurrently, and/or increasing the minimum Apache Airflow *Workers*.
 - c. If there are a large number of tasks that were queued before autoscaling has had time to detect and deploy additional workers, we recommend **staggering** task deployment and/or increasing the minimum Apache Airflow *Workers*.
 - d. You can use the <u>update-environment</u> command in the AWS Command Line Interface (AWS CLI) to change the minimum or maximum number of *Workers* that run on your environment.

```
aws mwaa update-environment --name MyEnvironmentName --min-workers 2 --max-
workers 10
```

- e. To learn more about the best practices we recommend to tune the performance of your environment, refer to the section called "Performance tuning for Apache Airflow".
- 3. If your tasks are stuck in the "running" state, you can also clear the tasks or mark them as succeeded or failed. This allows the autoscaling component for your environment to scale down the number of workers running on your environment. The following image shows an example of a stranded task.

Amazon Ma	nage	d Workflows for Apache Airflow				User Guide
G	Off	movie-list-dag	athena redshift	*/10 * * * *	airflow	

• Choose the circle for the stranded task, and then select **Clear** (as shown). This allows Amazon MWAA to scale down workers; otherwise, Amazon MWAA can't determine which DAGs are enabled or disabled, and can't scale down, if there are still queued tasks.

List Task Instance				
Search -				
Actions-	•			
Clear				
Set state to 'failed' Set state to 'up_for_retry' k ld Set state to 'running'				
	o 'success'	ite_redshift_t		
queued	movie- list-dag	create_athena_ra		
dnened	movie- list-dag	create_athena_n		

4. Learn more about the Apache Airflow task lifecycle at <u>Concepts</u> in the *Apache Airflow reference guide*.

CLI

The following topic describes the errors you may receive when running Airflow CLI commands in the AWS Command Line Interface.

I see a '503' error when triggering a DAG in the CLI

The Airflow CLI runs on the Apache Airflow *Web server*, which has limited concurrency. Typically a maximum of 4 CLI commands can run simultaneously.

Troubleshooting: Creating and updating an Amazon MWAA environment

The topics on this page contains errors you may encounter when creating and updating an Amazon Managed Workflows for Apache Airflow environment and how to resolve these errors.

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 - I tried to create an environment and it's stuck in the "Creating" state
 - I tried to create an environment but it shows the status as "Create failed"
 - I tried to select a VPC and received a "Network Failure" error
 - I tried to create an environment and received a service, partition, or resource "must be passed" error
 - I tried to create an environment and it shows the status as "Available" but when I try to access the Airflow UI an "Empty Reply from Server" or "502 Bad Gateway" error is shown
 - I tried to create an environment and my user name is a bunch of random character names
- Update environment
 - I tried changing the environment class but the update failed

Amazon MWAA Create/Update

- Access environment
 - I can't access the Apache Airflow UI

Updating requirements.txt

The following topic describes the errors you may receive when updating your requirements.txt.

I specified a new version of my requirements.txt and it's taking more than 20 minutes to update my environment

If it takes more than twenty minutes for your environment to install a new version of a requirements.txt file, the environment update failed and Amazon MWAA is rolling back to the last stable version of the container image.

- Check package versions. We recommend always specifying either a specific version (==) or a maximum version (<=) for the Python dependencies in your requirements.txt.
- Check Apache Airflow logs. If you enabled Apache Airflow logs, verify your log groups were created successfully on the <u>Logs groups page</u> on the CloudWatch console. If you see blank logs, the most common reason is due to missing permissions in your execution role for CloudWatch or Amazon S3 where logs are written. To learn more, refer to <u>Execution role</u>.
- 3. Check Apache Airflow configuration options. If you're using Secrets Manager, verify that the key-value pairs you specified as an Apache Airflow configuration option were configured correctly. To learn more, refer to the section called "Configuring Secrets Manager".
- 4. Check VPC network configuration. To learn more, refer to <u>the section called "Environment</u> <u>stuck"</u>.
- 5. Check execution role permissions. An execution role is an AWS Identity and Access Management (IAM) role with a permissions policy that grants Amazon MWAA permission to invoke the resources of other AWS services (such as Amazon S3, CloudWatch, Amazon SQS, Amazon ECR) on your behalf. Your <u>Customer managed key</u> or <u>AWS owned key</u> also needs to be permitted access. To learn more, refer to <u>Execution role</u>.
- 6. To run a troubleshooting script that checks the Amazon VPC network setup and configuration for your Amazon MWAA environment, refer to the <u>Verify Environment</u> script in AWS Support Tools on GitHub.

Plugins

The following topic describes issues you may encounter when configuring or updating Apache Airflow plugins.

Does Amazon MWAA support implementing custom UI?

Starting with Apache Airflow v2.2.2, Amazon MWAA supports installing plugins on the Apache Airflow web server, and implementing custom UI. If your Amazon MWAA environment is running Apache Airflow v2.0.2 or older, you will not be able to implement custom UI.

For more information about version management, and upgrading your existing environments, refer to <u>Versions</u>.

I am able to implement custom UI changes on the <u>Amazon MWAA local runner</u> via plugins, yet when I try to do the same on Amazon MWAA, I do not see my changes nor any errors. Why is this happening?

the Amazon MWAA local runner has all the Apache Airflow components bundled into one image, allowing you to apply custom UI plugin changes.

Create bucket

The following topic describes the errors you may receive when creating an Amazon S3 bucket.

I can't select the option for S3 Block Public Access settings

The <u>execution role</u> for your Amazon MWAA environment needs permission to the GetBucketPublicAccessBlock action on the Amazon S3 bucket to verify the bucket blocked public access. We recommend the following steps:

- 1. Follow the steps to <u>Attach a JSON policy to your execution role</u>.
- 2. Attach the following JSON policy:

```
{
    "Effect":"Allow",
    "Action":[
        "s3:GetObject*",
        "s3:GetBucket*",
        "s3:List*"
],
```

```
"Resource":[
    "arn:aws:s3:::amzn-s3-demo-bucket",
    "arn:aws:s3:::amzn-s3-demo-bucket/*"
]
}
```

Substitute the sample placeholders in *amzn-s3-demo-bucket* with your Amazon S3 bucket name.

3. To run a troubleshooting script that checks the Amazon VPC network setup and configuration for your Amazon MWAA environment, refer to the <u>Verify Environment</u> script in AWS Support Tools on GitHub.

Create environment

The following topic describes the errors you may receive when creating an environment.

I tried to create an environment and it's stuck in the "Creating" state

- 1. Check VPC network with *public routing*. If you're using an Amazon VPC *with Internet access*, verify the following:
 - That your Amazon VPC is configured to allow network traffic between the different AWS resources used by your Amazon MWAA environment, as defined in <u>the section called</u> <u>"About networking"</u>. For example, your VPC security group must either allow all traffic in a self-referencing rule, or optionally specify the port range for HTTPS port range 443 and a TCP port range 5432.
- 2. Check VPC network with *private routing*. If you're using an Amazon VPC *without Internet access*, verify the following:
 - That your Amazon VPC is configured to allow network traffic between the different AWS resources for your Amazon MWAA environment, as defined in <u>the section called "About networking"</u>. For example, your two private subnets must **not** have a route table to a NAT gateway (or NAT instance), **nor** an Internet gateway.
- 3. To run a troubleshooting script that checks the Amazon VPC network setup and configuration for your Amazon MWAA environment, refer to the <u>Verify Environment</u> script in AWS Support Tools on GitHub.

