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# Amazon EKS

## User Guide

# n EKS



## **Amazon EKS: User Guide**

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# What is Amazon EKS?

Amazon EKS is a managed service that makes it easy for you to run Kubernetes on AWS without needing to install, operate, and maintain your own Kubernetes control plane or nodes. Kubernetes is an open-source system for automating the deployment, scaling, and management of containerized applications.

Amazon EKS runs Kubernetes control plane instances across multiple Availability Zones to ensure high availability. Amazon EKS automatically detects and replaces unhealthy control plane instances, and it provides automated version upgrades and patching for them.

Amazon EKS is integrated with many AWS services to provide scalability and security for your applications, including the following:

- Amazon ECR for container images
- Elastic Load Balancing for load distribution
- IAM for authentication
- Amazon VPC for isolation

Amazon EKS runs up-to-date versions of the open-source Kubernetes software, so you can use all of the existing plugins and tooling from the Kubernetes community. Applications running on Amazon EKS are fully compatible with applications running on any standard Kubernetes environment, whether running in on-premises data centers or public clouds. This means that you can easily migrate any standard Kubernetes application to Amazon EKS without any code modification required.

## Amazon EKS control plane architecture

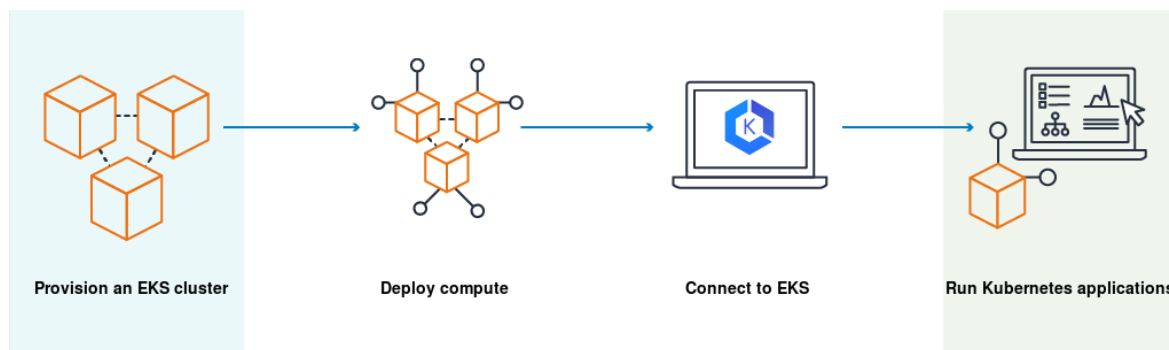
Amazon EKS runs a single tenant Kubernetes control plane for each cluster, and control plane infrastructure is not shared across clusters or AWS accounts.

This control plane consists of at least two API server nodes and three `etcd` nodes that run across three Availability Zones within a Region. Amazon EKS automatically detects and replaces unhealthy control plane instances, restarting them across the Availability Zones within the Region as needed. Amazon EKS leverages the architecture of AWS Regions in order to maintain high availability. Because of this, Amazon EKS is able to offer an [SLA for API server endpoint availability](#).

Amazon EKS uses Amazon VPC network policies to restrict traffic between control plane components to within a single cluster. Control plane components for a cluster cannot view or receive communication from other clusters or other AWS accounts, except as authorized with Kubernetes RBAC policies.

This secure and highly-available configuration makes Amazon EKS reliable and recommended for production workloads.

## How does Amazon EKS work?



Getting started with Amazon EKS is easy:

1. Create an Amazon EKS cluster in the AWS Management Console or with the AWS CLI or one of the AWS SDKs.
2. Launch managed or self-managed nodes that register with the Amazon EKS cluster. We provide you with an AWS CloudFormation template that automatically configures your nodes. You can also deploy applications to AWS Fargate if you don't need to manage nodes.
3. When your cluster is ready, you can configure your favorite Kubernetes tools (such as `kubectl`) to communicate with your cluster.
4. Deploy and manage applications on your Amazon EKS cluster the same way that you would with any other Kubernetes environment.

To create your first cluster and its associated resources, see [Getting started with Amazon EKS \(p. 3\)](#).

## Pricing

An Amazon EKS cluster consists of a control plane and the Amazon EC2 or AWS Fargate compute that you run pods on. For more information about pricing for the control plane, see [Amazon EKS pricing](#). Both Amazon EC2 and Fargate provide:

- **On-Demand Instances** – Pay for the instances that you use by the second, with no long-term commitments or upfront payments. For more information, see [Amazon EC2 On-Demand Pricing](#) and [AWS Fargate Pricing](#).
- **Savings Plans** – You can reduce your costs by making a commitment to a consistent amount of usage, in USD per hour, for a term of 1 or 3 years. For more information, see [Pricing with Savings Plans](#).

# Getting started with Amazon EKS

There are two getting started guides available for creating a new Kubernetes cluster with nodes in Amazon EKS:

- [Getting started with eksctl \(p. 3\)](#) – This getting started guide helps you to install all of the required resources to get started with Amazon EKS using `eksctl`, a simple command line utility for creating and managing Kubernetes clusters on Amazon EKS. At the end of the tutorial, you will have a running Amazon EKS cluster that you can deploy applications to. This is the fastest and simplest way to get started with Amazon EKS.
- [Getting started with the AWS Management Console \(p. 14\)](#) – This getting started guide helps you to create all of the required resources to get started with Amazon EKS using the AWS Management Console. At the end of the tutorial, you will have a running Amazon EKS cluster that you can deploy applications to. In this guide, you manually create each resource in the Amazon EKS or AWS CloudFormation consoles. The procedures give you complete visibility into how each resource is created and how they interact with each other.

## Getting started with eksctl

This getting started guide helps you to create all of the required resources to get started with Amazon EKS using `eksctl`, a simple command line utility for creating and managing Kubernetes clusters on Amazon EKS. At the end of this tutorial, you will have a running Amazon EKS cluster that you can deploy applications to.

The procedures in this guide create several resources for you automatically, that you have to create manually when you create your cluster using the AWS Management Console. If you'd rather manually create most of the resources to better understand how they interact with each other, then use the AWS Management Console to create your cluster and compute. For more information, see [Getting started with the AWS Management Console \(p. 14\)](#).

## Prerequisites

This section helps you to install and configure the tools and resources that you need to create and manage an Amazon EKS cluster.

### Install the AWS CLI

To install the latest version of the AWS CLI, choose the tab with the name of the operating system that you'd like to install the AWS CLI on.

#### macOS

If you currently have the AWS CLI installed, determine which version that you have installed.

```
aws --version
```

If you don't have version 1.18.120 or later, or version 2.0.40 or later installed, then install the AWS CLI version 2. For other installation options, or to upgrade your currently installed version 2, see [Upgrading the AWS CLI version 2 on macOS](#).

```
curl "https://awscli.amazonaws.com/AWSCLIV2.pkg" -o "AWSCLIV2.pkg"
```

```
sudo installer -pkg AWSCLIV2.pkg -target /
```

If you're unable to use the AWS CLI version 2, then ensure that you have the latest version of the [AWS CLI version 1](#) installed using the following command.

```
pip3 install awscli --upgrade --user
```

## Linux

If you currently have the AWS CLI installed, determine which version that you have installed.

```
aws --version
```

If you don't have version 1.18.120 or later, or version 2.0.40 or later installed, then install the AWS CLI version 2. For other installation options, or to upgrade your currently installed version 2, see [Upgrading the AWS CLI version 2 on Linux](#).

```
curl "https://awscli.amazonaws.com/awscli-exe-linux-x86_64.zip" -o "awscliv2.zip"  
unzip awscliv2.zip  
sudo ./aws/install
```

If you're unable to use the AWS CLI version 2, then ensure that you have the latest version of the [AWS CLI version 1](#) installed using the following command.

```
pip3 install --upgrade --user awscli
```

## Windows

If you currently have the AWS CLI installed, determine which version that you have installed.

```
aws --version
```

### To install the AWS CLI version 2

If you don't have either version 1.18.120 or later, or version 2.0.40 or later installed, then install the AWS CLI version 2 using the following steps. For other installation options, or to upgrade your currently installed version 2, see [Upgrading the AWS CLI version 2 on Windows](#).

1. Download the AWS CLI MSI installer for Windows (64-bit) at <https://awscli.amazonaws.com/AWSCLIV2.msi>
2. Run the downloaded MSI installer and follow the onscreen instructions. By default, the AWS CLI installs to C:\Program Files\Amazon\AWSCLIV2.

If you're unable to use the AWS CLI version 2, then ensure that you have the latest version of the [AWS CLI version 1](#) installed using the following command.

```
pip3 install --user --upgrade awscli
```

## Configure your AWS CLI credentials

Both `eksctl` and the AWS CLI require that you have AWS credentials configured in your environment. The `aws configure` command is the fastest way to set up your AWS CLI installation for general use.

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

When you type this command, the AWS CLI prompts you for four pieces of information: access key, secret access key, AWS Region, and output format. This information is stored in a profile (a collection of settings) named `default`. This profile is used when you run commands, unless you specify another one.

For more information, see [Configuring the AWS CLI](#) in the *AWS Command Line Interface User Guide*.

## Install eksctl

To install 0.26.0-rc.1 version or later of the `eksctl` command line utility, choose the tab with the name of the operating system that you'd like to install `eksctl` on. For more information, see <https://eksctl.io/>.

### macOS

#### To install or upgrade eksctl on macOS using Homebrew

The easiest way to get started with Amazon EKS and macOS is by installing `eksctl` with [Homebrew](#). The `eksctl` Homebrew recipe installs `eksctl` and any other dependencies that are required for Amazon EKS, such as `kubectl`. The recipe also installs the [aws-iam-authenticator](#) (p. 218), which is required if you don't have the AWS CLI version 1.16.156 or higher installed.

1. If you do not already have Homebrew installed on macOS, install it with the following command.

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

2. Install the Weaveworks Homebrew tap.

```
brew tap weaveworks/tap
```

3. Install or upgrade `eksctl`.

- Install `eksctl` with the following command:

```
brew install weaveworks/tap/eksctl
```

- If `eksctl` is already installed, run the following command to upgrade:

```
brew upgrade eksctl && brew link --overwrite eksctl
```

4. Test that your installation was successful with the following command.

```
eksctl version
```

#### Note

The `GitTag` version should be at least 0.26.0-rc.1. If not, check your terminal output for any installation or upgrade errors, or manually download an archive of the release from [https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl\\_Darwin\\_amd64.tar.gz](https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl_Darwin_amd64.tar.gz), extract `eksctl`, and then execute it.

## Linux

### To install or upgrade eksctl on Linux using curl

1. Download and extract the latest release of eksctl with the following command.

```
curl --silent --location "https://github.com/weaveworks/eksctl/releases/latest/download/eksctl_$(uname -s)_amd64.tar.gz" | tar xz -C /tmp
```

2. Move the extracted binary to /usr/local/bin.

```
sudo mv /tmp/eksctl /usr/local/bin
```

3. Test that your installation was successful with the following command.

```
eksctl version
```

#### Note

The GitTag version should be at least 0.26.0-rc.1. If not, check your terminal output for any installation or upgrade errors, or replace the address in step 1 with [https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl\\_Linux\\_amd64.tar.gz](https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl_Linux_amd64.tar.gz) and complete steps 1-3 again.

## Windows

### To install or upgrade eksctl on Windows using Chocolatey

1. If you do not already have Chocolatey installed on your Windows system, see [Installing Chocolatey](#).
2. Install or upgrade eksctl.
  - Install the binaries with the following command:

```
chocolatey install -y eksctl
```

- If they are already installed, run the following command to upgrade:

```
chocolatey upgrade -y eksctl
```

3. Test that your installation was successful with the following command.

```
eksctl version
```

#### Note

The GitTag version should be at least 0.26.0-rc.1. If not, check your terminal output for any installation or upgrade errors, or manually download an archive of the release from [https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl\\_Windows\\_amd64.zip](https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl_Windows_amd64.zip), extract eksctl, and then execute it.

## Install and configure kubectl

Kubernetes uses the kubectl command-line utility for communicating with the cluster API server.

### Note

If you used the preceding Homebrew instructions to install `eksctl` on macOS, then `kubectl` has already been installed on your system. You can skip to [Create your Amazon EKS cluster and compute](#) (p. 9).

To install version 1.17 of the `kubectl` command line utility, choose the tab with the name of the operating system that you'd like to install `kubectl` on. If you need to install a different version to use with a different cluster version, then see [??? \(p. 229\)](#).

## macOS

### To install kubectl on macOS

1. Download the Amazon EKS vended `kubectl` binary.

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/darwin/amd64/kubectl
```

2. (Optional) Verify the downloaded binary with the SHA-256 sum.

- a. Download the SHA-256 sum.

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/darwin/amd64/kubectl.sha256
```

- b. Check the SHA-256 sum.

```
openssl sha1 -sha256 kubectl
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded SHA-256 file. The two should match.

3. Apply execute permissions to the binary.

```
chmod +x ./kubectl
```

4. Move `kubectl` to a folder that is in your path.

- If you don't already have a version of `kubectl` installed, then move the binary to a folder that's already in your `PATH`.

```
sudo mv ./kubectl /usr/local/bin
```

- If you already have a version of `kubectl` installed, then we recommend creating a `$HOME/bin/kubectl` folder, moving the binary to that folder, and ensuring that `$HOME/bin` comes first in your `$PATH`.

```
mkdir -p $HOME/bin && mv ./kubectl $HOME/bin/kubectl && export PATH=$PATH:$HOME/bin
```

(Optional) Add the `$HOME/bin` path to your shell initialization file so that it is configured when you open a shell.

```
echo 'export PATH=$PATH:$HOME/bin' >> ~/.bash_profile
```

5. After you install `kubectl`, you can verify its version with the following command:

```
kubectl version --short --client
```

## Linux

### To install kubectl on Linux

1. Download the Amazon EKS vended kubectl binary.

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/linux/amd64/kubectl
```

2. (Optional) Verify the downloaded binary with the SHA-256 sum.

- a. Download the SHA-256 sum.

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/linux/amd64/kubectl.sha256
```

- b. Check the SHA-256 sum.

```
openssl sha1 -sha256 kubectl
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded SHA-256 file. The two should match.

3. Apply execute permissions to the binary.

```
chmod +x ./kubectl
```

4. Move kubectl to a folder that is in your path.

- If you don't already have a version of kubectl installed, then move the binary to a folder in your PATH.

```
sudo mv ./kubectl /usr/local/bin
```

- If you already have a version of kubectl installed, then we recommend creating a \$HOME/bin/kubectl folder, moving the binary to that folder, and ensuring that \$HOME/bin comes first in your \$PATH.

```
mkdir -p $HOME/bin && mv ./kubectl $HOME/bin/kubectl && export PATH=$PATH:$HOME/bin
```

(Optional) Add the \$HOME/bin path to your shell initialization file so that it is configured when you open a shell.

```
echo 'export PATH=$PATH:$HOME/bin' >> ~/.bash_profile
```

#### Note

This step assumes you are using the Bash shell; if you are using another shell, change the command to use your specific shell initialization file.

5. After you install kubectl, you can verify its version with the following command:

```
kubectl version --short --client
```



## Windows

### To install kubectl on Windows

1. Open a PowerShell terminal.
2. Download the Amazon EKS vended kubectl binary.

```
curl -o kubectl.exe https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/windows/amd64/kubectl.exe
```

3. (Optional) Verify the downloaded binary with the SHA-256 sum.
  - a. Download the SHA-256 sum.

```
curl -o kubectl.exe.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/windows/amd64/kubectl.exe.sha256
```

- b. Check the SHA-256 sum.

```
Get-FileHash kubectl.exe
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded SHA-256 file. The two should match, although the PowerShell output will be uppercase.
4. Copy the binary to a folder in your `PATH`. If you have an existing directory in your `PATH` that you use for command line utilities, copy the binary to that directory. Otherwise, complete the following steps.
    - a. Create a new directory for your command line binaries, such as `C:\bin`.
    - b. Copy the `kubectl.exe` binary to your new directory.
    - c. Edit your user or system `PATH` environment variable to add the new directory to your `PATH`.
    - d. Close your PowerShell terminal and open a new one to pick up the new `PATH` variable.
  5. After you install `kubectl`, you can verify its version with the following command:

```
kubectl version --short --client
```

## Create your Amazon EKS cluster and compute

This section helps you to create an Amazon EKS cluster with a compute option to run your applications. The latest Kubernetes version available in Amazon EKS is installed so that you can take advantage of the latest Kubernetes and Amazon EKS features. Some features are not available on older versions of Kubernetes.

### Important

Make sure that the AWS Security Token Service (STS) endpoint for the Region that your cluster is in is enabled for your account. If the endpoint is not enabled, then nodes will fail to join the cluster during cluster creation. For more information, see [Activating and deactivating AWS STS in an AWS Region](#).

### To create your cluster with eksctl

1. Choose a tab below that best matches your compute requirements. Though the following procedure will create a cluster with one compute option, you can add any of the other options after your cluster is created. To learn more about each option, see [Compute \(p. 85\)](#). If you want to create a cluster that only runs Linux applications on AWS Fargate, then choose **AWS Fargate – Linux**. If you intend to run Linux applications on Amazon EC2 instances, then choose **Managed nodes – Linux**. If

you want to run Windows applications on Amazon EC2 instances, then choose **Self-managed nodes – Windows**.

#### AWS Fargate – Linux

##### Note

You can only use AWS Fargate with Amazon EKS in some regions. Before using Fargate with Amazon EKS, ensure that the region that you want to use is supported. For more information, see [the section called “Getting started with Fargate” \(p. 119\)](#).

Create your Amazon EKS cluster with Fargate support with the following command. You can replace *prod* with your own value and you can replace *us-west-2* with any [Amazon EKS Fargate supported Region \(p. 118\)](#).

We recommend that you deploy version *1.17*. If you must deploy an earlier version, then you can only replace it with version 1.16 or 1.15. If you change *1.17*, then read the important [Amazon EKS release notes \(p. 61\)](#) for the version and install the corresponding version of *kubectl* ([p. 229](#)).

```
eksctl create cluster \
--name prod \
--version 1.17 \
--region us-west-2 \
--fargate
```

Your new Amazon EKS cluster is created without a node group. *Eksctl* creates a pod execution role, a [Fargate profile \(p. 123\)](#) for the default and kube-system namespaces, and it patches the coredns deployment so that it can run on Fargate. For more information see [AWS Fargate \(p. 118\)](#).

#### Managed nodes – Linux

You can create the nodes with or without a launch template. A launch template allows for greater customization, to include the ability to deploy a custom AMI.

Create your Amazon EKS cluster and Linux nodes **without** a launch template with the following command. Replace the example *values* with your own values. You can replace *us-west-2* with any Amazon EKS [supported Region](#).

##### Important

Amazon EKS nodes are standard Amazon EC2 instances, and you are billed for them based on normal Amazon EC2 instance prices. For more information, see [Amazon EC2 pricing](#).

We recommend that you deploy version *1.17*. If you must deploy an earlier version, then you can only replace it with version 1.16 or 1.15. If you change *1.17*, then read the important [Amazon EKS release notes \(p. 61\)](#) for the version and install the corresponding version of *kubectl* ([p. 229](#)).

Though *--ssh-public-key* is optional, we highly recommend that you specify it when you create your node group with a cluster. This option enables SSH access to the nodes in your managed node group. Enabling SSH access allows you to connect to your instances and gather diagnostic information if there are issues. You cannot enable remote access after the node group is created. If you don't have a public key, you can [create a key pair](#) for Amazon EC2 and then [retrieve the public key](#) for the key pair to specify for *--ssh-public-key*. Ensure that you create the key in the same Region that you create the cluster in.

```
eksctl create cluster \
--name prod \
--version 1.17 \
```

```
--region us-west-2 \  
--nodegroup-name linux-nodes \  
--node-type t3.medium \  
--nodes 3 \  
--nodes-min 1 \  
--nodes-max 4 \  
--ssh-access \  
--ssh-public-key my-public-key.pub \  
--managed
```

Create your Amazon EKS cluster and Linux nodes **with** a launch template. The launch template must already exist and must meet the requirements specified in [??? \(p. 97\)](#). Create a file named `cluster-node-group-lt.yaml` with the following contents, replacing the example **values** with your own values. Several settings that you specify when deploying without a launch template are moved into the launch template. If you don't specify a version, the template's default version is used.