I tried to create an environment but it shows the status as "Create failed"

We recommend the following steps:

- 1. Check VPC network configuration. To learn more, refer to <u>the section called "Environment</u> <u>stuck"</u>.
- 2. Check user permissions. Amazon MWAA performs a dry run against a user's credentials before creating an environment. Your AWS account may not have permission in AWS Identity and Access Management (IAM) to create some of the resources for an environment. For example, if you chose the **Private network** Apache Airflow access mode, your AWS account must have been granted access by your administrator to the <u>AmazonMWAAFullConsoleAccess</u> access control policy for your environment, which allows your account to create VPC endpoints.
- 3. Check execution role permissions. An execution role is an AWS Identity and Access Management (IAM) role with a permissions policy that grants Amazon MWAA permission to invoke the resources of other AWS services (such as Amazon S3, CloudWatch, Amazon SQS, Amazon ECR) on your behalf. Your <u>Customer managed key</u> or <u>AWS owned key</u> also needs to be permitted access. To learn more, refer to <u>Execution role</u>.
- 4. Check Apache Airflow logs. If you enabled Apache Airflow logs, verify your log groups were created successfully on the <u>Logs groups page</u> on the CloudWatch console. If you see blank logs, the most common reason is due to missing permissions in your execution role for CloudWatch or Amazon S3 where logs are written. To learn more, refer to Execution role.
- 5. To run a troubleshooting script that checks the Amazon VPC network setup and configuration for your Amazon MWAA environment, refer to the <u>Verify Environment</u> script in AWS Support Tools on GitHub.
- 6. If you are using an Amazon VPC *without* internet access, ensure that you've created an Amazon S3 gateway endpoint, and granted the minimum required permisions to Amazon ECR to access Amazon S3. To learn more about creating an Amazon S3 gateway endpoint, refer to the following:
 - Creating an Amazon VPC network without internet access
 - <u>Create the Amazon S3 gateway endpoint</u> in the Amazon Elastic Container Registry User Guide

I tried to select a VPC and received a "Network Failure" error

If you see a "Network Failure" error when you try to select an Amazon VPC when creating your environment, turn off any in-browser proxies that are running, and then try again.

I tried to create an environment and received a service, partition, or resource "must be passed" error

We recommend the following steps:

• You may be receiving this error because the URI you specified for your Amazon S3 bucket includes a '/' at the end of the URI. We recommend removing the '/' in the path. The value should be in the following format:

s3://amzn-s3-demo-bucket

I tried to create an environment and it shows the status as "Available" but when I try to access the Airflow UI an "Empty Reply from Server" or "502 Bad Gateway" error is shown

We recommend the following steps:

- Check VPC security group configuration. To learn more, refer to <u>the section called</u> "Environment stuck".
- 2. Confirm that any Apache Airflow packages you listed in the requirements.txt correspond to the Apache Airflow version you're running on Amazon MWAA. To learn more, refer to Installing Python dependencies.
- 3. To run a troubleshooting script that checks the Amazon VPC network setup and configuration for your Amazon MWAA environment, refer to the <u>Verify Environment</u> script in AWS Support Tools on GitHub.

I tried to create an environment and my user name is a bunch of random character names

• Apache Airflow has a maximum of 64 characters for user names. If your AWS Identity and Access Management (IAM) role exceeds this length, a hash algorithm is used to reduce it, while remaining unique.

Update environment

The following topic describes the errors you may receive when updating an environment.

I tried changing the environment class but the update failed

If you update your environment to a different environment class (such as changing an mw1.medium to an mw1.small), and the request to update your environment failed, the environment status goes into an UPDATE_FAILED state and the environment is rolled back to, and is billed according to, the previous stable version of an environment.

We recommend the following steps:

- 1. Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> runner on GitHub.
- 2. To run a troubleshooting script that checks the Amazon VPC network setup and configuration for your Amazon MWAA environment, refer to the <u>Verify Environment</u> script in AWS Support Tools on GitHub.

Access environment

The following topic describes the errors you may receive when accessing an environment.

I can't access the Apache Airflow UI

- Check user permissions. You may not have been granted access to a permissions policy that allows you to view the Apache Airflow UI. To learn more, refer to <u>the section called "Accessing</u> an Amazon MWAA environment".
- 2. Check network access. This may be because you selected the Private network access mode. If the URL of your Apache Airflow UI is in the following format 387fbcn-8dh4-9hfj-0dnd-834jhdfb-vpce.c10.uswest-2.airflow.amazonaws.com, it means that you're using private routing for your Apache Airflow Web server. You can either update the Apache Airflow access mode to the Public network access mode, or create a mechanism to access the VPC endpoint for your Apache Airflow Web server. To learn more, refer to the section called "Managing access to VPC endpoints".

Troubleshooting: CloudWatch Logs and CloudTrail errors

The topics on this page contains resolutions to Amazon CloudWatch Logs and AWS CloudTrail errors you may encounter on an Amazon Managed Workflows for Apache Airflow environment.

Contents

- Logs
 - I can't see my task logs, or I received a 'Reading remote log from Cloudwatch log_group' error
 - Tasks are failing without any logs
 - I see a 'ResourceAlreadyExistsException' error in CloudTrail
 - I see an 'Invalid request' error in CloudTrail
 - <u>I see a 'Cannot locate a 64-bit Oracle Client library: "libclntsh.so: cannot open shared object</u> file: No such file or directory' in Apache Airflow logs
 - I see psycopg2 'server closed the connection unexpectedly' in my Scheduler logs
 - I see 'Executor reports task instance %s finished (%s) although the task says its %s' in my DAG processing logs
 - I see 'Could not read remote logs from log_group: airflow-*{*environmentName}-Task log_stream:* {*DAG_ID}/*{*TASK_ID}/*{*time}/*{*n}.log.' in my task logs

Logs

The following topic describes the errors you may receive when viewing Apache Airflow logs.

I can't see my task logs, or I received a 'Reading remote log from Cloudwatch log_group' error

Amazon MWAA has configured Apache Airflow to read and write logs directly from and to Amazon CloudWatch Logs. If a worker fails to start a task, or fails to write any logs, you will see the error:

*** Reading remote log from Cloudwatch log_group: airflow-environmentName-Task
log_stream: DAG_ID/TASK_ID/timestamp/n.log.Could not read remote logs from log_group:
airflow-environmentName-Task log_stream: DAG_ID/TASK_ID/time/n.log.

- a. Verify that you have enabled task logs at the INFO level for your environment. For more information, refer to Viewing Airflow logs in Amazon CloudWatch.
- b. Verify that the environment <u>execution role</u> has the correct permission policies.
- c. Verify that your operator or task is working correctly, has sufficient resources to parse the DAG, and has the appropriate Python libraries to load. To verify your whether you have the correct dependencies, try eliminating imports until you find the one that is causing the issue. We recommend testing your Python dependencies using the <u>Amazon MWAA local-runner tool</u>.

Tasks are failing without any logs

If tasks are failing in a workflow and you can't locate any logs for the failed tasks, check if you are setting the queue parameter in your default arguments, as shown in the following.

```
from airflow import DAG
from airflow.operators.bash_operator import BashOperator
from airflow.utils.dates import days_ago
# Setting queue argument to default.
default_args = {
    "start_date": days_ago(1),
    "queue": "default"
}
with DAG(dag_id="any_command_dag", schedule_interval=None, catchup=False,
    default_args=default_args) as dag:
    cli_command = BashOperator(
        task_id="bash_command",
        bash_command="{{ dag_run.conf['command'] }}"
    )
```

To resovle the issue, remove queue from your code, and invoke the DAG again.

I see a 'ResourceAlreadyExistsException' error in CloudTrail

```
"errorCode": "ResourceAlreadyExistsException",
    "errorMessage": "The specified log stream already exists",
    "requestParameters": {
        "logGroupName": "airflow-MyAirflowEnvironment-DAGProcessing",
```

```
"logStreamName": "scheduler_cross-account-eks.py.log"
```

}

Certain Python requirements such as apache-airflow-backport-providers-amazon roll back the watchtower library that Amazon MWAA uses to communicate with CloudWatch to an older version. We recommend the following steps:

Add the following library to your requirements.txt

```
watchtower==1.0.6
```

I see an 'Invalid request' error in CloudTrail

```
Invalid request provided: Provided role does not have sufficient permissions for s3
location airflow-xxx-xxx/dags
```

If you're creating an Amazon MWAA environment and an Amazon S3 bucket using the same AWS CloudFormation template, you need to add a DependsOn section within your AWS CloudFormation template. The two resources (*MWAA Environment* and *MWAA Execution Policy*) have a dependency in AWS CloudFormation. We recommend the following steps:

• Add the following **DependsOn** statement to your AWS CloudFormation template.

```
. . .
     MaxWorkers: 5
     NetworkConfiguration:
       SecurityGroupIds:
          - !GetAtt SecurityGroup.GroupId
       SubnetIds: !Ref subnetIds
     WebserverAccessMode: PUBLIC ONLY
   DependsOn: MwaaExecutionPolicy
   MwaaExecutionPolicy:
   Type: AWS::IAM::ManagedPolicy
   Properties:
     Roles:
        - !Ref MwaaExecutionRole
     PolicyDocument:
       Version: 2012-10-17
       Statement:
```

. . .

```
    Effect: Allow
    Action: airflow:PublishMetrics
    Resource:
```

For an example, refer to <u>Quick start tutorial for Amazon Managed Workflows for Apache</u> Airflow.