```
---  
apiVersion: eksctl.io/v1alpha5  
kind: ClusterConfig  
  
metadata:  
  name: prod  
  region: us-west-2  
  version: '1.17'  
managedNodeGroups:  
- name: node-group-lt  
  launchTemplate:  
    id: lt-id  
    version: "1"
```

Create the cluster and node group with the following command.

```
eksctl create cluster --config-file cluster-node-group-lt.yaml
```

Output:

You'll see several lines of output as the cluster and nodes are created. The last line of output is similar to the following example line.

```
[#] EKS cluster "prod" in "us-west-2" region is ready
```

### Note

- If specifying an Arm node type, then review the considerations in [the section called "Arm" \(p. 136\)](#) before deploying.
- If nodes fail to join the cluster, see [??? \(p. 313\)](#) in the Troubleshooting guide.
- For more information on the available options for `eksctl` commands, enter the following command.

```
eksctl command -help
```

## Self-managed nodes – Windows

Familiarize yourself with the Windows support [considerations \(p. 70\)](#), which include supported values for `instanceType` in the example text below. Replace the example *values* with your own values.

We recommend that you deploy version **1.17**. If you must deploy an earlier version, then you can only replace it with version 1.16 or 1.15. If you change **1.17**, then read the important [Amazon EKS release notes \(p. 61\)](#) for the version and install the corresponding version of `kubect1` (p. 229).

### Important

Amazon EKS nodes are standard Amazon EC2 instances, and you are billed for them based on normal Amazon EC2 instance prices. For more information, see [Amazon EC2 pricing](#).

Save the text below to a file named `cluster-spec.yaml`. The configuration file is used to create a cluster with a self-managed Windows node group and a managed Linux node group. Even if you only want to run Windows applications in your cluster, all Amazon EKS clusters must contain at least one Linux node, though we recommend that you create at least two Linux nodes for availability purposes.

```
---
apiVersion: eksctl.io/v1alpha5
kind: ClusterConfig

metadata:
  name: windows-prod
  region: us-west-2
  version: '1.17'
managedNodeGroups:
  - name: linux-ng
    instanceType: t2.large
    minSize: 2
nodeGroups:
  - name: windows-ng
    instanceType: m5.large
    minSize: 2
    volumeSize: 100
    amiFamily: WindowsServer2019FullContainer
```

Create your Amazon EKS cluster and Windows and Linux nodes with the following command.

```
eksctl create cluster -f cluster-spec.yaml --install-vpc-controllers
```

### Note

For more information about the available options for `eksctl create cluster`, see the project [README on GitHub](#) or view the help page with the following command.

```
eksctl create cluster --help
```

Output:

You'll see several lines of output as the cluster and nodes are created. The last line of output is similar to the following example line.

```
[#] EKS cluster "windows-prod" in "region-code" region is ready
```

### Note

- If specifying an Arm node type, then review the considerations in [the section called “Arm” \(p. 136\)](#) before deploying.
- If nodes fail to join the cluster, see [??? \(p. 313\)](#) in the Troubleshooting guide.
- For more information on the available options for `eksctl` commands, enter the following command.

```
eksctl command -help
```

2. Cluster provisioning usually takes between 10 and 15 minutes. When your cluster is ready, test that your `kubectl` configuration is correct.

```
kubectl get svc
```

### Note

If you receive any authorization or resource type errors, see [Unauthorized or access denied \(kubectl\) \(p. 314\)](#) in the troubleshooting section.

Output:

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
svc/kubernetes	ClusterIP	10.100.0.1	<none>	443/TCP	1m

3. (Linux accelerated AMI nodes only) If you chose an accelerated AMI instance type and the Amazon EKS optimized accelerated AMI, then you must apply the [NVIDIA device plugin for Kubernetes](#) as a DaemonSet on your cluster with the following command.

```
kubectl apply -f https://raw.githubusercontent.com/NVIDIA/k8s-device-plugin/v0.6.0/nvidia-device-plugin.yml
```

## Next steps

Now that you have a working Amazon EKS cluster with nodes, you are ready to start installing Kubernetes add-ons and deploying applications to your cluster. The following documentation topics help you to extend the functionality of your cluster.

- [the section called “Cluster Autoscaler” \(p. 54\)](#) – Configure the Kubernetes Cluster Autoscaler to automatically adjust the number of nodes in your node groups.
- [the section called “Sample deployment” \(p. 200\)](#) – Deploy a sample application to test your cluster and Linux nodes.
- [Deploy a Windows sample application \(p. 75\)](#) – Deploy a sample application to test your cluster and Windows nodes.
- [Cluster management \(p. 229\)](#) – Learn how to use important tools for managing your cluster.

# Getting started with the AWS Management Console

This getting started guide helps you to create all of the required resources to get started with Amazon EKS using the AWS Management Console. In this guide, you manually create each resource in the Amazon EKS or AWS CloudFormation consoles. At the end of this tutorial, you will have a running Amazon EKS cluster that you can deploy applications to.

The procedures in this guide give you complete visibility into how each resource is created and how the resources interact with each other. If you'd rather have most of the resources created for you automatically, use the `eksctl` CLI to create your cluster and nodes. For more information, see [Getting started with `eksctl`](#) (p. 3).

## Prerequisites

This section helps you to install and configure the tools and resources that you need to create and manage an Amazon EKS cluster.

### Install the AWS CLI

To install the latest version of the AWS CLI, choose the tab with the name of the operating system that you'd like to install the AWS CLI on.

#### macOS

If you currently have the AWS CLI installed, determine which version that you have installed.

```
aws --version
```

If you don't have version 1.18.120 or later, or version 2.0.40 or later installed, then install the AWS CLI version 2. For other installation options, or to upgrade your currently installed version 2, see [Upgrading the AWS CLI version 2 on macOS](#).

```
curl "https://awscli.amazonaws.com/AWSCLIV2.pkg" -o "AWSCLIV2.pkg"
sudo installer -pkg AWSCLIV2.pkg -target /
```

If you're unable to use the AWS CLI version 2, then ensure that you have the latest version of the [AWS CLI version 1](#) installed using the following command.

```
pip3 install awscli --upgrade --user
```

#### Linux

If you currently have the AWS CLI installed, determine which version that you have installed.

```
aws --version
```

If you don't have version 1.18.120 or later, or version 2.0.40 or later installed, then install the AWS CLI version 2. For other installation options, or to upgrade your currently installed version 2, see [Upgrading the AWS CLI version 2 on Linux](#).

```
curl "https://awscli.amazonaws.com/awscli-exe-linux-x86_64.zip" -o "awscliv2.zip"
unzip awscliv2.zip
```

```
sudo ./aws/install
```

If you're unable to use the AWS CLI version 2, then ensure that you have the latest version of the [AWS CLI version 1](#) installed using the following command.

```
pip3 install --upgrade --user awscli
```

## Windows

If you currently have the AWS CLI installed, determine which version that you have installed.

```
aws --version
```

### To install the AWS CLI version 2

If you don't have either version 1.18.120 or later, or version 2.0.40 or later installed, then install the AWS CLI version 2 using the following steps. For other installation options, or to upgrade your currently installed version 2, see [Upgrading the AWS CLI version 2 on Windows](#).

1. Download the AWS CLI MSI installer for Windows (64-bit) at <https://awscli.amazonaws.com/AWSCLIV2.msi>
2. Run the downloaded MSI installer and follow the onscreen instructions. By default, the AWS CLI installs to C:\Program Files\Amazon\AWSCLIV2.

If you're unable to use the AWS CLI version 2, then ensure that you have the latest version of the [AWS CLI version 1](#) installed using the following command.

```
pip3 install --user --upgrade awscli
```

## Configure your AWS CLI credentials

The AWS CLI requires that you have AWS credentials configured in your environment. The `aws configure` command is the fastest way to set up your AWS CLI installation for general use.

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

When you type this command, the AWS CLI prompts you for four pieces of information: `access key`, `secret access key`, `AWS Region`, and `output format`. This information is stored in a profile (a collection of settings) named `default`. This profile is used when you run commands, unless you specify another one.

For more information, see [Configuring the AWS CLI](#) in the *AWS Command Line Interface User Guide*.

## Install and configure kubectl

Kubernetes uses the `kubectl` command-line utility for communicating with the cluster API server.

To install version 1.17 of the `kubectl` command line utility, choose the tab with the name of the operating system that you'd like to install `kubectl` on. If you need to install a different version to use with a different cluster version, then see [??? \(p. 229\)](#).

## macOS

### To install kubectl on macOS

1. Download the Amazon EKS vended kubectl binary.

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/darwin/amd64/kubectl
```

2. (Optional) Verify the downloaded binary with the SHA-256 sum.

- a. Download the SHA-256 sum.

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/darwin/amd64/kubectl.sha256
```

- b. Check the SHA-256 sum.

```
openssl sha1 -sha256 kubectl
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded SHA-256 file. The two should match.

3. Apply execute permissions to the binary.

```
chmod +x ./kubectl
```

4. Move kubectl to a folder that is in your path.

- If you don't already have a version of kubectl installed, then move the binary to a folder that's already in your `PATH`.

```
sudo mv ./kubectl /usr/local/bin
```

- If you already have a version of kubectl installed, then we recommend creating a `$HOME/bin/kubectl` folder, moving the binary to that folder, and ensuring that `$HOME/bin` comes first in your `$PATH`.

```
mkdir -p $HOME/bin && mv ./kubectl $HOME/bin/kubectl && export PATH=$PATH:$HOME/bin
```

(Optional) Add the `$HOME/bin` path to your shell initialization file so that it is configured when you open a shell.

```
echo 'export PATH=$PATH:$HOME/bin' >> ~/.bash_profile
```

5. After you install kubectl, you can verify its version with the following command:

```
kubectl version --short --client
```

## Linux

### To install kubectl on Linux

1. Download the Amazon EKS vended kubectl binary.



```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/linux/amd64/kubectl
```

2. (Optional) Verify the downloaded binary with the SHA-256 sum.

- a. Download the SHA-256 sum.

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/linux/amd64/kubectl.sha256
```

- b. Check the SHA-256 sum.

```
openssl sha1 -sha256 kubectl
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded SHA-256 file. The two should match.

3. Apply execute permissions to the binary.

```
chmod +x ./kubectl
```

4. Move kubectl to a folder that is in your path.

- If you don't already have a version of kubectl installed, then move the binary to a folder in your PATH.

```
sudo mv ./kubectl /usr/local/bin
```

- If you already have a version of kubectl installed, then we recommend creating a \$HOME/bin/kubectl folder, moving the binary to that folder, and ensuring that \$HOME/bin comes first in your \$PATH.

```
mkdir -p $HOME/bin && mv ./kubectl $HOME/bin/kubectl && export PATH=$PATH:$HOME/bin
```

(Optional) Add the \$HOME/bin path to your shell initialization file so that it is configured when you open a shell.

```
echo 'export PATH=$PATH:$HOME/bin' >> ~/.bash_profile
```

### Note

This step assumes you are using the Bash shell; if you are using another shell, change the command to use your specific shell initialization file.

5. After you install kubectl, you can verify its version with the following command:

```
kubectl version --short --client
```

## Windows

### To install kubectl on Windows

1. Open a PowerShell terminal.
2. Download the Amazon EKS vended kubectl binary.

```
curl -o kubectl.exe https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/windows/amd64/kubectl.exe
```

3. (Optional) Verify the downloaded binary with the SHA-256 sum.

- a. Download the SHA-256 sum.

```
curl -o kubectl.exe.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/windows/amd64/kubectl.exe.sha256
```

- b. Check the SHA-256 sum.

```
Get-FileHash kubectl.exe
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded SHA-256 file. The two should match, although the PowerShell output will be uppercase.
4. Copy the binary to a folder in your `PATH`. If you have an existing directory in your `PATH` that you use for command line utilities, copy the binary to that directory. Otherwise, complete the following steps.
    - a. Create a new directory for your command line binaries, such as `C:\bin`.
    - b. Copy the `kubectl.exe` binary to your new directory.
    - c. Edit your user or system `PATH` environment variable to add the new directory to your `PATH`.
    - d. Close your PowerShell terminal and open a new one to pick up the new `PATH` variable.
  5. After you install `kubectl`, you can verify its version with the following command:

```
kubectl version --short --client
```

## Create your Amazon EKS cluster IAM role

You can create the role using the AWS Management Console or AWS CloudFormation. Select the tab with the name of the tool that you'd like to use to create the role.

AWS Management Console

### To create your Amazon EKS cluster role in the IAM console

1. Open the IAM console at <https://console.aws.amazon.com/iam/>.
2. Choose **Roles**, then **Create role**.
3. Choose **EKS** from the list of services, then **EKS - Cluster** for your use case, and then **Next: Permissions**.
4. Choose **Next: Tags**.
5. (Optional) Add metadata to the role by attaching tags as key-value pairs. For more information about using tags in IAM, see [Tagging IAM Entities](#) in the *IAM User Guide*.
6. Choose **Next: Review**.
7. For **Role name**, enter a unique name for your role, such as `eksClusterRole`, then choose **Create role**.

## AWS CloudFormation

### To create your Amazon EKS cluster role with AWS CloudFormation

1. Save the following AWS CloudFormation template to a text file on your local system.

```
---
AWSTemplateFormatVersion: '2010-09-09'
Description: 'Amazon EKS Cluster Role'

Resources:

  eksClusterRole:
    Type: AWS::IAM::Role
    Properties:
      AssumeRolePolicyDocument:
        Version: '2012-10-17'
        Statement:
          - Effect: Allow
            Principal:
              Service:
                - eks.amazonaws.com
            Action:
              - sts:AssumeRole
      ManagedPolicyArns:
        - arn:aws:iam::aws:policy/AmazonEKSClusterPolicy

Outputs:

  RoleArn:
    Description: The role that Amazon EKS will use to create AWS resources for
    Kubernetes clusters
    Value: !GetAtt eksClusterRole.Arn
    Export:
      Name: !Sub "${AWS::StackName}-RoleArn"
```

#### Note

Prior to April 16, 2020, `ManagedPolicyArns` had an entry for `arn:aws:iam::aws:policy/AmazonEKSServicePolicy`. With the `AWSServiceRoleForAmazonEKS` service-linked role, that policy is no longer required.

2. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
3. Choose **Create stack**.
4. For **Specify template**, select **Upload a template file**, and then choose **Choose file**.
5. Choose the file you created earlier, and then choose **Next**.
6. For **Stack name**, enter a name for your role, such as `eksClusterRole`, and then choose **Next**.
7. On the **Configure stack options** page, choose **Next**.
8. On the **Review** page, review your information, acknowledge that the stack might create IAM resources, and then choose **Create stack**.

## Create your Amazon EKS cluster VPC

This section guides you through creating a VPC with either two public subnets and two private subnets or a VPC with three public subnets.

When you create an Amazon EKS cluster, you specify the VPC subnets for your cluster to use. Amazon EKS requires subnets in at least two Availability Zones. We recommend a VPC with public and private

subnets so that Kubernetes can create public load balancers in the public subnets that load balance traffic to pods running on nodes that are in private subnets.

For more information about both VPC types, see [??? \(p. 166\)](#).

Choose the tab below that represents your desired VPC configuration.

Public and private subnets

### To create your cluster VPC with public and private subnets

1. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
2. From the navigation bar, select a Region that supports Amazon EKS.
3. Choose **Create stack**.
4. For **Choose a template**, select **Specify an Amazon S3 template URL**.
5. Paste the following URL into the text area and choose **Next**:

```
https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/amazon-eks-vpc-private-subnets.yaml
```

6. On the **Specify Details** page, fill out the parameters accordingly, and then choose **Next**.
  - **Stack name**: Choose a stack name for your AWS CloudFormation stack. For example, you can call it **eks-vpc**.
  - **VpcBlock**: Choose a CIDR range for your VPC. Each worker node, pod, and load balancer that you deploy is assigned an IP address from this block. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it. For more information, see [VPC and subnet sizing](#) in the Amazon VPC User Guide. You can also add additional CIDR blocks to the VPC once it's created.
  - **PublicSubnet01Block**: Specify a CIDR block for public subnet 1. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **PublicSubnet02Block**: Specify a CIDR block for public subnet 2. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **PrivateSubnet01Block**: Specify a CIDR block for private subnet 1. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **PrivateSubnet02Block**: Specify a CIDR block for private subnet 2. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
7. (Optional) On the **Options** page, tag your stack resources. Choose **Next**.
8. On the **Review** page, choose **Create**.
9. When your stack is created, select it in the console and choose **Outputs**.
10. Record the **SecurityGroups** value for the security group that was created. When you add nodes to your cluster, you must specify the ID of the security group. The security group is applied to the cross-account elastic network interfaces that are created in your subnets that allow the Amazon EKS control plane to communicate with your nodes.
11. Record the **VpcId** for the VPC that was created. You need this when you launch your node group template.
12. Record the **SubnetIds** for the subnets that were created and whether you created them as public or private subnets. When you add nodes to your cluster, you must specify the IDs of the subnets that you want to launch the nodes into.

### Only public subnets

#### To create your cluster VPC with only public subnets

1. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
2. From the navigation bar, select a Region that supports Amazon EKS.
3. Choose **Create stack**.
4. For **Choose a template**, select **Specify an Amazon S3 template URL**.
5. Paste the following URL into the text area and choose **Next**:

```
https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/amazon-eks-vpc-sample.yaml
```

6. On the **Specify Details** page, fill out the parameters accordingly, and then choose **Next**.
  - **Stack name**: Choose a stack name for your AWS CloudFormation stack. For example, you can call it **eks-vpc**.
  - **VpcBlock**: Choose a CIDR block for your VPC. Each worker node, pod, and load balancer that you deploy is assigned an IP address from this block. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it. For more information, see [VPC and subnet sizing](#) in the Amazon VPC User Guide. You can also add additional CIDR blocks to the VPC once it's created.
  - **Subnet01Block**: Specify a CIDR block for subnet 1. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **Subnet02Block**: Specify a CIDR block for subnet 2. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **Subnet03Block**: Specify a CIDR block for subnet 3. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
7. (Optional) On the **Options** page, tag your stack resources. Choose **Next**.
8. On the **Review** page, choose **Create**.
9. When your stack is created, select it in the console and choose **Outputs**.
10. Record the **SecurityGroups** value for the security group that was created. When you add nodes to your cluster, you must specify the ID of the security group. The security group is applied to the cross-account elastic network interfaces that are created in your subnets that allow the Amazon EKS control plane to communicate with your nodes.
11. Record the **VpcId** for the VPC that was created. You need this when you launch your node group template.
12. Record the **SubnetIds** for the subnets that were created. When you add nodes to your cluster, you must specify the IDs of the subnets that you want to launch the nodes into.

### Only private subnets

#### To create your cluster VPC with only private subnets

1. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
2. From the navigation bar, select a Region that supports Amazon EKS.
3. Choose **Create stack**.
4. For **Choose a template**, select **Specify an Amazon S3 template URL**.
5. Paste the following URL into the text area and choose **Next**:

```
https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/amazon-eks-fully-private-vpc.yaml
```

6. On the **Specify Details** page, fill out the parameters accordingly, and then choose **Next**.
  - **Stack name:** Choose a stack name for your AWS CloudFormation stack. For example, you can call it **eks-vpc**.
  - **VpcBlock:** Choose a CIDR block for your VPC. Each worker node, pod, and load balancer that you deploy is assigned an IP address from this block. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it. For more information, see [VPC and subnet sizing](#) in the Amazon VPC User Guide. You can also add additional CIDR blocks to the VPC once it's created.
  - **PrivateSubnet01Block:** Specify a CIDR block for subnet 1. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **PrivateSubnet02Block:** Specify a CIDR block for subnet 2. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **PrivateSubnet03Block:** Specify a CIDR block for subnet 3. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
7. (Optional) On the **Options** page, tag your stack resources. Choose **Next**.
8. On the **Review** page, choose **Create**.
9. When your stack is created, select it in the console and choose **Outputs**.
10. Record the **SecurityGroups** value for the security group that was created. When you add nodes to your cluster, you must specify the ID of the security group. The security group is applied to the cross-account elastic network interfaces that are created in your subnets that allow the Amazon EKS control plane to communicate with your nodes.
11. Record the **VpcId** for the VPC that was created. You need this when you launch your node group template.
12. Record the **SubnetIds** for the subnets that were created. When you add nodes to your cluster, you must specify the IDs of the subnets that you want to launch the nodes into.

## Step 1: Create your Amazon EKS cluster

This section helps you to create an Amazon EKS cluster. The latest Kubernetes version available in Amazon EKS is installed so that you can take advantage of the latest Kubernetes and Amazon EKS features. Some features are not available on older versions of Kubernetes.

### Important

When an Amazon EKS cluster is created, the IAM entity (user or role) that creates the cluster is added to the Kubernetes RBAC authorization table as the administrator (with `system:masters` permissions). Initially, only that IAM user can make calls to the Kubernetes API server using `kubectl`. For more information, see [Managing users or IAM roles for your cluster \(p. 225\)](#). If you use the console to create the cluster, you must ensure that the same IAM user credentials are in the AWS SDK credential chain when you are running `kubectl` commands on your cluster. If you install and configure the AWS CLI, you can configure the IAM credentials for your user. If the AWS CLI version 1.16.156 or later is configured properly for your user, then `eksctl` can find those credentials. For more information, see [Configuring the AWS CLI](#) in the *AWS Command Line Interface User Guide*. If you can't install the AWS CLI version 1.16.156 or later, then you must install the `aws-iam-authenticator`.

### To create your cluster with the console

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose **Create cluster**.

### Note

If your IAM user doesn't have administrative privileges, you must explicitly add permissions for that user to call the Amazon EKS API operations. For more information, see [Amazon EKS identity-based policy examples \(p. 257\)](#).

3. On the **Configure cluster** page, fill in the following fields:
  - **Name** – A unique name for your cluster.
  - **Kubernetes version** – The version of Kubernetes to use for your cluster.
  - **Cluster service role** – Select the IAM role that you created with [Create your Amazon EKS cluster IAM role \(p. 18\)](#).
  - **Secrets encryption** – (Optional) Choose to enable envelope encryption of Kubernetes secrets using the AWS Key Management Service (AWS KMS). If you enable envelope encryption, the Kubernetes secrets are encrypted using the customer master key (CMK) that you select. The CMK must be symmetric, created in the same region as the cluster, and if the CMK was created in a different account, the user must have access to the CMK. For more information, see [Allowing users in other accounts to use a CMK](#) in the *AWS Key Management Service Developer Guide*.

Kubernetes secrets encryption with an AWS KMS CMK requires Kubernetes version 1.13 or later. If no keys are listed, you must create one first. For more information, see [Creating keys](#).
  - **Tags** – (Optional) Add any tags to your cluster. For more information, see [Tagging your Amazon EKS resources \(p. 243\)](#).
4. Select **Next**.
5. On the **Specify networking** page, select values for the following fields:
  - **VPC** – The VPC that you created previously in [the section called “Create your Amazon EKS cluster VPC” \(p. 19\)](#). You can find the name of your VPC in the drop-down list.
  - **Subnets** – By default, the available subnets in the VPC specified in the previous field are preselected. Select any subnet that you don't want to host cluster resources, such as worker nodes or load balancers.
  - **Security groups** – The **SecurityGroups** value from the AWS CloudFormation output that you generated with [Create your Amazon EKS cluster VPC \(p. 19\)](#). This security group has **ControlPlaneSecurityGroup** in the drop-down name.

**Important**  
The node AWS CloudFormation template modifies the security group that you specify here, so **Amazon EKS strongly recommends that you use a dedicated security group for each cluster control plane (one per cluster)**. If this security group is shared with other resources, you might block or disrupt connections to those resources.
  - For **Cluster endpoint access** – Choose one of the following options:
    - **Public** – Enables only public access to your cluster's Kubernetes API server endpoint. Kubernetes API requests that originate from outside of your cluster's VPC use the public endpoint. By default, access is allowed from any source IP address. You can optionally restrict access to one or more CIDR ranges such as 192.168.0.0/16, for example, by selecting **Advanced settings** and then selecting **Add source**.
    - **Private** – Enables only private access to your cluster's Kubernetes API server endpoint. Kubernetes API requests that originate from within your cluster's VPC use the private VPC endpoint.

**Important**  
If you created a VPC without outbound internet access, then you must enable private access.
  - **Public and private** – Enables public and private access.

For more information about the previous options, see [??? \(p. 49\)](#).
6. Select **Next**.
7. On the **Configure logging** page, you can optionally choose which log types that you want to enable. By default, each log type is **Disabled**. For more information, see [Amazon EKS control plane logging \(p. 58\)](#).
8. Select **Next**.

9. On the **Review and create** page, review the information that you entered or selected on the previous pages. Select **Edit** if you need to make changes to any of your selections. Once you're satisfied with your settings, select **Create**. The **Status** field shows **CREATING** until the cluster provisioning process completes.

**Note**

You might receive an error that one of the Availability Zones in your request doesn't have sufficient capacity to create an Amazon EKS cluster. If this happens, the error output contains the Availability Zones that can support a new cluster. Retry creating your cluster with at least two subnets that are located in the supported Availability Zones for your account. For more information, see [Insufficient capacity \(p. 313\)](#).

When your cluster provisioning is complete (usually between 10 and 15 minutes), note the **API server endpoint** and **Certificate authority** values. These are used in your `kubectl` configuration.

## Step 2: Create a kubeconfig file

In this section, you create a `kubeconfig` file for your cluster with the AWS CLI `update-kubeconfig` command.

### To create your kubeconfig file with the AWS CLI

1. Use the AWS CLI `update-kubeconfig` command to create or update a `kubeconfig` for your cluster.
  - By default, the resulting configuration file is created at the default `kubeconfig` path (`.kube/config`) in your home directory or merged with an existing `kubeconfig` at that location. You can specify another path with the `--kubeconfig` option.
  - You can specify an IAM role ARN with the `--role-arn` option to use for authentication when you issue `kubectl` commands. Otherwise, the IAM entity in your default AWS CLI or SDK credential chain is used. You can view your default AWS CLI or SDK identity by running the `aws sts get-caller-identity` command.
  - For more information, see the help page with the `aws eks update-kubeconfig help` command or see [update-kubeconfig](#) in the *AWS CLI Command Reference*.

**Note**

To run the following command, you must have permission to use the `eks:DescribeCluster` API action with the cluster that you specify. For more information, see [Amazon EKS identity-based policy examples \(p. 257\)](#).

```
aws eks --region us-west-2 update-kubeconfig --name cluster_name
```

2. Test your configuration.

```
kubectl get svc
```

**Note**

If you receive any authorization or resource type errors, see [Unauthorized or access denied \(kubectl\) \(p. 314\)](#) in the troubleshooting section.

Output:

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
svc/kubernetes	ClusterIP	10.100.0.1	<none>	443/TCP	1m



## Step 3: Create compute

Choose a tab below that best matches your compute requirements. Though the following procedure will create a cluster with one compute option, you can add any of the other options after your cluster is created. To learn more about each option, see [Compute \(p. 85\)](#). If you want to create a cluster that only runs Linux applications on AWS Fargate, then choose **AWS Fargate – Linux**. If you intend to run Linux applications on Amazon EC2 instances, then choose **Managed nodes – Linux**. If you want to run Windows applications on Amazon EC2 instances, then choose **Managed nodes – Linux**, complete the procedure, and add Windows support at the end of the procedure.

### AWS Fargate – Linux

#### Note

You can only use AWS Fargate with Amazon EKS in some regions. Before using Fargate with Amazon EKS, ensure that the region that you want to use is supported. For more information, see [the section called “Getting started with Fargate” \(p. 119\)](#).

Before creating an AWS Fargate profile, you must create a Fargate pod execution role to use with your profile.

#### To create an AWS Fargate pod execution role with the AWS Management Console

1. Open the IAM console at <https://console.aws.amazon.com/iam/>.
2. Choose **Roles**, then **Create role**.
3. Choose **EKS** from the list of services, **EKS - Fargate pod** for your use case, and then **Next: Permissions**.
4. Choose **Next: Tags**.
5. (Optional) Add metadata to the role by attaching tags as key–value pairs. For more information about using tags in IAM, see [Tagging IAM Entities](#) in the *IAM User Guide*.
6. Choose **Next: Review**.
7. For **Role name**, enter a unique name for your role, such as `AmazonEKSFargatePodExecutionRole`, then choose **Create role**.

You can now create the Fargate profile, specifying the IAM role that you created.

#### To create a Fargate profile for a cluster with the AWS Management Console

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose the cluster to create a Fargate profile for.
3. Under **Fargate profiles**, choose **Add Fargate profile**.
4. On the **Configure Fargate profile** page, enter the following information and choose **Next**.
  - a. For **Name**, enter a unique name for your Fargate profile.
  - b. For **Pod execution role**, choose the pod execution role to use with your Fargate profile. Only IAM roles with the `eks-fargate-pods.amazonaws.com` service principal are shown. If you do not see any roles listed here, you must create one. For more information, see [Pod execution role \(p. 267\)](#).
  - c. For **Subnets**, choose the subnets to use for your pods. By default, all subnets in your cluster's VPC are selected. Only private subnets are supported for pods running on Fargate; you must deselect any public subnets.
  - d. For **Tags**, you can optionally tag your Fargate profile. These tags do not propagate to other resources associated with the profile, such as its pods.
5. On the **Configure pods selection** page, enter the following information and choose **Next**.
  - a. For **Namespace**, enter a namespace to match for pods, such as `kube-system` or `default`.

- b. (Optional) Add Kubernetes labels to the selector that pods in the specified namespace must have to match the selector. For example, you could add the label `infrastructure:fargate` to the selector so that only pods in the specified namespace that also have the `infrastructure: fargate` Kubernetes label match the selector.
6. On the **Review and create** page, review the information for your Fargate profile and choose **Create**.

### Managed nodes – Linux

The Amazon EKS node `kubelet` daemon makes calls to AWS APIs on your behalf. Nodes receive permissions for these API calls through an IAM instance profile and associated policies. You must create an IAM role before you can launch the nodes. For more information, see [Amazon EKS node IAM role \(p. 265\)](#). You can create the role using the AWS Management Console or AWS CloudFormation. Select the tab with the name of the tool that you'd like to use to create the role.

#### Note

We recommend that you create a new node IAM role for each cluster. Otherwise, a node from one cluster could authenticate with another cluster that it does not belong to.

### To create your Amazon EKS node role in the IAM console

1. Open the IAM console at <https://console.aws.amazon.com/iam/>.
2. Choose **Roles**, then **Create role**.
3. Choose **EC2** from the list of **Common use cases** under **Choose a use case**, then choose **Next: Permissions**.
4. In the **Filter policies** box, enter **AmazonEKSWorkerNodePolicy**. Check the box to the left of **AmazonEKSWorkerNodePolicy**.
5. In the **Filter policies** box, enter **AmazonEKS\_CNI\_Policy**. Check the box to the left of **AmazonEKS\_CNI\_Policy**.
6. In the **Filter policies** box, enter **AmazonEC2ContainerRegistryReadOnly**. Check the box to the left of **AmazonEC2ContainerRegistryReadOnly**.
7. Choose **Next: Tags**.
8. (Optional) Add metadata to the role by attaching tags as key–value pairs. For more information about using tags in IAM, see [Tagging IAM Entities](#) in the *IAM User Guide*.
9. Choose **Next: Review**.
10. For **Role name**, enter a unique name for your role, such as **NodeInstanceRole**. For **Role description**, replace the current text with descriptive text such as **Amazon EKS – Node Group Role**, then choose **Create role**.

You can now create a managed node group.

#### Important

Amazon EKS nodes are standard Amazon EC2 instances, and you are billed for them based on normal Amazon EC2 instance prices. For more information, see [Amazon EC2 pricing](#).

### To launch your managed node group using the AWS Management Console

1. Wait for your cluster status to show as **ACTIVE**. You cannot create a managed node group for a cluster that is not yet **ACTIVE**.
2. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
3. Choose the name of the cluster that you want to create your managed node group in.
4. On the cluster page, select the **Compute** tab, and then choose **Add Node Group**.
5. On the **Configure node group** page, fill out the parameters accordingly, and then choose **Next**.

- **Name** – Enter a unique name for your managed node group.
- **Node IAM role name** – Choose the node instance role to use with your node group. For more information, see [Amazon EKS node IAM role](#) (p. 265).

**Important**

We recommend using a role that is not currently in use by any self-managed node group, or that you plan to use with a new self-managed node group. For more information, see [??? \(p. 100\)](#).

- **Use launch template** – (Optional) Choose if you want to use an existing launch template and then select a **Launch template version** (Optional). If you don't select a version, then Amazon EKS uses the template's default version. Launch templates allow for more customization of your node group, including allowing you to deploy a custom AMI. The launch template must meet the requirements in [the section called "Launch template support"](#) (p. 97).
  - **Kubernetes labels** – (Optional) You can choose to apply Kubernetes labels to the nodes in your managed node group.
  - **Tags** – (Optional) You can choose to tag your Amazon EKS managed node group. These tags do not propagate to other resources in the node group, such as Auto Scaling groups or instances. For more information, see [Tagging your Amazon EKS resources](#) (p. 243).
6. On the **Set compute and scaling configuration** page, fill out the parameters accordingly, and then choose **Next**.

**Node group compute configuration**

- **AMI type** – Choose **Amazon Linux 2 (AL2\_x86\_64)** for non-GPU instances, **Amazon Linux 2 GPU Enabled (AL2\_x86\_64\_GPU)** for GPU instances, or **Amazon Linux 2 (AL2\_ARM\_64)** for Arm.

If you are deploying Arm instances, be sure to review the considerations in [the section called "Arm"](#) (p. 136) before deploying.

If you specified a launch template on the previous page, and specified an AMI in the launch template, then you cannot select a value. The value from the template is displayed. The AMI specified in the template must meet the requirements in [the section called "Using a custom AMI"](#) (p. 100).

- **Instance type** – Choose the instance type to use in your managed node group. Each Amazon EC2 instance type supports a maximum number of elastic network interfaces (ENIs) and each ENI supports a maximum number of IP addresses. Since each worker node and pod is assigned its own IP address it's important to choose an instance type that will support the maximum number of pods that you want to run on each worker node. For a list of the number of ENIs and IP addresses supported by instance types, see [IP addresses per network interface per instance type](#). For example, the `t3.medium` instance type supports a maximum of 18 IP addresses for the worker node and pods. Some instance types might not be available in all Regions.

If you specified a launch template on the previous page, then you cannot select a value because it must be specified in the launch template. The value from the launch template is displayed.

- **Disk size** – Enter the disk size (in GiB) to use for your node's root volume.

If you specified a launch template on the previous page, then you cannot select a value because it must be specified in the launch template.

## Node group scaling configuration

### Note

Amazon EKS does not automatically scale your node group in or out. However, you can configure the Kubernetes [Cluster Autoscaler](#) (p. 54) to do this for you.

- **Minimum size** – Specify the minimum number of nodes that the managed node group can scale in to.
  - **Maximum size** – Specify the maximum number of nodes that the managed node group can scale out to.
  - **Desired size** – Specify the current number of nodes that the managed node group should maintain at launch.
7. On the **Specify networking** page, fill out the parameters accordingly, and then choose **Next**.
- **Subnets** – Choose the subnets to launch your managed nodes into.

### Important

If you are running a stateful application across multiple Availability Zones that is backed by Amazon EBS volumes and using the Kubernetes [Cluster Autoscaler](#) (p. 54), you should configure multiple node groups, each scoped to a single Availability Zone. In addition, you should enable the `--balance-similar-node-groups` feature.

### Important

If you choose a public subnet, then the subnet must have `MapPublicIpOnLaunch` set to true for the instances to be able to successfully join a cluster. If the subnet was created using `eksctl` or the [Amazon EKS vended AWS CloudFormation templates](#) (p. 166) on or after 03/26/2020, then this setting is already set to true. If the subnets were created with `eksctl` or the AWS CloudFormation templates before 03/26/2020, then you need to change the setting manually. For more information, see [Modifying the public IPv4 addressing attribute for your subnet](#).

- **Allow remote access to nodes** (Optional, but default). Enabling SSH allows you to connect to your instances and gather diagnostic information if there are issues. Complete the following steps to enable remote access. We highly recommend enabling remote access when you create your node group. You cannot enable remote access after the node group is created.

If you chose to use a launch template, then this option isn't shown. To enable remote access to your nodes, specify a key pair in the launch template and ensure that the proper port is open to the nodes in the security groups that you specify in the launch template. For more information, see [the section called "Using custom security groups"](#) (p. 98).

- For **SSH key pair** (Optional), choose an Amazon EC2 SSH key to use. For more information, see [Amazon EC2 key pairs](#) in the Amazon EC2 User Guide for Linux Instances. If you chose to use a launch template, then you can't select one.
  - For **Allow remote access from**, if you want to limit access to specific instances, then select the security groups that are associated to those instances. If you don't select specific security groups, then SSH access is allowed from anywhere on the internet (0.0.0.0/0).
8. On the **Review and create** page, review your managed node group configuration and choose **Create**.

### Note

- If specifying an Arm node type, then review the considerations in [the section called "Arm"](#) (p. 136) before deploying.
- If nodes fail to join the cluster, see [??? \(p. 313\)](#) in the Troubleshooting guide.

- For more information on the available options for `eksctl` commands, enter the following command.

```
eksctl command -help
```

9. Watch the status of your nodes and wait for them to reach the Ready status.

```
kubectl get nodes --watch
```

10. (GPU nodes only) If you chose a GPU instance type and the Amazon EKS optimized accelerated AMI, then you must apply the [NVIDIA device plugin for Kubernetes](#) as a DaemonSet on your cluster with the following command.

```
kubectl apply -f https://raw.githubusercontent.com/NVIDIA/k8s-device-plugin/v0.6.0/nvidia-device-plugin.yml
```

11. (Optional) [Deploy a sample Linux application \(p. 200\)](#) – Deploy a sample application to test your cluster and Linux nodes.

### (Optional) To launch Windows nodes

Add Windows support to your cluster and launch Windows nodes. For more information, see [Windows support \(p. 70\)](#). All Amazon EKS clusters must contain at least one Linux node, even if you only want to run Windows workloads in your cluster.

## Next steps

Now that you have a working Amazon EKS cluster with nodes, you are ready to start installing Kubernetes add-ons and deploying applications to your cluster. The following documentation topics help you to extend the functionality of your cluster.

- [the section called “Cluster Autoscaler” \(p. 54\)](#) – Configure the Kubernetes Cluster Autoscaler to automatically adjust the number of nodes in your node groups.
- [the section called “Sample deployment” \(p. 200\)](#) – Deploy a sample application to test your cluster and Linux nodes.
- [Deploy a Windows sample application \(p. 75\)](#) – Deploy a sample application to test your cluster and Windows nodes.
- [Cluster management \(p. 229\)](#) – Learn how to use important tools for managing your cluster.

# Amazon EKS clusters

An Amazon EKS cluster consists of two primary components:

- The Amazon EKS control plane
- Amazon EKS nodes that are registered with the control plane

The Amazon EKS control plane consists of control plane nodes that run the Kubernetes software, such as `etcd` and the Kubernetes API server. The control plane runs in an account managed by AWS, and the Kubernetes API is exposed via the Amazon EKS endpoint associated with your cluster. Each Amazon EKS cluster control plane is single-tenant and unique, and runs on its own set of Amazon EC2 instances.

All of the data stored by the `etcd` nodes and associated Amazon EBS volumes is encrypted using AWS KMS. The cluster control plane is provisioned across multiple Availability Zones and fronted by an Elastic Load Balancing Network Load Balancer. Amazon EKS also provisions elastic network interfaces in your VPC subnets to provide connectivity from the control plane instances to the nodes (for example, to support `kubectl exec`, `logs`, and `proxy` data flows).

Amazon EKS nodes run in your AWS account and connect to your cluster's control plane via the API server endpoint and a certificate file that is created for your cluster.

## Creating an Amazon EKS cluster

This topic walks you through creating an Amazon EKS cluster. If this is your first time creating an Amazon EKS cluster, then we recommend that you follow one of our [Getting started with Amazon EKS \(p. 3\)](#) guides instead. They provide complete end-to-end walkthroughs for creating an Amazon EKS cluster with nodes.

### Important

When an Amazon EKS cluster is created, the IAM entity (user or role) that creates the cluster is added to the Kubernetes RBAC authorization table as the administrator (with `system:masters` permissions). Initially, only that IAM user can make calls to the Kubernetes API server using `kubectl`. For more information, see [Managing users or IAM roles for your cluster \(p. 225\)](#). If you use the console to create the cluster, you must ensure that the same IAM user credentials are in the AWS SDK credential chain when you are running `kubectl` commands on your cluster. If you install and configure the AWS CLI, you can configure the IAM credentials for your user. If the AWS CLI version 1.16.156 or later is configured properly for your user, then `eksctl` can find those credentials. For more information, see [Configuring the AWS CLI](#) in the *AWS Command Line Interface User Guide*. If you can't install the AWS CLI version 1.16.156 or later, then you must install the [aws-iam-authenticator](#).

### Prerequisites

You must have the AWS CLI version 1.16.156 or later or the `aws-iam-authenticator` installed. For more information, see [??? \(p. 14\)](#) or [??? \(p. 218\)](#).

Choose the tab below that corresponds to your desired cluster creation method.

`eksctl`

### To create your cluster with `eksctl`

This procedure requires `eksctl` version 0.26.0-rc.1 or later. You can check your version with the following command:

```
eksctl version
```

For more information on installing or upgrading `eksctl`, see [Installing or upgrading eksctl](#) (p. 234).

1. Create a cluster with the Amazon EKS latest Kubernetes version in your default region. Replace `my-cluster` with your own value.