I see a 'Cannot locate a 64-bit Oracle Client library: "libclntsh.so: cannot open shared object file: No such file or directory' in Apache Airflow logs

- We recommend the following steps:
 - If you're using Apache Airflow v2, add core.lazy_load_plugins : False as an Apache Airflow configuration option. To learn more, refer to <u>Using configuration options</u> to load plugins in 2.

I see psycopg2 'server closed the connection unexpectedly' in my Scheduler logs

If you see an error similar to the following, your Apache Airflow *Scheduler* may have run out of resources.

```
2021-06-14T10:20:24.581-05:00 sqlalchemy.exc.OperationalError:
(psycopg2.OperationalError) server closed the connection unexpectedly
2021-06-14T10:20:24.633-05:00 This probably means the server terminated abnormally
2021-06-14T10:20:24.686-05:00 before or while processing the request.
```

We recommend the following steps:

• Consider upgrading to Apache Airflow v2.0.2, which allows you to specify up to 5 *Schedulers*.

I see 'Executor reports task instance %s finished (%s) although the task says its %s' in my DAG processing logs

If you see an error similar to the following, your long-running tasks may have reached the task time limit on Amazon MWAA. Amazon MWAA has a limit of 12 hours for any one Airflow task, to prevent tasks from getting stuck in the queue and blocking activities like autoscaling.

Executor reports task instance %s finished (%s) although the task says its %s. (Info: %s) Was the task killed externally

We recommend the following steps:

Consider breaking up the task into multiple, shorter running tasks. Airflow typically has a
model whereby operators are asynchronous. It invokes activities on external systems, and
Apache Airflow Sensors poll to see when its complete. If a Sensor fails, it can be safely retried
without impacting the Operator's functionality.

I see 'Could not read remote logs from log_group: airflow-*{*environmentName}-Task log_stream:* {*DAG_ID}/*{*TASK_ID}/*{*time}/*{*n}.log.' in my task logs

If you see an error similar to the following, the execution role for your environment may not contain a permissions policy to create log streams for task logs.

Could not read remote logs from log_group: airflow-*{*environmentName}-Task log_stream:* {*DAG_ID}/*{*TASK_ID}/*{*time}/*{*n}.log.

We recommend the following steps:

 Modify the execution role for your environment using one of the sample policies at <u>the section</u> called "Execution role".

You may have also specified a provider package in your requirements.txt file that is incompatible with your Apache Airflow version. For example, if you're using Apache Airflow v2.0.2, you may have specified a package, such as the <u>apache-airflow-providers-databricks</u> package, which is only compatible with Airflow 2.1+.

- If you're using Apache Airflow v2.0.2, modify the requirements.txt file and add apacheairflow[databricks]. This installs the correct version of the Databricks package that is compatible with Apache Airflow v2.0.2.
- 2. Test your DAGs, custom plugins, and Python dependencies locally using the <u>aws-mwaa-local-</u> <u>runner</u> on GitHub.

Amazon MWAA Document History

The following table describes important additions to the Amazon MWAA service documentation, beginning in November 2020. To receive notifications about updates to this documentation, subscribe to the RSS feed.

Change	Description	Date
IPv6 updates	Added information about IPv6 support.	August 26, 2025
	 the section called "About networking" 	
Environment updates	Added a note about the workerReplacementS trategy changing from GRACEFUL to FORCED if you perform an update while your environment is in MAINTENANCE status.	August 6, 2025
	 the section called "Update an environment" 	
<u>Version deprecation informati</u> <u>on</u>	Updated topic on version deprecation to include deprecation notices and timelines for Apache Airflow v2.4.3, Apache Airflow v2.5.1, and Apache Airflow v2.6.3.	June 24, 2025
	 the section called "Apache Airflow deprecated versions" 	

Added a new environment class: mw1.micro	Amazon MWAA now provides a new environment class: mw1.micro.	November 19, 2024
	 the section called "Configur ing the environment class" 	
	 <u>the section called</u> <u>"Performance tuning for</u> <u>Apache Airflow"</u> 	
Support for simpler method to access Apache Airflow REST API	Amazon MWAA now provides a simplified approach for interacting with the Apache Airflow REST API using AWS credentials.	October 23, 2024
	 the section called "Using the Apache Airflow REST API" the section called "Apache Airflow Rest API access" 	
New Apache Airflow version	Amazon MWAA now supports Apache Airflow v2.10.1. This update includes informati on on updated provider packages, and details about using Apache Airflow v2.10.1 on Amazon MWAA.	September 26, 2024
	 <u>Versions</u> <u>the section called "Provider packages for Apache</u> <u>Airflow v2.10.1 connectio</u> <u>ns"</u> 	

New Apache Airflow version	Amazon MWAA now supports Apache Airflow v2.9.2. This update includes informati on on updated provider packages, and details about using Apache Airflow v2.9.2 on Amazon MWAA.	July 9, 2024
	 <u>Versions</u> the section called "Provider packages for Apache Airflow v2.9.2 connections" 	
Amazon MWAA supports configuring a custom web server domain names	Amazon MWAA supports configuring a custom web server domain names for private environments with no internet access. This update includes the following new topic that describes setting up a new custom domain.	June 18, 2024
	 the section called "Setting up a custom domain" 	
Amazon MWAA supports web server automatic scaling and the Apache Airflow REST API	Amazon MWAA now supports automatic scaling of web servers as well as the ability to access and use the Apache Airflow REST API.	May 16, 2024
	 the section called "Configur ing web server auto scaling" the section called "Using the Apache Airflow REST API" 	

leave and dependentions of	Undeted the fellowing to give	May 10, 2024
Improved description of automatic scaling behavior	Updated the following topic to reflect the new Amazon MWAA automatic scaling behavior when workers pick up new tasks as Fargate workers downscale.	May 10, 2024
	 the section called "Configur ing worker auto scaling" 	
Support for larger instance sizes	Amazon MWAA now supports two larger instance size options for larger workloads :mw1.xlarge , and mw1.2xlarge	April 16, 2024
	 <u>the section called</u> <u>"Environment capabilities"</u> 	
<u>New Apache Airflow version</u>	Amazon MWAA now supports Apache Airflow v2.8.1. This update includes informati on on updated provider packages, and details about using Apache Airflow v2.8.1 on Amazon MWAA.	February 22, 2024
	 <u>Versions</u> <u>the section called "Provider packages for Apache</u> Airflow v2.8.1 connections" 	

Support for shared Amazon VPC	Amazon MWAA supports cross-account environment creation for organizations using Amazon OpenSearch Service to manage Amazon MWAA resources using a central shared Amazon VPC in an <i>owner</i> account. As part of this launch, Amazon MWAA lets you choose to create, and manage, your own Amazon VPC endpoints.	November 15, 2023
<u>New Apache Airflow version</u>	 Amazon MWAA now supports Apache Airflow v2.7.2. This update includes informati on on updated provider packages, and details about using Apache Airflow v2.7.2 on Amazon MWAA. <u>Versions</u> <u>the section called "Provider packages for Apache</u> 	November 6, 2023

Airflow v2.7.2 connections"

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<u>New Apache Airflow version</u>	Amazon MWAA now supports Apache Airflow v2.6.3. This update includes informati on on updated provider packages, and details about using Apache Airflow v2.6.3 on Amazon MWAA,	August 9, 2023
	 <u>Versions</u> the section called "Provider packages for Apache Airflow v2.6.3 connections" 	
<u>Version deprecation informati</u> <u>on</u>	Updated topic on version deprecation to include deprecation notices and timelines for Apache Airflow v2.0.2 and Apache Airflow v2.2.2.	July 31, 2023
	 the section called "Apache Airflow deprecated versions" 	
<u>New topics and use cases</u>	Amazon MWAA supports minor version upgrades. This updates includes the following new topic that describes how to upgrade the environment and make sure your workflow resources are compatible with the version of Apache Airflow you are upgrading to:	June 5, 2023
	 the section called "Changing the version" 	

Updated topic

Updated customer managed
IAM policies that grant a
user full console and API
access to Amazon MWAA. The
update describes why you
must provide permission for
iam:PassRole in order
to allow a user to pass roles
to Amazon MWAA. Amazon
MWAA uses these permissions
to perform actions on a user's
behalf.