```
eksctl create cluster \
  --name my-cluster \
  --version 1.17 \
  --without-nodgroup
```

### Note

To see most options that can be specified when creating a cluster with `eksctl`, use the `eksctl create cluster --help` command. To see all options, you can use a config file. For more information, see [Using config files](#) and the [config file schema](#) in the `eksctl` documentation. You can find [config file examples](#) on GitHub.

### Warning

If you create a cluster using a config file with the `secretsEncryption` option, which requires an existing AWS Key Management Service key, and the key that you use is ever deleted, then there is no path to recovery for the cluster. If you enable envelope encryption, the Kubernetes secrets are encrypted using the customer master key (CMK) that you select. The CMK must be symmetric, created in the same region as the cluster, and if the CMK was created in a different account, the user must have access to the CMK. For more information, see [Allowing users in other accounts to use a CMK](#) in the *AWS Key Management Service Developer Guide*. Kubernetes secrets encryption with an AWS KMS CMK requires Kubernetes version 1.13 or later.

By default, the `create-key` command creates a [symmetric key](#) with a key policy that gives the account's root user admin access on AWS KMS actions and resources. For more information, see [Creating keys](#). If you want to scope down the permissions, make sure that the `kms:DescribeKey` and `kms:CreateGrant` actions are permitted on the key policy for the principal that will be calling the `create-cluster` API. Amazon EKS does not support the key policy condition `kms:GrantIsForAWSResource`. Creating a cluster will not work if this action is in the key policy statement.

Cluster provisioning takes several minutes. During cluster creation, you'll see several lines of output. The last line of output is similar to the following example line.

```
[#] EKS cluster "my-cluster" in "region-code" region is ready
```

2. When your cluster is ready, test that your `kubectl` configuration is correct.

```
kubectl get svc
```

### Note

If you receive any authorization or resource type errors, see [Unauthorized or access denied \(kubectl\)](#) (p. 314) in the troubleshooting section.

Output:

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
svc/kubernetes	ClusterIP	10.100.0.1	<none>	443/TCP	1m

3. (Optional) If you want to run pods on AWS Fargate in your cluster, then you must [??? \(p. 121\)](#) and [??? \(p. 121\)](#).
4. Follow the procedures in [Launching self-managed Amazon Linux nodes \(p. 102\)](#) to add Linux nodes to your cluster to support your workloads.
5. (Optional) After you add Linux nodes to your cluster, follow the procedures in [Windows support \(p. 70\)](#) to add Windows support to your cluster and to add Windows nodes. All Amazon EKS clusters must contain at least one Linux node, even if you only want to run Windows workloads in your cluster.

## AWS Management Console

This procedure has the following prerequisites:

- You have created a VPC and a dedicated security group that meet the requirements for an Amazon EKS cluster. For more information, see [Cluster VPC considerations \(p. 170\)](#) and [Amazon EKS security group considerations \(p. 173\)](#). The [Getting started with the AWS Management Console \(p. 14\)](#) guide creates a VPC that meets the requirements, or you can also follow [Creating a VPC for your Amazon EKS cluster \(p. 166\)](#) to create one.
- You have created an Amazon EKS cluster IAM role to apply to your cluster. The [Getting started with Amazon EKS \(p. 3\)](#) guide creates a service role for you, or you can also follow [Amazon EKS IAM roles \(p. 256\)](#) to create one manually.

## To create your cluster with the console

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose **Create cluster**.

### Note

If your IAM user doesn't have administrative privileges, you must explicitly add permissions for that user to call the Amazon EKS API operations. For more information, see [Amazon EKS identity-based policy examples \(p. 257\)](#).

3. On the **Configure cluster** page, fill in the following fields:
  - **Name** – A unique name for your cluster.
  - **Kubernetes version** – The version of Kubernetes to use for your cluster.
  - **Cluster service role** – Choose the Amazon EKS cluster role to allow the Kubernetes control plane to manage AWS resources on your behalf. For more information, see [Amazon EKS cluster IAM role \(p. 263\)](#).
  - **Secrets encryption** – (Optional) Choose to enable envelope encryption of Kubernetes secrets using the AWS Key Management Service (AWS KMS). If you enable envelope encryption, the Kubernetes secrets are encrypted using the customer master key (CMK) that you select. The CMK must be symmetric, created in the same region as the cluster, and if the CMK was created in a different account, the user must have access to the CMK. For more information, see [Allowing users in other accounts to use a CMK](#) in the *AWS Key Management Service Developer Guide*.

Kubernetes secrets encryption with an AWS KMS CMK requires Kubernetes version 1.13 or later. If no keys are listed, you must create one first. For more information, see [Creating keys](#).

### Note

By default, the `create-key` command creates a [symmetric key](#) with a key policy that gives the account's root user admin access on AWS KMS actions and resources. If you want to scope down the permissions, make sure that the `kms:DescribeKey` and `kms:CreateGrant` actions are permitted on the key policy for the principal that will be calling the `create-cluster` API.



Amazon EKS does not support the key policy condition `kms:GrantIsForAWSResource`. Creating a cluster will not work if this action is in the key policy statement.

### Warning

Deletion of the CMK will permanently put the cluster in a degraded state. If any CMKs used for cluster creation are scheduled for deletion, verify that this is the intended action before deletion. Once the key is deleted, there is no path to recovery for the cluster.

- **Tags** – (Optional) Add any tags to your cluster. For more information, see [Tagging your Amazon EKS resources \(p. 243\)](#).
4. Select **Next**.
  5. On the **Specify networking** page, select values for the following fields:
    - **VPC** – Select an existing VPC to use for your cluster. If none are listed, then you need to create one first. For more information, see [??? \(p. 166\)](#).
    - **Subnets** – By default, the available subnets in the VPC specified in the previous field are preselected. Select any subnet that you don't want to host cluster resources, such as worker nodes or load balancers. The subnets must meet the requirements for an Amazon EKS cluster. For more information, see [Cluster VPC considerations \(p. 170\)](#).

### Important

If you select subnets that were created before 03/26/2020 using one of the Amazon EKS AWS CloudFormation VPC templates, be aware of a default setting change that was introduced on 03/26/2020. For more information, see [??? \(p. 166\)](#).

- **Security groups** – The **SecurityGroups** value from the AWS CloudFormation output that you generated with [Create your Amazon EKS cluster VPC \(p. 19\)](#). This security group has **ControlPlaneSecurityGroup** in the drop-down name.

### Important

The node AWS CloudFormation template modifies the security group that you specify here, so **Amazon EKS strongly recommends that you use a dedicated security group for each cluster control plane (one per cluster)**. If this security group is shared with other resources, you might block or disrupt connections to those resources.

- For **Cluster endpoint access** – Choose one of the following options:
  - **Public** – Enables only public access to your cluster's Kubernetes API server endpoint. Kubernetes API requests that originate from outside of your cluster's VPC use the public endpoint. By default, access is allowed from any source IP address. You can optionally restrict access to one or more CIDR ranges such as 192.168.0.0/16, for example, by selecting **Advanced settings** and then selecting **Add source**.
  - **Private** – Enables only private access to your cluster's Kubernetes API server endpoint. Kubernetes API requests that originate from within your cluster's VPC use the private VPC endpoint.

### Important

If you created a VPC without outbound internet access, then you must enable private access.

- **Public and private** – Enables public and private access.

For more information about the previous options, see [??? \(p. 49\)](#).

6. Select **Next**.
7. On the **Configure logging** page, you can optionally choose which log types that you want to enable. By default, each log type is **Disabled**. For more information, see [Amazon EKS control plane logging \(p. 58\)](#).
8. Select **Next**.

9. On the **Review and create** page, review the information that you entered or selected on the previous pages. Select **Edit** if you need to make changes to any of your selections. Once you're satisfied with your settings, select **Create**. The **Status** field shows **CREATING** until the cluster provisioning process completes.

**Note**

You might receive an error that one of the Availability Zones in your request doesn't have sufficient capacity to create an Amazon EKS cluster. If this happens, the error output contains the Availability Zones that can support a new cluster. Retry creating your cluster with at least two subnets that are located in the supported Availability Zones for your account. For more information, see [Insufficient capacity \(p. 313\)](#).

Cluster provisioning usually takes between 10 and 15 minutes.

10. Now that you have created your cluster, follow the procedures in [Installing aws-iam-authenticator \(p. 218\)](#) and [Create a kubeconfig for Amazon EKS \(p. 221\)](#) to enable communication with your new cluster.
11. (Optional) If you want to run pods on AWS Fargate in your cluster, see [Getting started with AWS Fargate using Amazon EKS \(p. 119\)](#).
12. After you enable communication, follow the procedures in [Launching self-managed Amazon Linux nodes \(p. 102\)](#) to add Linux worker nodes to your cluster to support your workloads.
13. (Optional) After you add Linux worker nodes to your cluster, follow the procedures in [Windows support \(p. 70\)](#) to add Windows support to your cluster and to add Windows worker nodes. All Amazon EKS clusters must contain at least one Linux worker node, even if you only want to run Windows workloads in your cluster.

## AWS CLI

### To create your cluster with the AWS CLI

This procedure has the following prerequisites:

- You have created a VPC and a dedicated security group that meets the requirements for an Amazon EKS cluster. For more information, see [Cluster VPC considerations \(p. 170\)](#) and [Amazon EKS security group considerations \(p. 173\)](#). The [Getting started with the AWS Management Console \(p. 14\)](#) guide creates a VPC that meets the requirements, or you can also follow [Creating a VPC for your Amazon EKS cluster \(p. 166\)](#) to create one.
  - You have created an Amazon EKS cluster IAM role to apply to your cluster. The [Getting started with Amazon EKS \(p. 3\)](#) guide creates a service role for you, or you can also follow [Amazon EKS IAM roles \(p. 256\)](#) to create one manually.
1. Create your cluster with the following command. Substitute your cluster name, the Amazon Resource Name (ARN) of your Amazon EKS cluster IAM role that you created in [Create your Amazon EKS cluster IAM role \(p. 18\)](#), and the subnet and security group IDs for the VPC that you created in [Create your Amazon EKS cluster VPC \(p. 19\)](#).

```
aws eks create-cluster \
  --region region-code \
  --name devel \
  --kubernetes-version 1.17 \
  --role-arn arn:aws:iam::111122223333:role/eks-service-role-  
AWSServiceRoleForAmazonEKS-EXAMPLEBKZRQR \
  --resources-vpc-config subnetIds=subnet-  
a9189fe2,subnet-50432629,securityGroupIds=sg-f5c54184
```

### Note

If your IAM user doesn't have administrative privileges, you must explicitly add permissions for that user to call the Amazon EKS API operations. For more information, see [Amazon EKS identity-based policy examples \(p. 257\)](#).

Output:

```
{
  "cluster": {
    "name": "devel",
    "arn": "arn:aws:eks:region-code:111122223333:cluster/devel",
    "createdAt": 1527785885.159,
    "version": "1.17",
    "roleArn": "arn:aws:iam::111122223333:role/eks-service-role-AWSServiceRoleForAmazonEKS-AFNL4H8HB71F",
    "resourcesVpcConfig": {
      "subnetIds": [
        "subnet-a9189fe2",
        "subnet-50432629"
      ],
      "securityGroupIds": [
        "sg-f5c54184"
      ],
      "vpcId": "vpc-a54041dc",
      "endpointPublicAccess": true,
      "endpointPrivateAccess": false
    },
    "status": "CREATING",
    "certificateAuthority": {}
  }
}
```

### Note

You might receive an error that one of the Availability Zones in your request doesn't have sufficient capacity to create an Amazon EKS cluster. If this happens, the error output contains the Availability Zones that can support a new cluster. Retry creating your cluster with at least two subnets that are located in the supported Availability Zones for your account. For more information, see [Insufficient capacity \(p. 313\)](#).

To encrypt the Kubernetes secrets with a customer master key (CMK) from AWS Key Management Service (AWS KMS), first create a CMK using the [create-key](#) operation.

```
MY_KEY_ARN=$(aws kms create-key --query KeyMetadata.Arn --output text)
```

### Note

By default, the `create-key` command creates a [symmetric key](#) with a key policy that gives the account's root user admin access on AWS KMS actions and resources. If you want to scope down the permissions, make sure that the `kms:DescribeKey` and `kms:CreateGrant` actions are permitted on the key policy for the principal that will be calling the `create-cluster` API. Amazon EKS does not support the key policy condition `kms:GrantIsForAWSResource`. Creating a cluster will not work if this action is in the key policy statement.

Add the `--encryption-config` parameter to the `aws eks create-cluster` command. Encryption of Kubernetes secrets can only be enabled when the cluster is created.

```
--encryption-config '[{"resources":["secrets"],"provider":  
{ "keyArn": "$MY_KEY_ARN" } } ]'
```

The `keyArn` member can contain either the alias or ARN of your CMK. The CMK must be symmetric, created in the same Region as the cluster, and if the CMK was created in a different account, the user must have access to the CMK. For more information, see [Allowing users in other accounts to use a CMK](#) in the *AWS Key Management Service Developer Guide*. Kubernetes secrets encryption with an AWS KMS CMK requires Kubernetes version 1.13 or later.

### Warning

Deletion of the CMK will permanently put the cluster in a degraded state. If any CMKs used for cluster creation are scheduled for deletion, verify that this is the intended action before deletion. Once the key is deleted, there is no path to recovery for the cluster.

2. Cluster provisioning usually takes between 10 and 15 minutes. You can query the status of your cluster with the following command. When your cluster status is `ACTIVE`, you can proceed.

```
aws eks --region region-code describe-cluster --name devel --query "cluster.status"
```

3. When your cluster provisioning is complete, retrieve the endpoint and `certificateAuthority.data` values with the following commands. You must add these values to your `kubectl` configuration so that you can communicate with your cluster.
  - a. Retrieve the endpoint.

```
aws eks --region region-code describe-cluster --name devel --query  
"cluster.endpoint" --output text
```

- b. Retrieve the `certificateAuthority.data`.

```
aws eks --region region-code describe-cluster --name devel --query  
"cluster.certificateAuthority.data" --output text
```

4. Now that you have created your cluster, follow the procedures in [Create a kubeconfig for Amazon EKS \(p. 221\)](#) to enable communication with your new cluster.
5. (Optional) If you want to run pods on AWS Fargate in your cluster, see [Getting started with AWS Fargate using Amazon EKS \(p. 119\)](#).
6. After you enable communication, follow the procedures in [Launching self-managed Amazon Linux nodes \(p. 102\)](#) to add nodes to your cluster to support your workloads.
7. (Optional) After you add Linux nodes to your cluster, follow the procedures in [Windows support \(p. 70\)](#) to add Windows support to your cluster and to add Windows nodes. All Amazon EKS clusters must contain at least one Linux node, even if you only want to run Windows workloads in your cluster.

## Updating an Amazon EKS cluster Kubernetes version

When a new Kubernetes version is available in Amazon EKS, you can update your cluster to the latest version.

### Important

We recommend that before updating to a new Kubernetes version that you review the information in [??? \(p. 61\)](#) and in the update steps in this topic.

New Kubernetes versions introduce significant changes, so we recommend that you test the behavior of your applications against a new Kubernetes version before performing the update on your production clusters. You can achieve this by building a continuous integration workflow to test your application behavior end-to-end before moving to a new Kubernetes version.

The update process consists of Amazon EKS launching new API server nodes with the updated Kubernetes version to replace the existing ones. Amazon EKS performs standard infrastructure and readiness health checks for network traffic on these new nodes to verify that they are working as expected. If any of these checks fail, Amazon EKS reverts the infrastructure deployment, and your cluster remains on the prior Kubernetes version. Running applications are not affected, and your cluster is never left in a non-deterministic or unrecoverable state. Amazon EKS regularly backs up all managed clusters, and mechanisms exist to recover clusters if necessary. We are constantly evaluating and improving our Kubernetes infrastructure management processes.

In order to upgrade the cluster, Amazon EKS requires 2-3 free IP addresses from the subnets which were provided when you created the cluster. If these subnets do not have available IP addresses, then the upgrade can fail. Additionally, if any of the subnets or security groups that were provided during cluster creation have been deleted, the cluster upgrade process can fail.

**Note**

Although Amazon EKS runs a highly available control plane, you might experience minor service interruptions during an update. For example, if you attempt to connect to an API server just before or just after it's terminated and replaced by a new API server running the new version of Kubernetes, you might experience API call errors or connectivity issues. If this happens, retry your API operations until they succeed.

Amazon EKS does not modify any of your Kubernetes add-ons when you update a cluster. After updating your cluster, we recommend that you update your add-ons to the versions listed in the following table for the new Kubernetes version that you're updating to. Steps to accomplish this are included in the update procedures.

Kubernetes version	1.17	1.16	1.15	1.14
Amazon VPC CNI plug-in	1.6.3	1.6.3	1.6.3	1.6.3
DNS (CoreDNS)	1.6.6	1.6.6	1.6.6	1.6.6
KubeProxy	1.17.9	1.16.13	1.15.11	1.14.9

If you're using additional add-ons for your cluster that aren't listed in the previous table, update them to the latest compatible versions after updating your cluster.

## Update an existing cluster

Update the cluster and Kubernetes add-ons.

### To update an existing cluster

1. Compare the Kubernetes version of your cluster control plane to the Kubernetes version of your nodes.
  - Get the Kubernetes version of your cluster control plane with the following command.

```
kubectl version --short
```

- Get the Kubernetes version of your nodes with the following command.

```
kubectl get nodes
```

If your nodes are more than one Kubernetes minor version older than your control plane, then you must upgrade your nodes to a newer Kubernetes minor version before you update your cluster's Kubernetes version. For more information, see [Kubernetes version and version skew support policy](#) in the Kubernetes documentation.

We recommend that you update your nodes to your cluster's current pre-update Kubernetes minor version prior to your cluster update. Your nodes must not run a newer Kubernetes version than your control plane. For example, if your control plane is running version 1.16 and your nodes are running version 1.14, update your nodes to version 1.15 or 1.16 (recommended) before you update your cluster's Kubernetes version to 1.17. For more information, see [Self-managed node updates \(p. 110\)](#).

2. The pod security policy admission controller is enabled on Amazon EKS clusters running Kubernetes version 1.13 or later. If you are upgrading your cluster to Kubernetes version 1.13 or later, ensure that the proper pod security policies are in place before you update to avoid any issues. You can check for the default policy with the following command:

```
kubectl get psp eks.privileged
```

If you receive the following error, see [To install or restore the default pod security policy \(p. 287\)](#) before proceeding.

```
Error from server (NotFound): podsecuritypolicies.extensions "eks.privileged" not found
```

3. Update your cluster. For instructions, select the tab with the name of the tool that you want to use to update your cluster.

eksctl

This procedure requires `eksctl` version `0.26.0-rc.1` or later. You can check your version with the following command:

```
eksctl version
```

For more information on installing or upgrading `eksctl`, see [Installing or upgrading eksctl \(p. 234\)](#).

#### Note

This procedure only works for clusters that were created with `eksctl`.

Update your Amazon EKS cluster Kubernetes version one minor version later than its current version with the following command, replacing `dev` with your cluster name. Because Amazon EKS runs a highly available control plane, you can update only one minor version at a time. See [Kubernetes Version and Version Skew Support Policy](#) for the rationale behind this requirement.

#### Important

You may need to update some of your deployed resources before you can update to 1.16. For more information, see [the section called "Kubernetes 1.16 upgrade prerequisites" \(p. 44\)](#). Upgrading a cluster from 1.16 to 1.17 will fail if any of your AWS Fargate pods have a kubelet minor version earlier than 1.16. Before upgrading your cluster from 1.16 to 1.17, you need to recycle your Fargate pods so that their kubelet is 1.16 before attempting to upgrade the cluster to 1.17.

```
eksctl upgrade cluster --name dev --approve
```

This process takes several minutes to complete.

#### AWS Management Console

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose the name of the cluster to update and choose **Update cluster version**.
3. For **Kubernetes version**, select the version to update your cluster to and choose **Update**.

#### Important

- Upgrading a cluster from 1.16 to 1.17 will fail if any of your AWS Fargate pods have a kubelet minor version earlier than 1.16. Before upgrading your cluster from 1.16 to 1.17, you need to recycle your Fargate pods so that their kubelet is 1.16 before attempting to upgrade the cluster to 1.17.
- You may need to update some of your deployed resources before you can update to 1.16. For more information, see [the section called “Kubernetes 1.16 upgrade prerequisites” \(p. 44\)](#).

#### Important

Because Amazon EKS runs a highly available control plane, you can update only one minor version at a time. See [Kubernetes Version and Version Skew Support Policy](#) for the rationale behind this requirement. Therefore, if your current version is 1.15 and you want to upgrade to 1.17, then you must first upgrade your cluster to 1.16 and then upgrade it from 1.16 to 1.17. If you try to update directly from 1.15 to 1.17, then the update version command throws an error.

4. For **Cluster name**, type the name of your cluster and choose **Confirm**.

#### Note

The cluster update should finish in a few minutes.

#### AWS CLI

1. Update your cluster with the following AWS CLI command. Substitute your cluster name and desired Kubernetes minor version.

#### Important

You may need to update some of your deployed resources before you can update to 1.16. For more information, see [the section called “Kubernetes 1.16 upgrade prerequisites” \(p. 44\)](#). Upgrading a cluster from 1.16 to 1.17 will fail if any of your AWS Fargate pods have a kubelet minor version earlier than 1.16. Before upgrading your cluster from 1.16 to 1.17, you need to recycle your Fargate pods so that their kubelet is 1.16 before attempting to upgrade the cluster to 1.17.

#### Important

Because Amazon EKS runs a highly available control plane, you can update only one minor version at a time. See [Kubernetes Version and Version Skew Support Policy](#) for the rationale behind this requirement. Therefore, if your current version is 1.15 and you want to upgrade to 1.17, then you must first upgrade your cluster to 1.16 and then upgrade it from 1.16 to 1.17. If you try to update directly from 1.15 to 1.17, then the update version command throws an error.

```
aws eks --region region-code update-cluster-version --name prod --kubernetes-version 1.17
```

Output:

```
{
  "update": {
    "id": "b5f0ba18-9a87-4450-b5a0-825e6e84496f",
    "status": "InProgress",
    "type": "VersionUpdate",
    "params": [
      {
        "type": "Version",
        "value": "1.17"
      },
      {
        "type": "PlatformVersion",
        "value": "eks.1"
      }
    ]
  },
  ...
  "errors": []
}
```

2. Monitor the status of your cluster update with the following command, using the cluster name and update ID that the previous command returned. Your update is complete when the status appears as Successful.

**Note**

The cluster update should finish in a few minutes.

```
aws eks --region region-code describe-update --name prod --update-id b5f0ba18-9a87-4450-b5a0-825e6e84496f
```

Output:

```
{
  "update": {
    "id": "b5f0ba18-9a87-4450-b5a0-825e6e84496f",
    "status": "Successful",
    "type": "VersionUpdate",
    "params": [
      {
        "type": "Version",
        "value": "1.17"
      },
      {
        "type": "PlatformVersion",
        "value": "eks.1"
      }
    ]
  },
  ...
  "errors": []
}
```

4. Patch the kube-proxy daemonset to use the image that corresponds to your cluster's Region and current Kubernetes version (in this example, **1.17.9**).

Kubernetes version	1.17	1.16	1.15	1.14
KubeProxy	1.17.9	1.16.13	1.15.11	1.14.9



- a. First, retrieve your current kube-proxy image:

```
kubectl get daemonset kube-proxy --namespace kube-system -o=jsonpath='{#.spec.template.spec.containers[:1].image}'
```

- b. Update kube-proxy to the recommended version by taking the output from the previous step and replacing the version tag with your cluster's recommended kube-proxy version:

```
kubectl set image daemonset.apps/kube-proxy \
  -n kube-system \
  kube-proxy=602401143452.dkr.ecr.us-west-2.amazonaws.com/eks/kube-proxy:v1.17.9-eksbuild.1
```

Your account ID and region may differ from the example above.

- c. (Optional) If using x86 and Arm nodes in the same cluster, and your cluster was deployed before August 17, 2020, then edit your kube-proxy manifest to include a node selector for multiple hardware architectures with the following command. This is a one-time operation. Once you've added the selector to your manifest, you don't need to do it each time you upgrade. If your cluster was deployed on or after August 17, 2020, then kube-proxy is already multi-architecture capable.

```
kubectl edit -n kube-system daemonset/kube-proxy
```

Add the following node selector to the file in the editor and then save the file. For an example of where to include this text in the editor, see the [CNI manifest](#) file on GitHub. This enables Kubernetes to pull the correct hardware image based on the node's hardware architecture.

```
- key: "beta.kubernetes.io/arch"
  operator: In
  values:
    - amd64
    - arm64
```

5. Check your cluster's DNS provider. Clusters that were created with Kubernetes version 1.10 shipped with kube-dns as the default DNS and service discovery provider. If you have updated a 1.10 cluster to a newer version and you want to use CoreDNS for DNS and service discovery, then you must install CoreDNS and remove kube-dns.

To check if your cluster is already running CoreDNS, use the following command.

```
kubectl get pod -n kube-system -l k8s-app=kube-dns
```

If the output shows `coredns` in the pod names, you're already running CoreDNS in your cluster. If not, see [Installing or upgrading CoreDNS \(p. 191\)](#) to install CoreDNS on your cluster, update it to the recommended version, return here, and skip steps 6-8.

6. Check the current version of your cluster's coredns deployment.

```
kubectl describe deployment coredns --namespace kube-system | grep Image | cut -d "/" -f 3
```

Output:

```
coredns:v1.1.3
```

The recommended `coredns` versions for the corresponding Kubernetes versions are as follows:

Kubernetes version	1.17	1.16	1.15	1.14
CoreDNS	1.6.6	1.6.6	1.6.6	1.6.6

7. If your current `coredns` version is 1.5.0 or later, but earlier than the recommended version, then skip this step. If your current version is earlier than 1.5.0, then you need to modify the config map for `coredns` to use the `forward` plug-in, rather than the `proxy` plug-in.

- a. Open the configmap with the following command.

```
kubectl edit configmap coredns -n kube-system
```

- b. Replace `proxy` in the following line with `forward`. Save the file and exit the editor.

```
proxy . /etc/resolv.conf
```

8. Retrieve your current `coredns` image:

```
kubectl get deployment coredns --namespace kube-system -
o=jsonpath='{$.spec.template.spec.containers[:1].image}'
```

9. Update `coredns` to the recommended version by taking the output from the previous step and replacing the version tag with your cluster's recommended `coredns` version:

```
kubectl set image --namespace kube-system deployment.apps/coredns \
    coredns=602401143452.dkr.ecr.us-west-2.amazonaws.com/eks/coredns:v1.6.6-
    eksbuild.1
```

#### Note

If you're updating to the latest 1.14 version, then remove `-eksbuild.1` from the end of the image above.

10. (Optional) If using x86 and Arm nodes in the same cluster, and your cluster was deployed before August 17, 2020, then edit your `coredns` manifest to include a node selector for multiple hardware architectures with the following command. This is a one-time operation. Once you've added the selector to your manifest, you don't need to do it each time you upgrade. If your cluster was deployed on or after August 17, 2020, then `coredns` is already multi-architecture capable.

```
kubectl edit -n kube-system deployment/coredns
```

Add the following node selector to the file in the editor and then save the file. For an example of where to include this text in the editor, see the [CNI manifest](#) file on GitHub.

```
- key: "beta.kubernetes.io/arch"
  operator: In
  values:
    - amd64
    - arm64
```

11. Check the version of your cluster's Amazon VPC CNI Plugin for Kubernetes. Use the following command to print your cluster's CNI version.

```
kubectl describe daemonset aws-node --namespace kube-system | grep Image | cut -d "/" -
f 2
```

Output:

```
amazon-k8s-cni:1.6.2
```

If your CNI version is earlier than 1.6.3, then use the appropriate command below to update your CNI version to the latest recommended version:

- US West (Oregon) (us-west-2)

```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/release-1.6/config/v1.6/aws-k8s-cni.yaml
```

- China (Beijing) (cn-north-1) or China (Ningxia) (cn-northwest-1)

```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/release-1.6/config/v1.6/aws-k8s-cni-cn.yaml
```

- AWS GovCloud (US-East) (us-gov-east-1)

```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/release-1.6/config/v1.6/aws-k8s-cni-us-gov-east-1.yaml
```

- AWS GovCloud (US-West) (us-gov-west-1)

```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/release-1.6/config/v1.6/aws-k8s-cni-us-gov-west-1.yaml
```

- For all other Regions
  - Download the manifest file.

```
curl -o aws-k8s-cni.yaml https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/release-1.6/config/v1.6/aws-k8s-cni.yaml
```

- Replace *region-code* in the following command with the Region that your cluster is in and then run the modified command to replace the Region code in the file (currently us-west-2).

```
sed -i -e 's/us-west-2/region-code/' aws-k8s-cni.yaml
```

- Apply the modified manifest file to your cluster.

```
kubectl apply -f aws-k8s-cni.yaml
```

12. (Optional) If you deployed the Kubernetes Cluster Autoscaler to your cluster prior to upgrading the cluster, update the Cluster Autoscaler to the latest version that matches the Kubernetes major and minor version that you upgraded to.

### Important

You can't use the Kubernetes Cluster Autoscaler with Arm.

- a. Open the Cluster Autoscaler [releases](#) page in a web browser and find the latest Cluster Autoscaler version that matches your cluster's Kubernetes major and minor version. For example, if your cluster's Kubernetes version is 1.17 find the latest Cluster Autoscaler release that begins with 1.17. Record the semantic version number (1.17.*n*) for that release to use in the next step.

- b. Set the Cluster Autoscaler image tag to the version that you recorded in the previous step with the following command. Replace `1.17.n` with your own value. You can replace `us` with `asia` or `eu`.

```
kubectl -n kube-system set image deployment.apps/cluster-autoscaler cluster-autoscaler=us.gcr.io/k8s-artifacts-prod/autoscaling/cluster-autoscaler:v1.17.n
```

#### Note

Depending on the version that you need, you may need to change the previous address to `gcr.io/google-containers/cluster-autoscaler:v1.n.n`. The image address is listed on the [releases](#) page.

13. (Clusters with GPU nodes only) If your cluster has node groups with GPU support (for example, `p3.2xlarge`), you must update the [NVIDIA device plugin for Kubernetes](#) DaemonSet on your cluster with the following command.

```
kubectl apply -f https://raw.githubusercontent.com/NVIDIA/k8s-device-plugin/v0.6.0/nvidia-device-plugin.yml
```

14. After your cluster update is complete, update your nodes to the same Kubernetes version of your updated cluster. For more information, see [Self-managed node updates \(p. 110\)](#) or [Updating a managed node group \(p. 93\)](#). Any new pods launched on Fargate will have a kubelet version that matches your cluster version. Existing Fargate pods will not be changed.

## Kubernetes 1.16 upgrade prerequisites

As noted in the [Kubernetes 1.15 changelog](#), and [Deprecated APIs Removed In 1.16: Here's What You Need To Know](#) documents, if you have an existing cluster, API changes are required for the following deployed resources before upgrading a cluster to 1.16.

#### Warning

If you do not change these APIs before upgrading to 1.16, workloads will fail after the upgrade is complete.

- NetworkPolicy resources will no longer be served from `extensions/v1beta1` in v1.16. Migrate use to the `networking.k8s.io/v1` API, available since v1.8. Existing persisted data can be retrieved through the `networking.k8s.io/v1` API.
- PodSecurityPolicy resources will no longer be served from `extensions/v1beta1` in v1.16. Migrate to the `policy/v1beta1` API, available since v1.10. Existing persisted data can be retrieved through the `policy/v1beta1` API.
- DaemonSet, Deployment, StatefulSet, and ReplicaSet resources will no longer be served from `extensions/v1beta1`, `apps/v1beta1`, or `apps/v1beta2` in v1.16. Migrate to the `apps/v1` API, available since v1.9. Existing persisted data can be retrieved through the `apps/v1` API. For example, to convert a Deployment that currently uses `apps/v1beta1`, enter the following command.

```
kubectl convert -f ./my-deployment.yaml --output-version apps/v1
```

#### Note

The previous command may use different default values from what is set in your current manifest file. To learn more about a specific resource, see the [Kubernetes API reference](#).

If you originally created an Amazon EKS cluster with Kubernetes version 1.11 or earlier and have not removed the `--resource-container` flag from the kube-proxy DaemonSet, then updating to Kubernetes 1.16 will cause kube-proxy failures. This flag is deprecated in Kubernetes 1.16. For more

information, see `kube-proxy` in [Kubernetes 1.16 Deprecations and removals](#). You must remove this flag before updating to Kubernetes 1.16.

### What you need to do before upgrading to 1.16

- Change your YAML files to reference the new APIs.
- Update custom integrations and controllers to call the new APIs.
- Ensure that you use an updated version of any third party tools, such as ingress controllers, continuous delivery systems, and others, that call the new APIs.

To easily check for deprecated API usage in your cluster, make sure that the audit [control plane log \(p. 58\)](#) is enabled, and specify `v1beta` as a filter for the events. All of the replacement APIs are in Kubernetes versions later than 1.10. Applications on any supported version of Amazon EKS can begin using the updated APIs now.

- Remove the `--resource-container=""` flag from your `kube-proxy` DaemonSet, if your cluster was originally deployed with Kubernetes 1.11 or earlier or use a `kube-proxy` configuration file (recommended). To determine whether your current version of `kube-proxy` has the flag, enter the following command.

```
kubectl get daemonset kube-proxy --namespace kube-system -o yaml | grep 'resource-container='
```

If you receive no output, then you don't need to remove anything. If you receive output similar to `--resource-container=""`, then you need to remove the flag. Enter the following command to edit your current `kube-proxy` config.

```
kubectl edit daemonset kube-proxy --namespace kube-system
```

With the editor open, remove the `--resource-container=""` line, and save the file. We recommend that you instead, start using a `kube-proxy` configuration file. To do so, download the following manifest.

```
curl -o kube-proxy-daemonset.yaml https://amazon-eks.s3-us-west-2.amazonaws.com/cloudformation/2020-06-10/kube-proxy-daemonset.yaml
```

Determine your cluster's endpoint with the following command.

```
aws eks describe-cluster \
  --name cluster-name \
  --region region-code \
  --query 'cluster.endpoint' \
  --output text
```

### Output

```
https://A89DBB2140C8AC0C2F920A36CCC6E18C.sk1.region-code.eks.amazonaws.com
```

Edit the `kube-proxy-daemonset.yaml` file that you downloaded. In your editor, replace **MASTER\_ENDPOINT** with the output from the previous command. Replace **REGION** with your cluster's region. On the same line, replace the version with the version of your cluster, if necessary. Apply the file with the following command.

```
kubectl apply -f kube-proxy-daemonset.yaml
```

## Deleting a cluster

When you're done using an Amazon EKS cluster, you should delete the resources associated with it so that you don't incur any unnecessary costs.

### Important

If you have active services in your cluster that are associated with a load balancer, you must delete those services before deleting the cluster so that the load balancers are deleted properly. Otherwise, you can have orphaned resources in your VPC that prevent you from being able to delete the VPC.

Choose the tab below that corresponds to your preferred cluster deletion method.

eksctl

### To delete an Amazon EKS cluster and nodes with `eksctl`

This procedure requires `eksctl` version `0.26.0-rc.1` or later. You can check your version with the following command:

```
eksctl version
```

For more information on installing or upgrading `eksctl`, see [Installing or upgrading eksctl \(p. 234\)](#).

### Note

This procedure only works for clusters that were created with `eksctl`.

1. List all services running in your cluster.

```
kubectl get svc --all-namespaces
```

2. Delete any services that have an associated `EXTERNAL-IP` value. These services are fronted by an Elastic Load Balancing load balancer, and you must delete them in Kubernetes to allow the load balancer and associated resources to be properly released.

```
kubectl delete svc service-name
```

3. Delete the cluster and its associated nodes with the following command, replacing `prod` with your cluster name.

```
eksctl delete cluster --name prod
```

Output:

```
[#] using region region-code
[#] deleting EKS cluster "prod"
[#] will delete stack "eksctl-prod-nodegroup-standard-nodes"
[#] waiting for stack "eksctl-prod-nodegroup-standard-nodes" to get deleted
[#] will delete stack "eksctl-prod-cluster"
[#] the following EKS cluster resource(s) for "prod" will be deleted: cluster. If
    in doubt, check CloudFormation console
```

## AWS Management Console

### To delete an Amazon EKS cluster with the AWS Management Console

1. List all services running in your cluster.

```
kubectl get svc --all-namespaces
```

2. Delete any services that have an associated `EXTERNAL-IP` value. These services are fronted by an Elastic Load Balancing load balancer, and you must delete them in Kubernetes to allow the load balancer and associated resources to be properly released.

```
kubectl delete svc service-name
```

3. Delete all node groups and Fargate profiles.
  - a. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
  - b. In the left navigation, select **Clusters**, and then in the tabbed list of clusters, select the name of the cluster that you want to delete.
  - c. Select the **Compute** tab, select a node group to delete, select **Delete**, enter the name of the node group, and then select **Delete**. Delete all node groups in the cluster.

#### Note

The node groups listed are [managed node groups \(p. 88\)](#) only.

- d. Select a **Fargate Profile** to delete, select **Delete**, enter the name of the profile, and then select **Delete**. Delete all Fargate profiles in the cluster.
4. Delete all self-managed node AWS CloudFormation stacks.
    - a. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
    - b. Select the node stack to delete and then choose **Actions, Delete Stack**.
    - c. On the **Delete Stack** confirmation screen, choose **Yes, Delete**. Delete all self-managed node stacks in the cluster.
  5. Delete the cluster.
    - a. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
    - b. Select the cluster to delete and choose **Delete**.
    - c. On the delete cluster confirmation screen, choose **Delete**.
  6. (Optional) Delete the VPC AWS CloudFormation stack.
    - a. Select the VPC stack to delete and choose **Actions** and then **Delete Stack**.
    - b. On the **Delete Stack** confirmation screen, choose **Yes, Delete**.

## AWS CLI

### To delete an Amazon EKS cluster with the AWS CLI

1. List all services running in your cluster.

```
kubectl get svc --all-namespaces
```

2. Delete any services that have an associated `EXTERNAL-IP` value. These services are fronted by an Elastic Load Balancing load balancer, and you must delete them in Kubernetes to allow the load balancer and associated resources to be properly released.

```
kubectl delete svc service-name
```

3. Delete all node groups and Fargate profiles.

- a. List the node groups in your cluster with the following command.

```
aws eks list-nodegroups --cluster-name my-cluster
```

**Note**

The node groups listed are [managed node groups \(p. 88\)](#) only.

- b. Delete each node group with the following command. Delete all node groups in the cluster.