• the section called "Accessin g an Amazon MWAA environment"

New guidance	Updated topic on configuri ng AWS Secrets Manager	April 12, 2023
	as a backend for Amazon	
	MWAA to provide guidance on	
	using lookup patterns. Using	
	lookup patterns narrow the	
	secrets that Apache Airflow	
	searches for and reduce the	
	number of API calls Amazon	
	MWAA makes to Secrets	
	Manager to retrieve connectio	
	ns and variables. This reduces	
	the costs associated with	
	using Secrets Manager as a	
	backend.	
	Create the Secrets Manager	

backend as an Apache **Airflow configuration** option

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<u>New Apache Airflow version</u>	Amazon MWAA now supports Apache Airflow v2.5.1. This update includes informati on on updated provider packages, and details about using Apache Airflow v2.5.1 on Amazon MWAA,	April 11, 2023
	 <u>Versions</u> <u>the section called "Provider packages for Apache</u> <u>Airflow v2.5.1 connections"</u> 	
New topics and use cases	Added a new topic on using a startup script with an Amazon MWAA environment. This topic descibes configuring a startup script for an existing environment, using it to install Linux runtimes, and setting environment variables .	April 3, 2023
Updated section on private web server access	 startup script" Updated the following topic on private web server access. The update clarifies that, in environments with private web server access, you must use a Python wheel archive (.wh1) to package, and install, dependencies. Private web server access mode 	February 24, 2023

Added information on deprecated Apache Airflow versions Updated the <u>Versions</u> topic with new information on how Amazon MWAA managed deprecating Apache Airflow versions. Removed a section about upgrading to newer version of Apache Airflow, and a section that described changes between Apach e Airflow v1 and Apache Airflow v2. For more informati on about migrating to a newversion of Apache Airflow, refer to the <u>Amazon MWAA</u> <u>Migration Guide</u>.

- the section called "Apache <u>Airflow deprecated</u> <u>versions"</u>
- the section called "Apache Airflow version support and FAQ"

February 17, 2023

Fixes in Amazon MWAA container metrics

Updated the container metrics topic, and removed a set of erroneous metrics that did not exist under the Cluster dimension. Added an additional section that describes how you can evaluate the number of additional workers that an environment is utilizing at a given time by graphing the CPUUtilization or the MemoryUtilization metric for the Additiona lWorker component, and setting the statistics type to Sample Count.

 the section called "Evaluati ng the number of additiona l worker and web server containers" January 20, 2023

Updated topic on service-l

inked role

New Apache Airflow versionAmazon MWAA now supportsJanuary 5, 2023Apache Airflow v2.4.3. This
update includes informati
on on updated provider
packages, details about
using Apache Airflow v2.4.3
on Amazon MWAA, and
consolidated information
about which features are
supported in each Apache
Airflow version on Amazon
MWAA.

- Versions
- the section called "Provider packages for Apache Airflow v2.4.3 connections"

Updated information about the service-linked role that Amazon MWAA uses to create and manage AWS resources on your behalf, including information about how you can delete the service-linked role when you no longer need it. This includes an updated service-linked role permissio n policy that allows Amazon MWAA to publishe additiona l CloudWatch metrics under the AWS/MWAA namespace.

 the section called "Servicelinked role" November 18, 2022

User		

<u>New topic on service metrics</u>	Added new topic that describes service metrics emitted by Amazon MWAA under the AWS/MWAA namespace. These include Amazon ECS cluster metrics schedulers, workers, and web servers, Amazon SQS metrics for the queues that allow Amazon MWAA to decouple schedulers and workers, as well as Amazon RDS metrics for the metadata database.	November 18, 2022
<u>New topic</u>	metrics" Added new guidance on modifying a constraints file to specify new versions of provider packages to use with your Amazon MWAA environment.	November 18, 2022
	 the section called "Specifyi ng newer provider packages" 	
Updated FAQ entry	Updated information related to Amazon MWAA's HIPAA eligibility.	November 15, 2022
	 the section called "HIPAA compliance" 	

<u>New topic</u>	Added new topic on using <u>aws:SourceArn</u> and <u>aws:SourceAccount</u> global condition context keys in an Amazon MWAA execution role trust policy, in order to prevent cross-service confused deputy. • <u>the section called "Cross-</u> <u>service confused deputy</u> <u>prevention"</u>	October 21, 2022
<u>New sample code</u>	Added updated instructi ons and DAG code example that writes custom OS-level metrics to CloudWatch.	September 13, 2022
	 the section called "Using a DAG to write custom metrics" 	
<u>New sample code</u>	Added updated instructi ons and a new AWS Lambda Python code example that retrieves an Apache Airflow CLI token, then invokes a DAG in a specified Amazon MWAA environment.	September 12, 2022
	 the section called "Invoking 	

DAGs with Lambda"

New architectural diagrams	Added new architectural diagrams that demonstrate an Amazon MWAA environme nt with a public and private web server.	September 12, 2022
	 the section called "Apache Airflow access modes" 	
<u>New sample code</u>	Added updated instructi ons and a new DAG code example that retrieves an Apache Airflow CLI token, then invokes another DAG in a different Amazon MWAA environment.	August 16, 2022
	 <u>the section called</u> <u>"Invoking DAGs in different</u> <u>environments"</u> 	
<u>New sample code</u>	Added updated instructions and new DAG that queries an environment's Aurora PostgreSQL for metadata information, writes the result to CSV files and stores the files in Amazon S3.	August 12, 2022
	 the section called "Exportin g environment metadata to Amazon S3" 	

<u>New sample code</u>	Added updated instructions and new DAG that refreshes an AWS CodeArtifact token at runtime and stores the result in Amazon S3.	August 3, 2022
	 the section called "Refreshing an AWS CodeArtifact token at runtime" 	
<u>New sample code</u>	Added updated instructions and DAG code sample for using the ECSOperator in Amazon MWAA.	July 26, 2022
	 the section called "Using the ECSOperator " 	
<u>New sample code</u>	Added updated instructions and DAG code sample for using the SSHOperator in Amazon MWAA.	July 15, 2022
	 the section called "Using the SSHOperator " 	
<u>New sample code</u>	Added new instructions and DAG code sample for using dbt Postgres with Amazon MWAA.	June 17, 2022
	 the section called "Using dbt with Amazon MWAA" 	

New topics and use cases	Added new instructions and DAG code sample for installin g dependencies using Python wheel files for Amazon MWAA environments with public and private access.	May 13, 2022
	 Managing dependencies using Python wheels 	
<u>New topics and use cases</u>	Added new guidance on choosing which Apache Airflow metrics Amazon MWAA sends to CloudWatch. • <u>Choosing which Apache</u> <u>Airflow metrics are</u> reported	April 19, 2022
<u>New guides</u>	Amazon MWAA offers a migration guide for migrating Apache Airflow workflows from self-mana ged deployments, as well as existing Amazon MWAA environments.	March 7, 2022
	• Anazon MWAA Migration Guide	

New topics and use cases	Added new security best practice for working with Apache Airflow, including a solution for detecting changes to the Apache Airflow user privileges.	February 18, 2022
	 the section called "Security best practices in Apache Airflow" 	
<u>New sample code</u>	Added new code sample for creating timezone-aware DAGs using Pendulum, and clarified how to use a custom plugin to change the timezone in which Apache Airflow logs are created.	February 11, 2022

Apache Airflow v2.2.2 launch

Amazon Managed Workflows for Apache Airflow now supports Apache Airflow v2.2.2. Beginning with v2.2, Amazon MWAA will install Python packages and custom plugins directly on the Apache Airflow web server allowing you greater flexibility to manage your environments. For more information, refer to the following.

- Apache Airflow versions on Amazon Managed Workflows for Apache Airflow.
- the section called "Provider packages for Apache Airflow v2.2.2 connections".
- <u>Apache Airflow v2.2.2</u> <u>changelog</u> on the Apache Airflow documentation website.

January 27, 2022

<u>New tutorials</u>	Added a new tutorial that demonstrates creating a new custom Apache Airflow role, and assigning the role to an Apache Airflow user mapped from IAM in order to limit the user's access to a subset of specified DAGs.	December 8, 2021
	 the section called "Tutorial: Restricting users to a subset of DAGs" 	
Fixes	Fixed a best practices recommendation for setting the value of scheduler .min_file_process_ interval in order to optimize CPU usage. Added an IAM policy example granting access to Secrets Manager resources in the execution role. Added troubleshooting topic on using Secrets Manager condition keys.	November 22, 2021
	 Performance tuning how the scheduler parses DAGs Provide Amazon MWAA with permission to access Secrets Manager secret keys Configuring condition keys in the Amazon MWAA execution role for Secrets Manager 	

New sample code

Fixes

Added the following new code sample for modifying the time zone in which DAGs are processed using a custom plugin, and new troublesh ooting topic for invoking the dags backfill Apache Airflow CLI command from within a bash operator.

- <u>the section called</u> "Changing a DAG's <u>timezone"</u>
- Backfill CLI command using
 <u>a bash operator</u>

Fixed issues in the Amazon ECS operator code sample, and clarified the additional permissions required in the Amazon MWAA execution role to allow the environment to access Amazon ECS task log group in CloudWatch Logs.

 Amazon ECS operator permissions. November 1, 2021

October 26, 2021

<u>New sample code</u>	Added new code sample that queries the Aurora PostgreSQ L database for information relevant to DAG runs and writes the results to CSV file stored on Amazon S3.	October 1, 2021
	 the section called "Exportin g environment metadata to Amazon S3". 	
<u>Fixes</u>	Corrected information about how Amazon MWAA automatically syncs new and changed objects from your target Amazon S3 bucket to your schedulers and workers.	October 1, 2021
<u>Now supported</u>	Amazon MWAA now supports additional provider packages for Apache Airflow 2.0+. To learn more about supported packages, refer to the following: • <u>the section called "Provider</u> <u>packages for Apache</u> Airflow v2.0.2 connections".	September 24, 2021

<u>New commands and</u> procedures	Added additional guidance and AWS CLI command examples for creating an Amazon S3 gateway endpoint when using an Amazon VPC without internet access:	September 24, 2021
	 Creating an Amazon VPC network without Internet access. 	
<u>New topics and use cases</u>	 Added the following changes: Added a new code sample that uses an Amazon Elastic Container Service operator in the section called "Using the ECSOperator ". Added new troublesh ooting topics for issues in configuring Apache Airflow plugins in the section called "Plugins". 	September 19, 2021

Amazon MWAA is now New supported region available in the following regions: • Asia Pacific (Mumbai) - apsouth-1 • Asia Pacific (Seoul) - apnortheast-2 • Europe (London) - euwest-2 • Europe (Paris) - eu-west-3 • Canada (Central) - ca-centra l-1 South America (São Paulo) sa-east-1 For more information about region availability and service endpoints, refer to the following: Amazon MWAA endpoints and quotas in the AWS General Reference. New topics and use cases Added the following changes: August 27, 2021

• Updated the sample policies to allow Amazon MWAA to fetch account-l evel Amazon S3 settings (s3:GetAccountPubli cAccessBlock) in Amazon MWAA execution role.

August 31, 2021

Fixes	Added the following changes:	August 27, 2021
	 Fixed the AWS CloudForm ation template to use a self-referencing inbound rule for the security group in <u>Create the VPC network</u>. Fixed the AWS CloudForm ation template to use a 	
	self-referencing inbound rule for the security group in <u>Quick start tutorial</u> for Amazon Managed <u>Workflows for Apache</u> <u>Airflow</u> .	
<u>New topics and use cases</u>	Added the following changes: • Added DAG decorator to the list of what's supported for Apache Airflow v2.0.2 <u>Apache Airflow versions</u> <u>on Amazon Managed</u> <u>Workflows for Apache</u> <u>Airflow</u> .	August 20, 2021

August 13, 2021

New topics and use cases	Added the following changes:	
	 Added celery.sy 	
	nc_parallelism use	
	case to <u>Performance tuning</u>	
	for Apache Airflow on	
	Amazon MWAA.	

• Added service endpoints to quotas page and changed name to Amazon Managed Workflows for Apache Airflow service endpoints and quotas.

- Clarified networking prerequisites based on user feedback at Get started with Amazon Managed Workflows for Apache Airflow.
- Moved dags list-runs and dags next-exec ution to unsupported Airflow CLI commands in Apache Airflow CLI command reference.

New sample code	Added the following changes:	August 13, 2021
	 Added bash example to set, get or delete an Apache Airflow v2.0.2 variable in <u>Apache Airflow CLI</u> <u>command reference</u>. 	
	 Added Apache Airflow v2.0.2 dependencies and Airflow connection example to <u>Using Amazon MWAA</u> with Amazon RDS for <u>Microsoft SQL Server</u>. 	
Fixes	Added the following changes:	August 13, 2021
	 Fixed the Python code sample based on user feedback at <u>Creating an</u> <u>SSH connection using the</u> <u>SSHOperator</u>. 	

Added the following changes: August 6, 2021

- Moved variables set to supported Airflow CLI commands in <u>Apache</u> <u>Airflow CLI command</u> reference.
- Added the summary of What's changed in v2.0.2 from the Airflow versions page to <u>Installing Python</u> <u>dependencies</u> based on user feedback.
- Added the summary of What's changed in v2.0.2 from the Airflow versions page to <u>Apache Airflow CLI</u> <u>command reference</u> based on user feedback.
- Added the summary of What's changed in v2.0.2 from the Airflow versions page to <u>Overview of</u> <u>connection types</u> based on user feedback.
- Added the summary of What's changed in v2.0.2 from the Airflow versions page to Installing custom plugins based on user feedback.
- Added the summary of What's changed in v2.0.2 from the Airflow versions page to <u>Adding or</u>

	updating DAGs based on user feedback.	
New sample code	Added the following changes:	August 6, 2021
	 Added Apache Airflow v2.0.2 sample code to <u>Using</u> a DAG to import variables in the CLI. 	
	 Added Apache Airflow v2.0.2 sample code to <u>Invoking DAGs with a</u> <u>Lambda function</u>. 	
New topics and use cases	Added the following changes:	July 29, 2021
	 Added troubleshooting topic for 'I can't see my connection in the Airflow UI' at <u>Troublesh</u> <u>ooting Amazon Managed</u> <u>Workflows for Apache</u> <u>Airflow</u>. Added a list of Amazon VPCs Amazon MWAA supports to <u>About</u> <u>networking on Amazon</u> <u>MWAA</u>. 	

Fixes	Added the following changes:	July 29, 2021
	 Fixed the Python code sample based on user feedback to print the web login token at <u>Create a</u> <u>Apache Airflow web server</u> <u>access token</u>. Fixed the Snowflake connection topic based on user feedback to use a single quote for the warehouse parameter at <u>Troubleshooting Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>. 	
Removed or moved topics	Added the following changes:	July 23, 2021
	 Restructed the existing page to include all monitoring and metrics documentation pages in Monitoring and metrics for Amazon Managed Workflows for Apache Airflow. Moved Apache Airflow v2 environment metrics in CloudWatch to the monitoring and metrics navigation menu. 	

New guides	Added the following changes:	July 23, 2021
	 Created <u>Apache Airflow</u> provider packages installed on Amazon MWAA environments. Created <u>Monitoring</u> overview on Amazon <u>MWAA</u>. 	
	 Created <u>Viewing audit logs</u> <u>in AWS CloudTrail</u>. Created <u>Viewing Airflow</u> <u>logs in Amazon CloudWatc</u> <u>h</u>. 	
Fixes	 Added the following changes: Fixed the Python code sample based on user feedback to generate an Airflow connection string in the correct sequence and added the port parameter in <u>Configuring an Apache</u> <u>Airflow connection using</u> <u>a AWS Secrets Manager</u> <u>secret.</u> Added a step to install an unzip package locally based on user feedback in <u>Creating a custom plugin</u> 	July 23, 2021
	<u>Creating a custom plugin</u> with Oracle.	