```
aws eks delete-nodegroup --nodegroup-name my-nodegroup --cluster-name my-cluster
```

- c. List the Fargate profiles in your cluster with the following command.

```
aws eks list-fargate-profiles --cluster-name my-cluster
```

- d. Delete each Fargate profile with the following command. Delete all Fargate profiles in the cluster.

```
aws eks delete-fargate-profile --fargate-profile-name my-fargate-profile --cluster-name my-cluster
```

4. Delete all self-managed node AWS CloudFormation stacks.

- a. List your available AWS CloudFormation stacks with the following command. Find the node template name in the resulting output.

```
aws cloudformation list-stacks --query "StackSummaries[].StackName"
```

- b. Delete each node stack with the following command, replacing *node-stack* with your node stack name. Delete all self-managed node stacks in the cluster.

```
aws cloudformation delete-stack --stack-name node-stack
```

5. Delete the cluster with the following command, replacing *my-cluster* with your cluster name.

```
aws eks delete-cluster --name my-cluster
```

6. (Optional) Delete the VPC AWS CloudFormation stack.

- a. List your available AWS CloudFormation stacks with the following command. Find the VPC template name in the resulting output.

```
aws cloudformation list-stacks --query "StackSummaries[].StackName"
```

- b. Delete the VPC stack with the following command, replacing *my-vpc-stack* with your VPC stack name.

```
aws cloudformation delete-stack --stack-name my-vpc-stack
```



## Amazon EKS cluster endpoint access control

This topic helps you to enable private access for your Amazon EKS cluster's Kubernetes API server endpoint and limit, or completely disable, public access from the internet.

When you create a new cluster, Amazon EKS creates an endpoint for the managed Kubernetes API server that you use to communicate with your cluster (using Kubernetes management tools such as `kubectl`). By default, this API server endpoint is public to the internet, and access to the API server is secured using a combination of AWS Identity and Access Management (IAM) and native Kubernetes [Role Based Access Control](#) (RBAC).

You can enable private access to the Kubernetes API server so that all communication between your nodes and the API server stays within your VPC. You can limit the IP addresses that can access your API server from the internet, or completely disable internet access to the API server.

### Note

Because this endpoint is for the Kubernetes API server and not a traditional AWS PrivateLink endpoint for communicating with an AWS API, it doesn't appear as an endpoint in the Amazon VPC console.

When you enable endpoint private access for your cluster, Amazon EKS creates a Route 53 private hosted zone on your behalf and associates it with your cluster's VPC. This private hosted zone is managed by Amazon EKS, and it doesn't appear in your account's Route 53 resources. In order for the private hosted zone to properly route traffic to your API server, your VPC must have `enableDnsHostnames` and `enableDnsSupport` set to `true`, and the DHCP options set for your VPC must include `AmazonProvidedDNS` in its domain name servers list. For more information, see [Updating DNS support for your VPC](#) in the *Amazon VPC User Guide*.

### Note

In addition to standard Amazon EKS permissions, your IAM user or role must have `route53:AssociateVPCWithHostedZone` permissions to enable the cluster's endpoint private access.

You can define your API server endpoint access requirements when you create a new cluster, and you can update the API server endpoint access for a cluster at any time.

## Modifying cluster endpoint access

Use the procedures in this section to modify the endpoint access for an existing cluster. The following table shows the supported API server endpoint access combinations and their associated behavior.

### API server endpoint access options

Endpoint public access	Endpoint private access	Behavior
Enabled	Disabled	<ul style="list-style-type: none"><li>This is the default behavior for new Amazon EKS clusters.</li><li>Kubernetes API requests that originate from within your cluster's VPC (such as node to control plane communication) leave the VPC but not Amazon's network.</li><li>Your cluster API server is accessible from the internet. You can, optionally, limit the CIDR blocks that can access the public endpoint.</li></ul>

Endpoint public access	Endpoint private access	Behavior
		If you limit access to specific CIDR blocks, then it is recommended that you also enable the private endpoint, or ensure that the CIDR blocks that you specify include the addresses that nodes and Fargate pods (if you use them) access the public endpoint from.
Enabled	Enabled	<ul style="list-style-type: none"><li>• Kubernetes API requests within your cluster's VPC (such as node to control plane communication) use the private VPC endpoint.</li><li>• Your cluster API server is accessible from the internet. You can, optionally, limit the CIDR blocks that can access the public endpoint.</li></ul>

Endpoint public access	Endpoint private access	Behavior
Disabled	Enabled	<ul style="list-style-type: none"><li>• All traffic to your cluster API server must come from within your cluster's VPC or a <a href="#">connected network</a>.</li><li>• There is no public access to your API server from the internet. Any <code>kubectl</code> commands must come from within the VPC or a connected network. For connectivity options, see <a href="#">Accessing a private only API server (p. 53)</a>.</li><li>• The cluster's API server endpoint is resolved by public DNS servers to a private IP address from the VPC. In the past, the endpoint could only be resolved from within the VPC.</li></ul> <p>If your endpoint does not resolve to a private IP address within the VPC for an existing cluster, you can:</p> <ul style="list-style-type: none"><li>• Enable public access and then disable it again. You only need to do so once for a cluster and the endpoint will resolve to a private IP address from that point forward.</li><li>• <a href="#">Update (p. 36)</a> your cluster.</li></ul>

You can modify your cluster API server endpoint access using the AWS Management Console or AWS CLI. For instructions, select the tab for the tool that you want to use.

#### AWS Management Console

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose the name of the cluster to display your cluster information.
3. Under **Networking**, choose **Update**.
4. For **Private access**, choose whether to enable or disable private access for your cluster's Kubernetes API server endpoint. If you enable private access, Kubernetes API requests that originate from within your cluster's VPC use the private VPC endpoint. You must enable private access to disable public access.
5. For **Public access**, choose whether to enable or disable public access for your cluster's Kubernetes API server endpoint. If you disable public access, your cluster's Kubernetes API server can only receive requests from within the cluster VPC.
6. (Optional) If you've enabled **Public access**, you can specify which addresses from the Internet can communicate to the public endpoint. Select **Advanced Settings**. Enter a CIDR block, such

as `203.0.113.5/32`. The block cannot include [reserved addresses](#). You can enter additional blocks by selecting **Add Source**. There is a maximum number of CIDR blocks that you can specify. For more information, see [Amazon EKS service quotas \(p. 247\)](#). If you specify no blocks, then the public API server endpoint receives requests from all (0.0.0.0/0) IP addresses. If you restrict access to your public endpoint using CIDR blocks, it is recommended that you also enable private endpoint access so that nodes and Fargate pods (if you use them) can communicate with the cluster. Without the private endpoint enabled, your public access endpoint CIDR sources must include the egress sources from your VPC. For example, if you have a node in a private subnet that communicates to the internet through a NAT Gateway, you will need to add the outbound IP address of the NAT gateway as part of an allowed CIDR block on your public endpoint.

7. Choose **Update** to finish.

## AWS CLI

Complete the following steps using the AWS CLI version 1.18.120 or later. You can check your current version with `aws --version`. To install or upgrade the AWS CLI, see [Installing the AWS CLI](#).

1. Update your cluster API server endpoint access with the following AWS CLI command. Substitute your cluster name and desired endpoint access values. If you set `endpointPublicAccess=true`, then you can (optionally) enter single CIDR block, or a comma-separated list of CIDR blocks for `publicAccessCidrs`. The blocks cannot include [reserved addresses](#). If you specify CIDR blocks, then the public API server endpoint will only receive requests from the listed blocks. There is a maximum number of CIDR blocks that you can specify. For more information, see [Amazon EKS service quotas \(p. 247\)](#). If you restrict access to your public endpoint using CIDR blocks, it is recommended that you also enable private endpoint access so that nodes and Fargate pods (if you use them) can communicate with the cluster. Without the private endpoint enabled, your public access endpoint CIDR sources must include the egress sources from your VPC. For example, if you have a node in a private subnet that communicates to the internet through a NAT Gateway, you will need to add the outbound IP address of the NAT gateway as part of an allowed CIDR block on your public endpoint. If you specify no CIDR blocks, then the public API server endpoint receives requests from all (0.0.0.0/0) IP addresses.

### Note

The following command enables private access and public access from a single IP address for the API server endpoint. Replace `203.0.113.5/32` with a single CIDR block, or a comma-separated list of CIDR blocks that you want to restrict network access to.

```
aws eks update-cluster-config \
  --region region-code \
  --name dev \
  --resources-vpc-config
  endpointPublicAccess=true,publicAccessCidrs="203.0.113.5/32",endpointPrivateAccess=true
```

Output:

```
{
  "update": {
    "id": "e6f0905f-a5d4-4a2a-8c49-EXAMPLE00000",
    "status": "InProgress",
    "type": "EndpointAccessUpdate",
    "params": [
      {
        "type": "EndpointPublicAccess",
        "value": "true"
      }
    ]
  }
}
```

```
{
  {
    "type": "EndpointPrivateAccess",
    "value": "true"
  },
  {
    "type": "publicAccessCidrs",
    "value": "[\203.0.113.5/32]"
  }
],
"createdAt": 1576874258.137,
"errors": []
}
```

2. Monitor the status of your endpoint access update with the following command, using the cluster name and update ID that was returned by the previous command. Your update is complete when the status is shown as Successful.

```
aws eks describe-update \
  --region region-code \
  --name dev \
  --update-id e6f0905f-a5d4-4a2a-8c49-EXAMPLE00000
```

Output:

```
{
  "update": {
    "id": "e6f0905f-a5d4-4a2a-8c49-EXAMPLE00000",
    "status": "Successful",
    "type": "EndpointAccessUpdate",
    "params": [
      {
        "type": "EndpointPublicAccess",
        "value": "true"
      },
      {
        "type": "EndpointPrivateAccess",
        "value": "true"
      },
      {
        "type": "publicAccessCidrs",
        "value": "[\203.0.113.5/32]"
      }
    ],
    "createdAt": 1576874258.137,
    "errors": []
  }
}
```

## Accessing a private only API server

If you have disabled public access for your cluster's Kubernetes API server endpoint, you can only access the API server from within your VPC or a [connected network](#). Here are a few possible ways to access the Kubernetes API server endpoint:

- **Connected network** – Connect your network to the VPC with an [AWS transit gateway](#) or other [connectivity](#) option and then use a computer in the connected network. You must ensure that your Amazon EKS control plane security group contains rules to allow ingress traffic on port 443 from your connected network.

- **Amazon EC2 bastion host** – You can launch an Amazon EC2 instance into a public subnet in your cluster's VPC and then log in via SSH into that instance to run `kubectl` commands. For more information, see [Linux bastion hosts on AWS](#). You must ensure that your Amazon EKS control plane security group contains rules to allow ingress traffic on port 443 from your bastion host. For more information, see [Amazon EKS security group considerations](#) (p. 173).

When you configure `kubectl` for your bastion host, be sure to use AWS credentials that are already mapped to your cluster's RBAC configuration, or add the IAM user or role that your bastion will use to the RBAC configuration before you remove endpoint public access. For more information, see [Managing users or IAM roles for your cluster](#) (p. 225) and [Unauthorized or access denied \(kubectl\)](#) (p. 314).

- **AWS Cloud9 IDE** – AWS Cloud9 is a cloud-based integrated development environment (IDE) that lets you write, run, and debug your code with just a browser. You can create an AWS Cloud9 IDE in your cluster's VPC and use the IDE to communicate with your cluster. For more information, see [Creating an environment in AWS Cloud9](#). You must ensure that your Amazon EKS control plane security group contains rules to allow ingress traffic on port 443 from your IDE security group. For more information, see [Amazon EKS security group considerations](#) (p. 173).

When you configure `kubectl` for your AWS Cloud9 IDE, be sure to use AWS credentials that are already mapped to your cluster's RBAC configuration, or add the IAM user or role that your IDE will use to the RBAC configuration before you remove endpoint public access. For more information, see [Managing users or IAM roles for your cluster](#) (p. 225) and [Unauthorized or access denied \(kubectl\)](#) (p. 314).

## Cluster Autoscaler

The Kubernetes [Cluster Autoscaler](#) automatically adjusts the number of nodes in your cluster when pods fail to launch due to lack of resources or when nodes in the cluster are underutilized and their pods can be rescheduled onto other nodes in the cluster.

This topic shows you how to deploy the Cluster Autoscaler to your Amazon EKS cluster and how to configure it to modify your Amazon EC2 Auto Scaling groups. The Cluster Autoscaler modifies your node groups so that they scale out when you need more resources and scale in when you have underutilized resources.

## Create an Amazon EKS cluster

This section helps you to create a cluster and node group or groups. If you already have a cluster, you can skip ahead to [Cluster Autoscaler node group considerations](#) (p. 55).

If you are running a stateful application across multiple Availability Zones that is backed by Amazon EBS volumes and using the Kubernetes [Cluster Autoscaler](#) (p. 54), you should configure multiple node groups, each scoped to a single Availability Zone. In addition, you should enable the `--balance-similar-node-groups` feature. Otherwise, you can create a single node group that spans multiple Availability Zones.

Choose one of the cluster creation procedures below that meets your requirements.

### To create a cluster with a single managed group that spans multiple Availability Zones

- Create an Amazon EKS cluster with a single managed node group with the following `eksctl` command. For more information, see [Creating an Amazon EKS cluster](#) (p. 30). Substitute the *variable text* with your own values.

```
eksctl create cluster --name my-cluster --version 1.17 --managed --asg-access
```

Portions of the output showing the Availability Zones:

```
...
[#] using region region-code
[#] setting availability zones to [region-codea region-codeb region-codec]
[#] subnets for region-codea - public:192.168.0.0/19 private:192.168.96.0/19
[#] subnets for region-codeb - public:192.168.32.0/19 private:192.168.128.0/19
[#] subnets for region-codec - public:192.168.64.0/19 private:192.168.160.0/19
...
[#] nodegroup "ng-6bcca56a" has 2 node(s)
[#] node "ip-192-168-28-68.region-code.compute.internal" is ready
[#] node "ip-192-168-61-153.region-code.compute.internal" is ready
[#] waiting for at least 2 node(s) to become ready in "ng-6bcca56a"
[#] nodegroup "ng-6bcca56a" has 2 node(s)
[#] node "ip-192-168-28-68.region-code.compute.internal" is ready
[#] node "ip-192-168-61-153.region-code.compute.internal" is ready
...
[#] EKS cluster "my-cluster" in "region-code" region-code is ready
```

### To create a cluster with a dedicated managed node group for each Availability Zone

1. Create an Amazon EKS cluster with no node groups with the following `eksctl` command. For more information, see [Creating an Amazon EKS cluster \(p. 30\)](#). Note the Availability Zones that the cluster is created in. You will use these Availability Zones when you create your node groups. Substitute the red variable text with your own values.

```
eksctl create cluster --name my-cluster --version 1.17 --without-nodegroup
```

Portions of the output showing the Availability Zones:

```
...
[#] using region region-code
[#] setting availability zones to [region-codea region-codec region-codeb]
[#] subnets for region-codea - public:192.168.0.0/19 private:192.168.96.0/19
[#] subnets for region-codec - public:192.168.32.0/19 private:192.168.128.0/19
[#] subnets for region-codeb - public:192.168.64.0/19 private:192.168.160.0/19
...
[#] EKS cluster "my-cluster" in "region-code" region is ready
```

This cluster was created in the following Availability Zones: *region-codea*, *region-codec*, and *region-codeb*.

2. For each Availability Zone in your cluster, use the following `eksctl` command to create a node group. Substitute the *variable text* with your own values. This command creates an Auto Scaling group with a minimum count of one and a maximum count of ten.

```
eksctl create nodegroup --cluster my-cluster --node-zones region-codea --name region-codea --asg-access --nodes-min 1 --nodes 5 --nodes-max 10 --managed
```

## Cluster Autoscaler node group considerations

The Cluster Autoscaler requires additional IAM and resource tagging considerations that are explained in this section.

## Node group IAM policy

The Cluster Autoscaler requires the following IAM permissions to make calls to AWS APIs on your behalf.

If you used the previous `eksctl` commands to create your node groups, these permissions are automatically provided and attached to your node IAM roles. If you did not use `eksctl`, you must create an IAM policy with the following document and attach it to your node IAM roles. For more information, see [Modifying a role](#) in the *IAM User Guide*.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Action": [
        "autoscaling:DescribeAutoScalingGroups",
        "autoscaling:DescribeAutoScalingInstances",
        "autoscaling:DescribeLaunchConfigurations",
        "autoscaling:DescribeTags",
        "autoscaling:SetDesiredCapacity",
        "autoscaling:TerminateInstanceInAutoScalingGroup",
        "ec2:DescribeLaunchTemplateVersions"
      ],
      "Resource": "*",
      "Effect": "Allow"
    }
  ]
}
```

## Auto Scaling group tags

The Cluster Autoscaler requires the following tags on your node group Auto Scaling groups so that they can be auto-discovered.

If you used the previous `eksctl` commands to create your node groups, these tags are automatically applied. If not, you must manually tag your Auto Scaling groups with the following tags. For more information, see [Tagging your Amazon EC2 resources](#) in the *Amazon EC2 User Guide for Linux Instances*.

Key	Value
k8s.io/cluster-autoscaler/<cluster-name>	owned
k8s.io/cluster-autoscaler/enabled	true

## Deploy the Cluster Autoscaler

### To deploy the Cluster Autoscaler

1. Deploy the Cluster Autoscaler to your cluster with the following command.

```
kubectl apply -f https://raw.githubusercontent.com/kubernetes/autoscaler/master/cluster-autoscaler/cloudprovider/aws/examples/cluster-autoscaler-autodiscover.yaml
```

2. Add the `cluster-autoscaler.kubernetes.io/safe-to-evict` annotation to the deployment with the following command.



```
kubectl -n kube-system annotate deployment.apps/cluster-autoscaler cluster-autoscaler.kubernetes.io/safe-to-evict="false"
```

3. Edit the Cluster Autoscaler deployment with the following command.

```
kubectl -n kube-system edit deployment.apps/cluster-autoscaler
```

Edit the `cluster-autoscaler` container command to replace `<YOUR CLUSTER NAME>` with your cluster's name, and add the following options.

- `--balance-similar-node-groups`
- `--skip-nodes-with-system-pods=false`

```
spec:
  containers:
  - command:
    - ./cluster-autoscaler
    - --v=4
    - --stderrthreshold=info
    - --cloud-provider=aws
    - --skip-nodes-with-local-storage=false
    - --expander=least-waste
    - --node-group-auto-discovery=asg:tag=k8s.io/cluster-autoscaler/enabled,k8s.io/cluster-autoscaler/<YOUR CLUSTER NAME>
    - --balance-similar-node-groups
    - --skip-nodes-with-system-pods=false
```

Save and close the file to apply the changes.

4. Open the Cluster Autoscaler [releases](#) page in a web browser and find the latest Cluster Autoscaler version that matches your cluster's Kubernetes major and minor version. For example, if your cluster's Kubernetes version is 1.17 find the latest Cluster Autoscaler release that begins with 1.17. Record the semantic version number (1.17.*n*) for that release to use in the next step.
5. Set the Cluster Autoscaler image tag to the version that you recorded in the previous step with the following command. Replace `1.15.n` with your own value. You can replace `us` with `asia` or `eu`.

```
kubectl -n kube-system set image deployment.apps/cluster-autoscaler cluster-autoscaler=us.gcr.io/k8s-artifacts-prod/autoscaling/cluster-autoscaler:v1.15.n
```

#### Note

Depending on the version that you need, you may need to change the previous address to `gcr.io/google-containers/cluster-autoscaler:v1.n.n`. The image address is listed on the [releases](#) page.

## View your Cluster Autoscaler logs

After you have deployed the Cluster Autoscaler, you can view the logs and verify that it is monitoring your cluster load.