Added the following changes: July 16, 2021

- Added topic for AWS DMS
 Operators at <u>Amazon</u>

 <u>MWAA frequently asked</u>
 questions.
- Added troubleshooting topic for a remote logs error to <u>Troublesh</u> <u>ooting Amazon Managed</u> <u>Workflows for Apache</u> <u>Airflow</u>.
- Moved variables set to unsupported Airflow CLI commands in <u>Apache</u> <u>Airflow CLI command</u> <u>reference</u>.

New topics and use cases	Added the following changes:	July 9, 2021
	 Added sequential steps to create a requireme nts.txt file based on user feedback at <u>Installing</u> <u>Python dependencies</u>. 	
	 Added sequential steps to create a plugins.zip file based on user feedback at <u>Installing custom plugins</u>. 	
	 Added cross-reference links throughout the user guide to the API reference guide at <u>Amazon Managed</u> Workflows for Apache <u>Airflow API Reference</u> guide. 	
	 Added topic for why plugins aren't shown in the Airflow 2.0 Admin > Plugins menu at <u>Amazon MWAA frequentl</u> y asked questions. 	
New guides	Added the following changes:	July 9, 2021
	 Created <u>Deleting files on</u> <u>Amazon S3</u>. 	

New topics and use cases	Added the following changes:	July 2, 2021
	 Added a list of supported values at <u>Using customer</u> managed keys for encryptio <u>n</u>. Updated and clarified the example for a private 	
	repo URL based on user	
	feedback in <u>Managing</u> Python dependencies in requirements.txt.	
New sample code	Added the following changes:	July 2, 2021
	 Added Apache Airflow v1.10.12 sample code to use a private key in AWS Secrets Manager for an SSH connection at <u>Creating an</u> <u>SSH connection using the</u> <u>SSHOperator</u>. 	
New topics and use cases	Added the following changes:	June 25, 2021
	 Added StartedTaskInstanc es and FinishedTaskInstan ces metrics to <u>Apache</u> <u>Airflow v2 environment</u> <u>metrics in CloudWatch</u>. 	
New sample code	Added the following changes:	June 25, 2021
	 Added Apache Airflow v2.0.2 sample code at <u>Using Amazon MWAA with</u> <u>Amazon EKS</u>. 	

New guides

Added the following changes: June 25, 2021

Created <u>Performance</u>
 <u>tuning for Apache Airflow</u>
 on Amazon MWAA.

Added the following changes: June 18, 2021

- Added connections add and connections delete to the supported Apache Airflow v2.0.2 CLI commands at <u>Apache</u> <u>Airflow CLI command</u> reference.
- Added that the latest version available in AWS CloudFormation is Apache Airflow v2.0.2 at <u>Quick</u> <u>start tutorial for Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>.
- Added question for storing temporary data on Apache Airflow Workers to <u>Amazon</u> <u>MWAA frequently asked</u> <u>questions</u>.
- Added topic for the 'Executor reports task instance %s finished' error to <u>Troubleshooting Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>.
- Added topic for the 'server closed the connectio n unexpectedly' log to <u>Troubleshooting Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>.
- Added example to run
 CLI commands on an SSH

tunnel to a bastion host to Creating an Apache Airflow CLI token.

- Added topic for randomlygenerated user names to <u>Troubleshooting Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>.
- Added topic for a 503

 error when running a DAG
 in the CLI to <u>Troublesh</u>
 <u>ooting Amazon Managed</u>
 <u>Workflows for Apache</u>
 <u>Airflow</u>.
- Added topic for custom plugins in Apache Airflow v2.0.2 which need an Airflow configuration option of core.lazy _load_plugins : False to load plugins at the start of each Airflow process to override the version's default setting to <u>Using Apache Airflow</u> configuration options on <u>Amazon MWAA</u>.
- Added Airflow configura tion options step for Apache Airflow v2.0.2 plugins sample code at <u>Creating a custom plugin</u> with Apache Hive and <u>Hadoop</u>.

•	Added Airflow configura
	tion options step for
	Apache Airflow v2.0.2
	plugins sample code at
	Creating a custom plugin
	that generates runtime
	environment variables.
•	Added Airflow configura
	tion options step for

- tion options step for Apache Airflow v2.0.2 plugins sample code at <u>Creating a custom</u> <u>plugin for Apache Airflow</u> <u>PythonVirtualenvOperator</u>.
- Added Airflow configura tion options step for Apache Airflow v2.0.2 plugins sample code at <u>Creating a custom plugin</u> with Oracle.

New sample code

Added the following changes: June 18, 2021

 Added sample code for an Apache Airflow Snowflake connection at Using a secret key in AWS Secrets Manager for an Apache Airflow Snowflake connection.

Added the following changes: June 2, 2021

- Added server-side encryptio n guidance to <u>Create an</u> <u>Amazon S3 bucket for</u> <u>Amazon MWAA.</u>
- Added the secrets backend for Apache Airflow v2.0.2 to <u>Configuring an Apache</u> <u>Airflow connection using</u> <u>a AWS Secrets Manager</u> <u>secret</u>.
- Added question for Apache Airflow Workers quota increase requests to <u>Amazon MWAA frequently</u> <u>asked questions</u>.
- Added question for which metrics are used to determine whether to scale Apache Airflow Workers to <u>Amazon MWAA frequently</u> <u>asked questions</u>.
- Added question for creating custom metrics in CloudWatch to <u>Amazon</u> <u>MWAA frequently asked</u> <u>questions</u>.
- Added steps to enable private IP addresses for an Amazon S3 VPC interface endpoint for a VPC with private routing in <u>Creating</u> <u>the required VPC service</u>

	 endpoints in an Amazon VPC with private routing. Added an option to setup an SSH Tunnel using local port forwarding in <u>Tutorial: Configuring</u> private network access using a Linux Bastion Host. 	
New sample code	Added the following changes:	June 2, 2021
	 Added sample code for a DAG that queries the Amazon Aurora PostgreSQ L metadata database and publishes custom metrics to Amazon CloudWatc h at <u>Using a DAG to</u> write custom metrics in <u>CloudWatch</u>. 	
New guides	Added the following changes:	June 2, 2021
	 Created a guide on how to use connection templates interchangeably in the Apache Airflow UI in <u>Overview of connection</u> <u>types</u>. 	



Added the following changes: June 2, 2021

Added Apache Airflow
 VPC endpoints to the AWS
 CloudFormation template
 in Option three: Creating
 a VPC network without
 Internet access to Create
 the VPC network.

Apache Airflow v2.0.2 launch	General availability launch of Apache Airflow v2.0.2.	May 26, 2021
	 Created <u>Apache Airflow</u> <u>versions on Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>. Created <u>Apache Airflow</u> <u>v2 environment metrics in</u> <u>CloudWatch</u>. 	
	 Added version-specific links for Apache Airflow v2.0.2 to <u>Using Apache Airflow</u> <u>configuration options on</u> <u>Amazon MWAA</u>. 	
	 Added Apache Airflow v2.0.2 version-specific guidance to <u>Installing</u> <u>Python dependencies</u>. 	
	 Added Apache Airflow v2.0.2 version-specific guidance to <u>Managing</u> <u>Python dependencies in</u> requirements.txt. 	
	 Added Apache Airflow v2.0.2 sample plugins to <u>Installing custom plugins</u>. 	
	 Added Apache Airflow v2.0.2 sample code to <u>Aurora PostgreSQL</u> <u>database cleanup on an</u> <u>Amazon MWAA environme</u> <u>nt</u>. 	
	 Added Apache Airflow v2.0.2 sample code to Using 	

a secret key in AWS Secrets Manager for an Apache Airflow connection.

- Added Apache Airflow
 v2.0.2 sample code
 to Creating a custom
 plugin for Apache Airflow
 PythonVirtualenvOperator.
- Added Apache Airflow v2.0.2 commands to <u>Apache Airflow CLI</u> <u>command reference</u>.
- Added Apache Airflow
 v2.0.2 scripts to <u>Creating an</u> <u>Apache Airflow CLI token</u>.
- Added a note that Amazon MWAA uses the latest Apache Airflow version by default to <u>Create an</u> <u>Amazon MWAA environme</u> <u>nt</u>.

New topics and use cases

- Added the following changes: May 14, 2021
- Added guidance to troubleshooting Airflow tasks that are stuck or not running to <u>Troublesh</u> <u>ooting Amazon Managed</u> <u>Workflows for Apache</u> Airflow.

Fixes	Added the following changes:	May 12, 2021
	 We've updated the sample plugins code to use the latest Java version in <u>Creating a custom plugin</u> with Apache Hive and <u>Hadoop</u>. Previously, it was os.environ["JAVA_H OME"]="/usr/lib/jv m/jre-1.8.0-openjd k-1.8.0.272.b10-1. amzn2.0.1.x86_64" 	
Removed or moved topics	Added the following changes:	May 10, 2021
	 Moved topics in <u>Troublesh</u> <u>ooting Amazon Managed</u> <u>Workflows for Apache</u> <u>Airflow</u> to new pages by category. 	
New topics and use cases	Added the following changes:	May 10, 2021
	 Added Amazon S3 bucket overview to <u>Working with</u> <u>DAGs on Amazon MWAA</u>. 	

Removed or moved topics	Added the following changes:	May 7, 2021
	• Moved <u>Accessing Apache</u> <u>Airflow</u> to the top-level navigation, and added pages for <u>Create a Apache</u> <u>Airflow web server access</u> <u>token</u> , <u>Creating an Apache</u> <u>Airflow CLI token</u> , and <u>Apache Airflow CLI</u> <u>command reference</u> .	
<u>New topics and use cases</u>	 Added the following changes: Added version-specific links to the <i>Apache Airflow</i> <i>reference guide</i> for all supported and unsupport ed Airflow CLI commands in <u>Apache Airflow CLI</u> <u>command reference</u>. Added version-specific links to the <i>Apache Airflow</i> <i>reference guide</i> for all configuration options in <u>Using Apache Airflow</u> <u>configuration options on</u> <u>Amazon MWAA</u>. Added the Amazon MWAA CLI utility to <u>Managing</u> <u>Python dependencies in</u> <u>requirements.txt</u>. 	May 7, 2021

Added the following changes: April 30, 2021

- Added flat and nested examples for how to structure a plugins.zip in <u>Installing custom plugins</u>.
- Added the Amazon MWAA CLI utility to the <u>Adding or updating DAGs</u>, <u>Installing custom plugins</u>, and <u>Installing Python</u> <u>dependencies</u> pages.
- Restructured content into an overview, upload to Amazon S3, and installing on Amazon MWAA sections based on user feedback in <u>Installing custom plugins</u>, and <u>Installing Python</u> <u>dependencies</u> pages.
- Added an example use case to create and attach required VPC endpoints to an existing Amazon VPC without Internet access in About networking on Amazon MWAA.

New sample code	Added the following changes:	April 30, 2021
	 Added sample code that uses a secret key in Secrets Manager for an Apache Airflow variable in <u>Using a</u> <u>secret key in AWS Secrets</u> <u>Manager for an Apache</u> <u>Airflow variable</u>. 	
New guides	Added the following changes:	April 30, 2021
	 Created <u>Creating the</u> required VPC service endpoints in an Amazon VPC with private routing. 	
Fixes	Added the following changes:	April 30, 2021
	 Oops! We've updated core.default_ui_ti mezone to webserver .default_ui_timezo ne in <u>Using Apache</u> <u>Airflow configuration</u> options on Amazon MWAA. 	

New topics and use cases	Added the following changes:	April 23, 2021
	 Added Windows (PuTTY) steps for SSH tunnel to <u>Tutorial: Configuring</u> private network access using a Linux Bastion Host. 	
	 Added topic for apache- airflow-providers- amazon , which is only compatible with Apache Airflow 2.0 to <u>Troublesh</u> <u>ooting Amazon Managed</u> <u>Workflows for Apache</u> <u>Airflow</u>. 	
New sample code	Added the following changes:	April 23, 2021
	 Added sample code that uses a secret key in Secrets Manager for an Apache Airflow connection in <u>Using</u> a secret key in AWS Secrets <u>Manager for an Apache</u> <u>Airflow connection</u>. 	
New guides	Added the following changes:	April 23, 2021
	 Created <u>About networking</u> on <u>Amazon MWAA</u>. Created <u>Security in your</u> <u>VPC on Amazon MWAA</u>. Created <u>Managing access</u> to service-specific <u>Amazon</u> <u>VPC endpoints on Amazon</u> <u>MWAA</u>. 	

Added the following changes: April 16, 2021

- Added a new AWS CloudFormation template to create an Amazon VPC network without Internet access in <u>Create the VPC</u> <u>network</u>.
- Added a new tutorial to create an AWS Client VPN in <u>Tutorial: Configuring</u> private network access using an AWS Client VPN.
- Changed the name of the Networking access page to Apache Airflow access modes based on user feedback, and streamlin ed docs in <u>Apache Airflow</u> access modes.
- Streamlined docs to include only Amazon VPC getting started information and templates based on user feedback in <u>Create the VPC</u> <u>network</u>.
- Added BigQuery operator workaround to <u>Troublesh</u> <u>ooting Amazon Managed</u> <u>Workflows for Apache</u> <u>Airflow.</u>
- Added an Apache Airflow v1.10.12 constraints file best practice to <u>Installing</u> <u>Python dependencies</u>.

New sample code

Added the following changes: April 16, 2021

- Added sample code to create a custom plugin using Oracle in <u>Creating a</u> <u>custom plugin with Oracle</u>.
- Added sample code to create a custom plugin that generates runtime environment variables in <u>Creating a custom plugin</u> that generates runtime environment variables.

•

New topics and use cases	Added the following changes:	April 9, 2021
	 Added topic for the self- referencing rule requireme nt on a VPC security group to <u>Amazon MWAA frequentl</u> y asked questions. 	
	 Added custom plugins directory and size limits to <u>Installing custom plugins</u>. 	
	 Added requirements directory and size limits to <u>Installing Python</u> <u>dependencies</u>. 	
	 Clarified the Apache Airflow configuration options for foo.user and foo.pass in <u>Managing Python</u> <u>dependencies in requireme</u> <u>nts.txt</u>. 	
	 Added configuration options overview to <u>Using</u> <u>Apache Airflow configura</u> 	

tion options on Amazon

MWAA.

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New sample code	Added the following changes:	April 9, 2021
	 Added sample code to create a custom plugin using PythonVirtualenvOp erator in <u>Creating a custom</u> <u>plugin for Apache Airflow</u> <u>PythonVirtualenvOperator</u>. 	
	 Added sample code to create a custom plugin with Apache Hive and Hadoop in <u>Creating a custom plugin</u> with Apache Hive and <u>Hadoop</u>. 	
<u>Fixes</u>	Added the following changes: • Oops! We've updated the format for a requireme nts.txt, and added an example that's compatibl e with Apache Airflow v1.10.12 in Installing Python dependencies.	March 31, 2021

Added the following changes: March 26, 2021

- Added workaround to removing a requireme nts.txt or plugins.zip to <u>Amazon MWAA frequently</u> <u>asked questions</u>.
- Added a bash workaround for SSH on an environment to <u>Amazon MWAA frequentl</u> <u>y asked questions</u>.
- Added topic for CloudTrai l ResourceAlreadyExi stsException error to <u>Troubleshooting Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>.

Added the following changes: March 19, 2021

- Added list of AWS services used to <u>Amazon MWAA</u> execution role.
- Added list of AWS services used to <u>Service-linked role</u> for Amazon MWAA.
- Added question for Python
 3.7 version for Amazon
 MWAA to <u>Amazon MWAA</u>
 <u>frequently asked questions</u>.
- Added question for PythonVirtualenvOperator to <u>Amazon MWAA frequentl</u> <u>y asked questions</u>.
- Added the troubleshooting script as next steps for all topics related to VPC and environment configuration at <u>Troubleshooting Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>.
- Clarified the docs that a linux bastion must be in the same Region as an environment at <u>Tutorial</u>: <u>Configuring private</u> <u>network access using a</u> <u>Linux Bastion Host</u>.