View your Cluster Autoscaler logs with the following command.

```
kubectl -n kube-system logs -f deployment.apps/cluster-autoscaler
```

Output:

```
I0926 23:15:55.165842      1 static_autoscaler.go:138] Starting main loop
I0926 23:15:55.166279      1 utils.go:595] No pod using affinity / antiaffinity found in
  cluster, disabling affinity predicate for this loop
I0926 23:15:55.166293      1 static_autoscaler.go:294] Filtering out schedulables
I0926 23:15:55.166330      1 static_autoscaler.go:311] No schedulable pods
I0926 23:15:55.166338      1 static_autoscaler.go:319] No unschedulable pods
I0926 23:15:55.166345      1 static_autoscaler.go:366] Calculating unneeded nodes
I0926 23:15:55.166357      1 utils.go:552] Skipping ip-192-168-3-111.region-
code.compute.internal - node group min size reached
I0926 23:15:55.166365      1 utils.go:552] Skipping ip-192-168-71-83.region-
code.compute.internal - node group min size reached
I0926 23:15:55.166373      1 utils.go:552] Skipping ip-192-168-60-191.region-
code.compute.internal - node group min size reached
I0926 23:15:55.166435      1 static_autoscaler.go:393] Scale down status:
  unneededOnly=false lastScaleUpTime=2019-09-26 21:42:40.908059094 ...
I0926 23:15:55.166458      1 static_autoscaler.go:403] Starting scale down
I0926 23:15:55.166488      1 scale_down.go:706] No candidates for scale down
```

## Amazon EKS control plane logging

Amazon EKS control plane logging provides audit and diagnostic logs directly from the Amazon EKS control plane to CloudWatch Logs in your account. These logs make it easy for you to secure and run your clusters. You can select the exact log types you need, and logs are sent as log streams to a group for each Amazon EKS cluster in CloudWatch.

You can start using Amazon EKS control plane logging by choosing which log types you want to enable for each new or existing Amazon EKS cluster. You can enable or disable each log type on a per-cluster basis using the AWS Management Console, AWS CLI (version 1.16.139 or higher), or through the Amazon EKS API. When enabled, logs are automatically sent from the Amazon EKS cluster to CloudWatch Logs in the same account.

When you use Amazon EKS control plane logging, you're charged standard Amazon EKS pricing for each cluster that you run. You are charged the standard CloudWatch Logs data ingestion and storage costs for any logs sent to CloudWatch Logs from your clusters. You are also charged for any AWS resources, such as Amazon EC2 instances or Amazon EBS volumes, that you provision as part of your cluster.

The following cluster control plane log types are available. Each log type corresponds to a component of the Kubernetes control plane. To learn more about these components, see [Kubernetes Components](#) in the Kubernetes documentation.

- **Kubernetes API server component logs (api)** – Your cluster's API server is the control plane component that exposes the Kubernetes API. For more information, see [kube-apiserver](#) in the Kubernetes documentation.
- **Audit (audit)** – Kubernetes audit logs provide a record of the individual users, administrators, or system components that have affected your cluster. For more information, see [Auditing](#) in the Kubernetes documentation.
- **Authenticator (authenticator)** – Authenticator logs are unique to Amazon EKS. These logs represent the control plane component that Amazon EKS uses for Kubernetes [Role Based Access Control](#) (RBAC) authentication using IAM credentials. For more information, see [Cluster authentication \(p. 218\)](#).
- **Controller manager (controllerManager)** – The controller manager manages the core control loops that are shipped with Kubernetes. For more information, see [kube-controller-manager](#) in the Kubernetes documentation.
- **Scheduler (scheduler)** – The scheduler component manages when and where to run pods in your cluster. For more information, see [kube-scheduler](#) in the Kubernetes documentation.

## Enabling and disabling control plane logs

By default, cluster control plane logs aren't sent to CloudWatch Logs. You must enable each log type individually to send logs for your cluster. CloudWatch Logs ingestion, archive storage, and data scanning rates apply to enabled control plane logs. For more information, see [CloudWatch pricing](#).

When you enable a log type, the logs are sent with a log verbosity level of 2.

### To enable or disable control plane logs with the console

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose the name of the cluster to display your cluster information.
3. Under **Logging**, choose **Update**.
4. For each individual log type, choose whether the log type should be **Enabled** or **Disabled**. By default, each log type is **Disabled**.
5. Choose **Update** to finish.

### To enable or disable control plane logs with the AWS CLI

1. Check your AWS CLI version with the following command.

```
aws --version
```

If your AWS CLI version is below 1.16.139, you must first update to the latest version. To install or upgrade the AWS CLI, see [Installing the AWS command line interface](#) in the *AWS Command Line Interface User Guide*.

2. Update your cluster's control plane log export configuration with the following AWS CLI command. Substitute your cluster name and desired endpoint access values.

#### Note

The following command sends all available log types to CloudWatch Logs.

```
aws eks --region region-code update-cluster-config --name prod \
--logging '{"clusterLogging":[{"types":
["api","audit","authenticator","controllerManager","scheduler"],"enabled":true}]}'
```

Output:

```
{
  "update": {
    "id": "883405c8-65c6-4758-8cee-2a7c1340a6d9",
    "status": "InProgress",
    "type": "LoggingUpdate",
    "params": [
      {
        "type": "ClusterLogging",
        "value": "{\"clusterLogging\":{\"types\":[\"api\",\"audit\",
\"authenticator\",\"controllerManager\",\"scheduler\"],\"enabled\":true}}}"
      }
    ],
    "createdAt": 1553271814.684,
    "errors": []
  }
}
```

3. Monitor the status of your log configuration update with the following command, using the cluster name and the update ID that were returned by the previous command. Your update is complete when the status appears as Successful.

```
aws eks --region region-code describe-update --name prod --update-id 883405c8-65c6-4758-8cee-2a7c1340a6d9
```

Output:

```
{
  "update": {
    "id": "883405c8-65c6-4758-8cee-2a7c1340a6d9",
    "status": "Successful",
    "type": "LoggingUpdate",
    "params": [
      {
        "type": "ClusterLogging",
        "value": "{\"clusterLogging\": [{\"types\": [\"api\", \"audit\", \"authenticator\", \"controllerManager\", \"scheduler\"], \"enabled\": true}]}"
      }
    ],
    "createdAt": 1553271814.684,
    "errors": []
  }
}
```

## Viewing cluster control plane logs

After you have enabled any of the control plane log types for your Amazon EKS cluster, you can view them on the CloudWatch console.

To learn more about viewing, analyzing, and managing logs in CloudWatch, see the [Amazon CloudWatch Logs User Guide](#).

### To view your cluster control plane logs on the CloudWatch console

1. Open the CloudWatch console at <https://console.aws.amazon.com/cloudwatch/home#logs:prefix=/aws/eks>. This URL displays your current available log groups and filters them with the `/aws/eks` prefix.
2. Choose the cluster that you want to view logs for. The log group name format is `/aws/eks/cluster-name/cluster`.
3. Choose the log stream to view. The following list describes the log stream name format for each log type.

#### Note

As log stream data grows, the log stream names are rotated. When multiple log streams exist for a particular log type, you can view the latest log stream by looking for the log stream name with the latest **Last Event Time**.

- **Kubernetes API server component logs (api)** – kube-apiserver-*nnn...*
- **Audit (audit)** – kube-apiserver-audit-*nnn...*
- **Authenticator (authenticator)** – authenticator-*nnn...*
- **Controller manager (controllerManager)** – kube-controller-manager-*nnn...*
- **Scheduler (scheduler)** – kube-scheduler-*nnn...*

# Amazon EKS Kubernetes versions

The Kubernetes project is rapidly evolving with new features, design updates, and bug fixes. The community releases new Kubernetes minor versions, such as 1.17, as generally available approximately every three months, and each minor version is supported for approximately nine months after it is first released.

## Available Amazon EKS Kubernetes versions

The following Kubernetes versions are currently available for new clusters in Amazon EKS:

- 1.17.6
- 1.16.8
- 1.15.11
- 1.14.9

Unless your application requires a specific version of Kubernetes, we recommend that you choose the latest available Kubernetes version supported by Amazon EKS for your clusters. As new Kubernetes versions become available in Amazon EKS, we recommend that you proactively update your clusters to use the latest available version. For more information, see [Updating an Amazon EKS cluster Kubernetes version](#) (p. 36).

## Kubernetes 1.17

Kubernetes 1.17 is now available in Amazon EKS. For more information about Kubernetes 1.17, see the [official release announcement](#).

### Important

- EKS has not enabled the `CSIMigrationAWS` feature flag. This will be enabled in a future release, along with detailed migration instructions. For more info on CSI migration, see the [Kubernetes blog](#).
- Upgrading a cluster from 1.16 to 1.17 will fail if any of your AWS Fargate pods have a `kubelet` minor version earlier than 1.16. Before upgrading your cluster from 1.16 to 1.17, you need to recycle your Fargate pods so that their `kubelet` is 1.16 before attempting to upgrade the cluster to 1.17. To recycle a Kubernetes deployment on a 1.15 or later cluster, use the following command.

```
kubectl rollout restart deployment deployment-name
```

The following Kubernetes features are now supported in Kubernetes 1.17 Amazon EKS clusters:

- [Cloud Provider Labels](#) have reached general availability. If you are using the beta labels in your pod specs for features such as node affinity, or in any custom controllers, then we recommend that you start migrating them to the new GA labels. For information about the new labels, see the following Kubernetes documentation:
  - [node.kubernetes.io/instance-type](https://kubernetes.io/docs/concepts/scheduling-node/node-affinity-specific/#node-kubernetes-io-instance-type)
  - [topology.kubernetes.io/region](https://kubernetes.io/docs/concepts/scheduling-node/node-affinity-specific/#topology-kubernetes-io-region)
  - [topology.kubernetes.io/zone](https://kubernetes.io/docs/concepts/scheduling-node/node-affinity-specific/#topology-kubernetes-io-zone)
- The [ResourceQuotaScopeSelectors](#) feature has graduated to generally available. This feature allows you to limit the number of resources a quota supports to only those that pertain to the scope.

- The [TaintNodesByCondition](#) feature has graduated to generally available. This feature allows you to taint nodes that have conditions such as high disk or memory pressure.
- The [CSI Topology](#) feature has graduated to generally available, and is fully supported by the [EBS CSI driver](#). You can use topology to restrict the Availability Zone where a volume is provisioned.
- [Finalizer protection](#) for services of type `LoadBalancer` has graduated to generally available. This feature ensures that a service resource is not fully deleted until the correlating load balancer is also deleted.
- Custom resources now support [default values](#). You specify values in an [OpenAPI v3 validation schema](#).
- The [Windows containers RunAsUsername](#) feature is now in beta, allowing you to run Windows applications in a container as a different username than the default.

For the complete Kubernetes 1.17 changelog, see <https://github.com/kubernetes/kubernetes/blob/master/CHANGELOG/CHANGELOG-1.17.md>.

## Kubernetes 1.16

Kubernetes 1.16 is now available in Amazon EKS. For more information about Kubernetes 1.16, see the [official release announcement](#).

### Important

- Kubernetes 1.16 removes a number of deprecated APIs. Changes to your applications may be required before upgrading your cluster to 1.16. Carefully follow the 1.16 [upgrade prerequisites](#) (p. 44) before upgrading.
- Starting with 1.16, the Amazon EKS certificate authority will honor certificate signing requests with SAN X.509 extensions, which resolves the [EKS CA should honor SAN x509 extension](#) feature request from GitHub.

The following Kubernetes features are now supported in Kubernetes 1.16 Amazon EKS clusters:

- Volume expansion in the CSI specification has moved to beta, which allows for any CSI spec volume plugin to be resizeable. For more information, see [Volume Expansion](#) in the Kubernetes CSI documentation. The latest version of the [EBS CSI driver](#) supports volume expansion when running on an Amazon EKS 1.16 cluster.
- Windows GMSA support has graduated from alpha to beta, and is now supported by Amazon EKS. For more information, see [Configure GMSA for Windows Pods and containers](#) in the Kubernetes documentation.
- A new annotation: `service.beta.kubernetes.io/aws-load-balancer-eip-allocations` is available on service type `LoadBalancer` to assign an elastic IP address to Network Load Balancers. For more information, see the [Support EIP Allocations with AWS NLB](#) GitHub issue.
- Finalizer protection for service load balancers is now in beta and enabled by default. Service load balancer finalizer protection ensures that any load balancer resources allocated for a Kubernetes Service object, such as the [AWS Network Load Balancer](#), will be destroyed or released when the service is deleted. For more information, see [Garbage Collecting Load Balancers](#) in the Kubernetes documentation.
- The Kubernetes custom resource definitions and admission webhooks extensibility mechanisms have both reached general availability. For more information, see [Custom Resources](#) and [Dynamic Admission Control](#) in the Kubernetes documentation.
- The server-side apply feature has reached beta status and is enabled by default. For more information, see [Server Side Apply](#) in the Kubernetes documentation.
- The `CustomResourceDefaulting` feature is promoted to beta and enabled by default. Defaults may be specified in structural schemas through the `apiextensions.k8s.io/v1` API. For more information, see [Specifying a structural schema](#) in the Kubernetes documentation.

For the complete Kubernetes 1.16 changelog, see <https://github.com/kubernetes/kubernetes/blob/master/CHANGELOG/CHANGELOG-1.16.md>.

## Kubernetes 1.15

Kubernetes 1.15 is now available in Amazon EKS. For more information about Kubernetes 1.15, see the [official release announcement](#).

### Important

Starting with 1.15, Amazon EKS no longer tags the VPC containing your cluster.

- Subnets within the VPC of your cluster are still tagged.
- VPC tags will not be modified on existing cluster upgrades to 1.15.
- For more information about VPC tagging, see [??? \(p. 172\)](#).

### Important

Amazon EKS has set the re-invocation policy for the Pod Identity Webhook to `IfNeeded`.

This allows the webhook to be re-invoked if objects are changed by other mutating admission webhooks like the App Mesh sidecar injector. For more information about the App Mesh sidecar injector, see [Install the sidecar injector](#).

The following features are now supported in Kubernetes 1.15 Amazon EKS clusters:

- EKS now supports configuring transport layer security (TLS) termination, access logs, and source ranges for network load balancers. For more information, see [Network Load Balancer support on AWS on GitHub](#).
- Improved flexibility of Custom Resource Definitions (CRD), including the ability to convert between versions on the fly. For more information, see [Extend the Kubernetes API with CustomResourceDefinitions on GitHub](#).
- NodeLocal DNSCache is in beta for Kubernetes version 1.15 clusters. This feature can help improve cluster DNS performance by running a DNS caching agent on cluster nodes as a DaemonSet. For more information, see [Using NodeLocal DNSCache in Kubernetes clusters on GitHub](#).

### Note

When running CoreDNS on Amazon EC2, we recommend not using `force_tcp` in the configuration and ensuring that `options use-vc` is not set in `/etc/resolv.conf`.

For the complete Kubernetes 1.15 changelog, see <https://github.com/kubernetes/kubernetes/blob/master/CHANGELOG/CHANGELOG-1.15.md>.

## Kubernetes 1.14

Kubernetes 1.14 is now available in Amazon EKS. For more information about Kubernetes 1.14, see the [official release announcement](#).

### Important

The `--allow-privileged` flag has been removed from `kubelet` on Amazon EKS 1.14 nodes. If you have modified or restricted the [Amazon EKS default pod security policy \(p. 285\)](#) on your cluster, you should verify that your applications have the permissions they need on 1.14 nodes.

The following features are now supported in Kubernetes 1.14 Amazon EKS clusters:

- Container Storage Interface Topology is in beta for Kubernetes version 1.14 clusters. For more information, see [CSI Topology Feature](#) in the Kubernetes CSI Developer Documentation. The following

CSI drivers provide a CSI interface for container orchestrators like Kubernetes to manage the life cycle of Amazon EBS volumes, Amazon EFS file systems, and Amazon FSx for Lustre file systems:

- [Amazon Elastic Block Store \(EBS\) CSI driver](#)
- [Amazon EFS CSI driver](#)
- [Amazon FSx for Lustre CSI driver](#)
- Process ID (PID) limiting is in beta for Kubernetes version 1.14 clusters. This feature allows you to set quotas for how many processes a pods can create, which can prevent resource starvation for other applications on a cluster. For more information, see [Process ID limiting for stability improvements in Kubernetes 1.14](#).
- Persistent Local Volumes are now GA and make locally attached storage available as a persistent volume source. For more information, see [Kubernetes 1.14: Local persistent volumes GA](#).
- Pod Priority and Preemption is now GA and allows pods to be assigned a scheduling priority level. For more information, see [Pod Priority and Preemption](#) in the Kubernetes documentation.
- Windows node support is GA with Kubernetes 1.14.

For the complete Kubernetes 1.14 changelog, see <https://github.com/kubernetes/kubernetes/blob/master/CHANGELOG/CHANGELOG-1.14.md>.

## Amazon EKS version deprecation

In line with the Kubernetes community support for Kubernetes versions, Amazon EKS is committed to running at least three production-ready versions of Kubernetes at any given time, with a fourth version in deprecation.

We will announce the deprecation of a given Kubernetes minor version at least 60 days before the end of support date. Because of the Amazon EKS qualification and release process for new Kubernetes versions, the deprecation of a Kubernetes version on Amazon EKS will be on or after the date the Kubernetes project stops supporting the version upstream.

Kubernetes supports compatibility between the control plane and nodes for up to two minor versions, so 1.15 nodes will continue to operate when orchestrated by a 1.17 control plane. For more information, see [Kubernetes version and version skew support policy](#) in the Kubernetes documentation.

## Platform versions

Amazon EKS platform versions represent the capabilities of the cluster control plane, such as which Kubernetes API server flags are enabled, as well as the current Kubernetes patch version. Each Kubernetes minor version has one or more associated Amazon EKS platform versions. The platform versions for different Kubernetes minor versions are independent.

When a new Kubernetes minor version is available in Amazon EKS, such as 1.17, the initial Amazon EKS platform version for that Kubernetes minor version starts at `eks . 1`. However, Amazon EKS releases new platform versions periodically to enable new Kubernetes control plane settings and to provide security fixes.

When new Amazon EKS platform versions become available for a minor version:

- The Amazon EKS platform version number is incremented (`eks . n+1`).
- Amazon EKS automatically upgrades all existing clusters to the latest Amazon EKS platform version for their corresponding Kubernetes minor version.
- Amazon EKS might publish a new node AMI with a corresponding patch version. However, all patch versions are compatible between the EKS control plane and node AMIs for a given Kubernetes minor version.



New Amazon EKS platform versions don't introduce breaking changes or cause service interruptions.

**Note**

Automatic upgrades of existing Amazon EKS platform versions are rolled out incrementally. The roll-out process might take some time. If you need the latest Amazon EKS platform version features immediately, you should create a new Amazon EKS cluster.

Clusters are always created with the latest available Amazon EKS platform version (eks.*n*) for the specified Kubernetes version. If you update your cluster to a new Kubernetes minor version, your cluster receives the current Amazon EKS platform version for the Kubernetes minor version that you updated to.

The current and recent Amazon EKS platform versions are described in the following tables.

## Kubernetes version 1.17

Kubernetes version	Amazon EKS platform version	Enabled admission controllers	Release notes
1.17.9	eks.2	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy, TaintNodesByCondition, Priority, StorageObjectInUseProtection, PersistentVolumeClaimResize	New platform version with security fixes and enhancements, including UDP support for services of type <code>NodeBalancer</code> when using NLB and support for using Amazon EFS volumes with Fargate pods. For more information, see the <a href="#">Allow UDP for AWS NLB issue on GitHub</a> .
1.17.6	eks.1	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy, TaintNodesByCondition, Priority, StorageObjectInUseProtection, PersistentVolumeClaimResize	Initial release of Kubernetes 1.17 for Amazon EKS. For more information, see <a href="#">Kubernetes 1.17 (p. 61)</a> .

## Kubernetes version 1.16

Kubernetes version	Amazon EKS platform version	Enabled admission controllers	Release notes
1.16.13	eks.3	NamespaceLifecycle, LimitRanger,	New platform version with security fixes

Kubernetes version	Amazon EKS platform version	Enabled admission controllers	Release notes
		ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy, TaintNodesByCondition, Priority, StorageObjectInUseProtection, PersistentVolumeClaimResize	and enhancements, including UDP support for services of type <code>LoadBalancer</code> when using NLB. For more information, see the <a href="#">Allow UDP for AWS NLB issue on GitHub</a> .
1.16.8	eks.2	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy, TaintNodesByCondition, Priority, StorageObjectInUseProtection, PersistentVolumeClaimResize	New platform version with security fixes.
1.16.8	eks.1	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy, TaintNodesByCondition, Priority, StorageObjectInUseProtection, PersistentVolumeClaimResize	Initial release of Kubernetes 1.16 for Amazon EKS. For more information, see <a href="#">Kubernetes 1.16 (p. 62)</a> .