New guides	Added the following changes:	March 19, 2021
	 Created Apache Airflow connections guide for AWS Secrets Manager at <u>Configuring an Apache</u> <u>Airflow connection using</u> <u>a AWS Secrets Manager</u> <u>secret</u>. 	
	 Created quick start tutorial using a AWS CloudForm ation template to create the Amazon VPC infrastru cture, Amazon S3 bucket, and Amazon MWAA environment at <u>Quick</u> <u>start tutorial for Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>. 	
<u>New topics and use cases</u>	 Added the following changes: Added the create Amazon S3 bucket troublesh ooting topic <u>Troublesh</u> <u>ooting Amazon Managed</u> <u>Workflows for Apache</u> <u>Airflow</u>. Added steps to create and attach a JSON policy to <u>Amazon MWAA execution</u> 	March 12, 2021

<u>role</u>.

Added the following changes:	March 12, 2021
 Added sample code to add a configuration when triggering a DAG to <u>Accessing Apache Airflow</u>. 	
Added the following changes:	March 12, 2021
 Created best practices guide at <u>Managing Python</u> <u>dependencies in requireme</u> <u>nts.txt</u>. 	
Added the following changes:	March 5, 2021
 Added Google/GCP/ BigQuery troublesh ooting topic to <u>Troublesh</u> ooting Amazon Managed Workflows for Apache <u>Airflow</u>. Added Cython troublesh ooting topic to <u>Troublesh</u> ooting Amazon Managed Workflows for Apache <u>Airflow</u>. Added MySQL troublesh ooting topic to <u>Troublesh</u> ooting Amazon Managed Workflows for Apache <u>Airflow</u>. Added 5xx web server error troubleshooting topic to <u>Troubleshooting Amazon</u> <u>Managed Workflows for</u> Apache Airflow. 	
	 Added sample code to add a configuration when triggering a DAG to Accessing Apache Airflow. Added the following changes: Created best practices guide at Managing Python dependencies in requireme nts.txt. Added the following changes: Added the following changes: Added the following changes: Added Google/GCP/ BigQuery troublesh ooting topic to Troublesh ooting Amazon Managed Workflows for Apache Airflow. Added Cython troublesh ooting topic to Troublesh ooting Amazon Managed Workflows for Apache Airflow. Added MySQL troublesh ooting topic to Troublesh ooting Amazon Managed Workflows for Apache Airflow. Added MySQL troublesh ooting Amazon Managed Workflows for Apache Airflow. Added Sxx web server error troubleshooting topic to Troubleshooting topic to

Now supported	Added the following changes:	March 4, 2021
	 Previously, backend_k wargs was not supported for AWS Secrets Manager and you needed a workaround to override the Secrets Manager function call. Now, backend_k wargs is supported. Refer to the AWS Secrets Manager troublesh ooting topic in Troublesh ooting Amazon Managed Workflows for Apache <u>Airflow</u>. 	
Fixes	Added the following changes:	March 4, 2021
	 Oops! We've updated the size of each environment class to reflect the actual GB in <u>Configuring the Amazon MWAA environme nt class</u>. 	

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New topics and use cases	Added the following changes:	February 26, 2021
	 Added private network access using a VPC endpoint policy to <u>Apache</u> <u>Airflow access modes</u>. Added additional checks for the creating an environme nt troubleshooting topic to <u>Troubleshooting Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>. Added steps to view logs for requirements.txt to <u>Installing Python</u> <u>dependencies</u>. 	
New topics and use cases	Added the following changes:	February 25, 2021
	 Added Apache Hive use case to Installing Python dependencies. Clarified the docs that the required dependencies for an Apache Airflow package needs to be included in the requirements.txt file at Installing Python dependencies. Added Updating requireme nts.txt troubleshooting topic to Troublesh ooting Amazon Managed Workflows for Apache Airflow. 	

New tutorials	Added the following changes:	February 22, 2021
	 Added private network tutorial to <u>Tutorial</u>: <u>Configuring private</u> <u>network access using a</u> <u>Linux Bastion Host</u>. 	
New topics and use cases	Added the following changes:	February 22, 2021
	 Added private and public network configurations to <u>Apache Airflow access</u> modes. Added development group use case and user scenarios to <u>Amazon MWAA</u> <u>execution role</u>. 	
New sample code	Added the following changes:	February 22, 2021
	 Added sample Python scripts for web login token and CLI token to <u>Accessing</u> <u>Apache Airflow</u>. 	
	 Added sample code to trigger DAG in another environment to <u>Code</u> <u>examples for Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>. Added sample code to trigger DAG using a Lambda function to <u>Invoking DAGs</u> <u>with a Lambda function</u>. 	

<u>New commands and</u> procedures	 Added the following changes: Added step by step procedures to all scripts at <u>Accessing Apache Airflow</u>. 	February 22, 2021
<u>New sample code</u>	 Added the following changes: Updated curl example for web login token at <u>Accessing Apache Airflow</u>. Added sample code to connect to an Amazon RDS Microsoft SQL Server to <u>Using Amazon MWAA with</u> <u>Amazon RDS for Microsoft</u> <u>SQL Server</u>. 	February 17, 2021

New commands and procedures	 Added the following changes: Added AWS CLI commands to <u>Working with DAGs on</u> <u>Amazon MWAA</u> pages. Apache Airflow doesn't support serialized DAGs in CLI commands. Since the CLI runs on the web server, which doesn't have plugins or requireme nts for security reasons, any MWAA environme 	February 17, 2021
	ip or requirements.txt will not support these commands. Moved Apache	
	Airflow list_dags and	
	backfill commands to	
	unsupported commands at	
	Accessing Apache Airflow.	
<u>GitHub launch</u>	User guide docs are now open source on GitHub. Choose	February 17, 2021

"Edit this page on GitHub" on

any page.

New topics and use cases	Added the following changes:	February 12, 2021
	 Added question for Step Functions v. Amazon MWAA use case to <u>Troublesh</u> <u>ooting Amazon Managed</u> <u>Workflows for Apache</u> <u>Airflow</u>. 	
	 Added CLI access policy to <u>Accessing an Amazon</u> <u>MWAA environment</u>. 	
	 Clarified the docs that any supported Apache Airflow configuration option can be specified at <u>Using Apache</u> <u>Airflow configuration</u> <u>options on Amazon MWAA</u>. 	
	 Clarified the docs that if a Fargate container in one availability zone fails, MWAA switches to the other container in a different availability zone at Create the VPC network. 	
New topics and use cases	Added the following changes:	February 5, 2021

Added <u>Configuring the</u>
 <u>Amazon MWAA environme</u>
 <u>nt class</u>.

Removed or moved topics	Added the following changes:	February 4, 2021
	 Removed requirement for Amazon S3 bucket name to start with airflow- at <u>Get started with Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>. 	
	• Moved <u>Accessing an</u> <u>Amazon MWAA environme</u> <u>nt and Amazon MWAA</u> <u>execution role to Managing</u> <u>access to an Amazon MWAA</u> <u>environment</u> .	
<u>Amazon MWAA CloudForm</u> ation	Update the parameters to create an environment at <u>Amazon MWAA CloudForm</u> ation.	February 4, 2021
	 Remove SubnetList. Remove TagList. Add NetworkConfiguration. Add TagMap. Add create environment 	

request examples.

New topics and use cases	Added the following changes:	
	 Added example email configuration to <u>Using</u> <u>Apache Airflow configura</u> <u>tion options on Amazon</u> <u>MWAA</u>. 	
	 Added PostgresHook troubleshooting topic to <u>Troubleshooting Amazon</u> <u>Managed Workflows for</u> <u>Apache Airflow</u>. 	
	 Added AWS Secrets Manager troublesh ooting topic to <u>Troublesh</u> <u>ooting Amazon Managed</u> <u>Workflows for Apache</u> <u>Airflow</u>. 	
	 Added high performan ce use case to <u>Configuri</u> <u>ng Amazon MWAA worker</u> <u>automatic scaling</u>. 	
Amazon MWAA launch	General availability launch of	

November 24, 2020

January 29, 2021

User guide documentation

for Apache Airflow.

Amazon Managed Workflows

AWS CloudFormation
 documentation