## Kubernetes version 1.15

Kubernetes version	Amazon EKS platform version	Enabled admission controllers	Release notes
1.15.11	eks.4	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass,	New platform version with security fixes and enhancements, including UDP support

Kubernetes version	Amazon EKS platform version	Enabled admission controllers	Release notes
		ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy, TaintNodesByCondition, Priority, StorageObjectInUseProtection, PersistentVolumeClaimResize	for services of type <code>LoadBalancer</code> when using NLB. For more information, see the <a href="#">known issue for AWS NLB</a> on GitHub.
1.15.11	eks.3	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy, TaintNodesByCondition, Priority, StorageObjectInUseProtection, PersistentVolumeClaimResize	New platform version with security fixes.
1.15.11	eks.2	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy, TaintNodesByCondition, Priority, StorageObjectInUseProtection, PersistentVolumeClaimResize	New platform version with bug fixes and enhancements, including an update to the server side AWS IAM Authenticator, with <a href="#">IAM role traceability</a> improvements.

Kubernetes version	Amazon EKS platform version	Enabled admission controllers	Release notes
1.15.10	eks.1	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy, TaintNodesByCondition, Priority, StorageObjectInUseProtection, PersistentVolumeClaimResize	Initial release of Kubernetes 1.15 for Amazon EKS. For more information, see <a href="#">Kubernetes 1.15 (p. 63)</a> .

## Kubernetes version 1.14

Kubernetes version	Amazon EKS platform version	Enabled admission controllers	Release notes
1.14.9	eks.11	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy	New platform version with security fixes and enhancements.
1.14.9	eks.10	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy	New platform version with security fixes.
1.14.9	eks.9	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy	New platform version with enhancements and additional feature support.

Kubernetes version	Amazon EKS platform version	Enabled admission controllers	Release notes
1.14.9	eks.8	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy	New platform version with security and bug fixes.
1.14.9	eks.7	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy	New platform version with security fixes.
1.14.9	eks.6	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy	New platform version updating Amazon EKS Kubernetes 1.14 clusters to 1.14.9, various bug fixes, and performance improvements.
1.14.8	eks.5	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy	New platform version adding support for <a href="#">AWS Fargate (p. 118)</a> .
1.14.8	eks.4	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy	New platform version for various bug fixes and performance improvements.

Kubernetes version	Amazon EKS platform version	Enabled admission controllers	Release notes
1.14.8	eks.3	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy	New platform version adding support for <a href="#">Managed node groups</a> (p. 88).
1.14.8	eks.2	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy	New platform version updating Amazon EKS Kubernetes 1.14 clusters to 1.14.8 to address <a href="#">CVE-2019-11253</a> .
1.14.6	eks.1	NamespaceLifecycle, LimitRanger, ServiceAccount, DefaultStorageClass, ResourceQuota, DefaultTolerationSeconds, NodeRestriction, MutatingAdmissionWebhook, ValidatingAdmissionWebhook, PodSecurityPolicy	Initial release of Kubernetes 1.14 for Amazon EKS. For more information, see <a href="#">Kubernetes 1.14</a> (p. 63).

## Windows support

This topic describes how to add Windows support to Amazon EKS clusters.

### Considerations

Before deploying Windows nodes, be aware of the following considerations.

- Windows workloads are supported with Amazon EKS clusters running Kubernetes version 1.14 or later.
- Amazon EC2 instance types C3, C4, D2, I2, M4 (excluding m4.16xlarge), and R3 instances are not supported for Windows workloads.
- Host networking mode is not supported for Windows workloads.
- Amazon EKS clusters must contain one or more Linux nodes to run core system pods that only run on Linux, such as `coredns` and the VPC resource controller.
- The `kubelet` and `kube-proxy` event logs are redirected to the EKS Windows Event Log and are set to a 200 MB limit.
- Windows nodes support one elastic network interface per node. The number of pods that you can run per Windows node is equal to the number of IP addresses available per elastic network interface for

the node's instance type, minus one. For more information, see [IP addresses per network interface per instance type](#) in the *Amazon EC2 User Guide for Linux Instances*.

- Group Managed Service Accounts (GMSA) for Windows pods and containers is not supported by Amazon EKS versions earlier than 1.16. You can follow the instructions in the Kubernetes documentation to enable and test this alpha feature on clusters that are earlier than 1.16.

## Enabling Windows support

The following steps help you to enable Windows support for your Amazon EKS cluster. Choose the tab below to use standard tools on your client operating system.

eksctl

### To enable Windows support for your cluster with eksctl

This procedure only works for clusters that were created with eksctl and assumes that your eksctl version is 0.26.0-rc.1 or later. You can check your version with the following command.

```
eksctl version
```

For more information about installing or upgrading eksctl, see [Installing or upgrading eksctl](#) (p. 234).

1. Enable Windows support for your Amazon EKS cluster with the following eksctl command. This command deploys the VPC resource controller and VPC admission controller webhook that are required on Amazon EKS clusters to run Windows workloads.

```
eksctl utils install-vpc-controllers --cluster cluster_name --approve
```

2. After you have enabled Windows support, you can launch a Windows node group into your cluster. For more information, see [Launching self-managed Windows nodes](#) (p. 106).

After you add Windows support to your cluster, you must specify node selectors on your applications so that the pods land on a node with the appropriate operating system. For Linux pods, use the following node selector text in your manifests.

```
nodeSelector:
  kubernetes.io/os: linux
  kubernetes.io/arch: amd64
```

For Windows pods, use the following node selector text in your manifests.

```
nodeSelector:
  kubernetes.io/os: windows
  kubernetes.io/arch: amd64
```

Windows

### To enable Windows support for your cluster with a Windows client

In the following steps, replace the *region-code* with the Region that your cluster resides in.

1. Deploy the VPC resource controller to your cluster.

```
kubectl apply -f https://amazon-eks.s3.us-west-2.amazonaws.com/manifests/region-code/vpc-resource-controller/latest/vpc-resource-controller.yaml
```

2. Deploy the VPC admission controller webhook to your cluster.

- a. Download the required scripts and deployment files.

```
curl -o vpc-admission-webhook-deployment.yaml https://amazon-eks.s3.us-west-2.amazonaws.com/manifests/region-code/vpc-admission-webhook/latest/vpc-admission-webhook-deployment.yaml;
curl -o Setup-VPCAdmissionWebhook.ps1 https://amazon-eks.s3.us-west-2.amazonaws.com/manifests/region-code/vpc-admission-webhook/latest/Setup-VPCAdmissionWebhook.ps1;
curl -o webhook-create-signed-cert.ps1 https://amazon-eks.s3.us-west-2.amazonaws.com/manifests/region-code/vpc-admission-webhook/latest/webhook-create-signed-cert.ps1;
curl -o webhook-patch-ca-bundle.ps1 https://amazon-eks.s3.us-west-2.amazonaws.com/manifests/region-code/vpc-admission-webhook/latest/webhook-patch-ca-bundle.ps1;
```

- b. Install [OpenSSL](#) and [jq](#).
    - c. Set up and deploy the VPC admission webhook.

```
./Setup-VPCAdmissionWebhook.ps1 -DeploymentTemplate ".\vpc-admission-webhook-deployment.yaml"
```

3. Determine if your cluster has the required cluster role binding.

```
kubectl get clusterrolebinding eks:kube-proxy-windows
```

If output similar to the following example output is returned, then the cluster has the necessary role binding.

NAME	AGE
eks:kube-proxy-windows	10d

If the output includes `Error from server (NotFound)`, then the cluster does not have the necessary cluster role binding. Add the binding by creating a file named `eks-kube-proxy-windows-crb.yaml` with the following content.

```
kind: ClusterRoleBinding
apiVersion: rbac.authorization.k8s.io/v1beta1
metadata:
  name: eks:kube-proxy-windows
  labels:
    k8s-app: kube-proxy
    eks.amazonaws.com/component: kube-proxy
subjects:
- kind: Group
  name: "eks:kube-proxy-windows"
roleRef:
  kind: ClusterRole
  name: system:node-proxier
  apiGroup: rbac.authorization.k8s.io
```

Apply the configuration to the cluster.



```
kubectl apply -f eks-kube-proxy-windows-crb.yaml
```

4. After you have enabled Windows support, you can launch a Windows node group into your cluster. For more information, see [Launching self-managed Windows nodes \(p. 106\)](#).

After you add Windows support to your cluster, you must specify node selectors on your applications so that the pods land on a node with the appropriate operating system. For Linux pods, use the following node selector text in your manifests.

```
nodeSelector:
  kubernetes.io/os: linux
  kubernetes.io/arch: amd64
```

For Windows pods, use the following node selector text in your manifests.

```
nodeSelector:
  kubernetes.io/os: windows
  kubernetes.io/arch: amd64
```

## macOS and Linux

### To enable Windows support for your cluster with a macOS or Linux client

This procedure requires that the `openssl` library and `jq` JSON processor are installed on your client system.

In the following steps, replace `region-code` with the Region that your cluster resides in.

1. Deploy the VPC resource controller to your cluster.

```
kubectl apply -f https://amazon-eks.s3.us-west-2.amazonaws.com/manifests/region-code/vpc-resource-controller/latest/vpc-resource-controller.yaml
```

2. Create the VPC admission controller webhook manifest for your cluster.

- a. Download the required scripts and deployment files.

```
curl -o webhook-create-signed-cert.sh https://amazon-eks.s3.us-west-2.amazonaws.com/manifests/region-code/vpc-admission-webhook/latest/webhook-create-signed-cert.sh
curl -o webhook-patch-ca-bundle.sh https://amazon-eks.s3.us-west-2.amazonaws.com/manifests/region-code/vpc-admission-webhook/latest/webhook-patch-ca-bundle.sh
curl -o vpc-admission-webhook-deployment.yaml https://amazon-eks.s3.us-west-2.amazonaws.com/manifests/region-code/vpc-admission-webhook/latest/vpc-admission-webhook-deployment.yaml
```

- b. Add permissions to the shell scripts so that they can be executed.

```
chmod +x webhook-create-signed-cert.sh webhook-patch-ca-bundle.sh
```

- c. Create a secret for secure communication.

```
./webhook-create-signed-cert.sh
```

- d. Verify the secret.

```
kubectl get secret -n kube-system vpc-admission-webhook-certs
```

- e. Configure the webhook and create a deployment file.

```
cat ./vpc-admission-webhook-deployment.yaml | ./webhook-patch-ca-bundle.sh > vpc-admission-webhook.yaml
```

3. Deploy the VPC admission webhook.

```
kubectl apply -f vpc-admission-webhook.yaml
```

4. Determine if your cluster has the required cluster role binding.

```
kubectl get clusterrolebinding eks:kube-proxy-windows
```

If output similar to the following example output is returned, then the cluster has the necessary role binding.

NAME	AGE
eks:kube-proxy-windows	10d

If the output includes `Error from server (NotFound)`, then the cluster does not have the necessary cluster role binding. Add the binding by creating a file named `eks-kube-proxy-windows-crb.yaml` with the following content.

```
kind: ClusterRoleBinding
apiVersion: rbac.authorization.k8s.io/v1beta1
metadata:
  name: eks:kube-proxy-windows
  labels:
    k8s-app: kube-proxy
    eks.amazonaws.com/component: kube-proxy
subjects:
- kind: Group
  name: "eks:kube-proxy-windows"
roleRef:
  kind: ClusterRole
  name: system:node-proxier
  apiGroup: rbac.authorization.k8s.io
```

Apply the configuration to the cluster.

```
kubectl apply -f eks-kube-proxy-windows-crb.yaml
```

5. After you have enabled Windows support, you can launch a Windows node group into your cluster. For more information, see [Launching self-managed Windows nodes \(p. 106\)](#).

After you add Windows support to your cluster, you must specify node selectors on your applications so that the pods land on a node with the appropriate operating system. For Linux pods, use the following node selector text in your manifests.

```
nodeSelector:
  kubernetes.io/os: linux
  kubernetes.io/arch: amd64
```

For Windows pods, use the following node selector text in your manifests.

```
nodeSelector:
  kubernetes.io/os: windows
  kubernetes.io/arch: amd64
```

## Deploy a Windows sample application

### To deploy a Windows sample application

1. Create a file named `windows-server-iis.yaml` with the following content.

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: windows-server-iis
spec:
  selector:
    matchLabels:
      app: windows-server-iis
      tier: backend
      track: stable
  replicas: 1
  template:
    metadata:
      labels:
        app: windows-server-iis
        tier: backend
        track: stable
    spec:
      containers:
        - name: windows-server-iis
          image: mcr.microsoft.com/windows/servercore:1809
          ports:
            - name: http
              containerPort: 80
          imagePullPolicy: IfNotPresent
          command:
            - powershell.exe
            - -command
            - "Add-WindowsFeature Web-Server; Invoke-WebRequest -UseBasicParsing
              -Uri 'https://dotnetbinaries.blob.core.windows.net/servicemonitor/2.0.1.6/
              ServiceMonitor.exe' -OutFile 'C:\\ServiceMonitor.exe'; echo '<html><body><br/
              ><br/><marquee><H1>Hello EKS!!!<H1><marquee></body><html>' > C:\\inetpub\\wwwroot\\
              \\default.html; C:\\ServiceMonitor.exe 'w3svc'; "
          nodeSelector:
            kubernetes.io/os: windows
      ---
apiVersion: v1
kind: Service
metadata:
  name: windows-server-iis-service
  namespace: default
spec:
  ports:
    - port: 80
      protocol: TCP
      targetPort: 80
  selector:
    app: windows-server-iis
    tier: backend
```

```
track: stable
sessionAffinity: None
type: LoadBalancer
```

2. Deploy the application to the cluster.

```
kubectl apply -f windows-server-iis.yaml
```

3. Get the status of the pod.

```
kubectl get pods -o wide --watch
```

Wait for the pod to transition to the Running state.

4. Query the services in your cluster and wait until the **External IP** column for the `windows-server-iis-service` service is populated.

**Note**

It might take several minutes for the IP address to become available.

```
kubectl get services -o wide
```

5. After your external IP address is available, point a web browser to that address to view the IIS home page.

**Note**

It might take several minutes for DNS to propagate and for your sample application to load in your web browser.

## Inferentia support

This topic describes how to create an Amazon EKS cluster with nodes running [Amazon EC2 Inf1](#) instances and (optionally) deploy a sample application. Amazon EC2 Inf1 instances are powered by [AWS Inferentia](#) chips, which are custom built by AWS to provide high performance and lowest cost inference in the cloud. Machine learning models are deployed to containers using [AWS Neuron](#), a specialized software development kit (SDK) consisting of a compiler, run-time, and profiling tools that optimize the machine learning inference performance of Inferentia chips. AWS Neuron supports popular machine learning frameworks such as TensorFlow, PyTorch, and MXNet.

## Considerations

- Inf1 instances are supported on Amazon EKS clusters running Kubernetes version 1.14 and later.
- Neuron device logical IDs must be contiguous. If a pod requesting multiple Neuron devices is scheduled on an `inf1.6xlarge` or `inf1.24xlarge` instance type (which have more than one Neuron device), that pod will fail to start if the Kubernetes scheduler selects non-contiguous device IDs. For more information, see [Device logical IDs must be contiguous](#) on GitHub.
- Amazon EC2 Inf1 instances are not currently supported with managed node groups.

## Prerequisites

- Have `eksctl` installed on your computer. If you don't have it installed, see [Install eksctl \(p. 5\)](#) for installation instructions.
- Have `kubectl` installed on your computer. For more information, see [Installing kubectl \(p. 229\)](#).

- (Optional) Have python3 installed on your computer. If you don't have it installed, then see [Python downloads](#) for installation instructions.

## Create a cluster

### To create a cluster with Inf1 Amazon EC2 instance nodes

1. Create a cluster with Inf1 Amazon EC2 instance nodes. You can replace `inf1.2xlarge` with any [Inf1 instance type](#). `eksctl` detects that you are launching a node group with an Inf1 instance type and will start your nodes using the [EKS-optimized accelerated AMI](#) (p. 139).

#### Note

You can't use [IAM roles for service accounts](#) (p. 268) with TensorFlow Serving.

```
eksctl create cluster \
  --name inferentia \
  --version 1.16 \
  --region region-code \
  --nodegroup-name ng-inf1 \
  --node-type inf1.2xlarge \
  --nodes 2 \
  --nodes-min 1 \
  --nodes-max 4
```

#### Note

Note the value of the following line of the output. It's used in a later (optional) step.

```
[#] adding identity "arn:aws:iam::111122223333:role/
eksctl-inferentia-nodegroup-ng-in-NodeInstanceRole-FI7HIYS3BS09" to auth
ConfigMap
```

When launching a node group with Inf1 instances, `eksctl` automatically installs the AWS Neuron Kubernetes device plugin. This plugin advertises Neuron devices as a system resource to the Kubernetes scheduler, which can be requested by a container. In addition to the default Amazon EKS node IAM policies, the Amazon S3 read only access policy is added so that the sample application, covered in a later step, can load a trained model from Amazon S3.

2. Make sure that all pods have started correctly.

```
kubectl get pods -n kube-system
```

#### Output

NAME	READY	STATUS	RESTARTS	AGE
aws-node-kx2m8	1/1	Running	0	5m
aws-node-q57pf	1/1	Running	0	5m
coredns-86d5cbb4bd-56dz2	1/1	Running	0	5m
coredns-86d5cbb4bd-d6n4z	1/1	Running	0	5m
kube-proxy-75zx6	1/1	Running	0	5m
kube-proxy-plkfq	1/1	Running	0	5m
neuron-device-plugin-daemonset-6djhp	1/1	Running	0	5m
neuron-device-plugin-daemonset-hwjsj	1/1	Running	0	5m

## (Optional) Create a Neuron TensorFlow Serving application image

### Note

Neuron will soon be available pre-installed in [AWS Deep Learning Containers](#). For updates, check [AWS Neuron](#).

1. Create an Amazon ECR repository to store your application image.

```
aws ecr create-repository --repository-name tensorflow-model-server-neuron
```

Note the `repositoryUri` returned in the output for use in a later step.

2. Create a Dockerfile named `Dockerfile.tf-serving` with the following contents. The Dockerfile contains the commands to build a [Neuron optimized TensorFlow Serving](#) application image. Neuron TensorFlow Serving uses the same API as normal TensorFlow Serving. The only differences are that the saved model must be compiled for Inferentia and the entry point is a different binary.

```
FROM amazonlinux:2

RUN yum install -y awscli

RUN echo $'[neuron] \n\
name=Neuron YUM Repository \n\
baseurl=https://yum.repos.neuron.amazonaws.com \n\
enabled=1' > /etc/yum.repos.d/neuron.repo

RUN rpm --import https://yum.repos.neuron.amazonaws.com/GPG-PUB-KEY-AMAZON-AWS-NEURON.PUB

RUN yum install -y tensorflow-model-server-neuron
```

3. Log your Docker client into your ECR repository.

```
aws ecr get-login-password \
  --region region-code \
  | docker login \
  --username AWS \
  --password-stdin 111122223333.dkr.ecr.region-code.amazonaws.com
```

4. Build the Docker image and upload it to the Amazon ECR repository created in a previous step.

```
docker build . -f Dockerfile.tf-serving -t tensorflow-model-server-neuron
docker tag tensorflow-model-server-neuron:latest 111122223333.dkr.ecr.region-code.amazonaws.com/tensorflow-model-server-neuron:1.15.0
docker push 111122223333.dkr.ecr.region-code.amazonaws.com/tensorflow-model-server-neuron:1.15.0
```

### Note

If you receive permission related issues from Docker, then you may need to configure Docker for non-root user use. For more information, see [Manage Docker as a non-root user](#) in the Docker documentation.

## (Optional) Deploy a TensorFlow Serving application image

A trained model must be compiled to an Inferentia target before it can be deployed on Inferentia instances. To continue, you will need a [Neuron optimized TensorFlow](#) model saved in Amazon S3. If you don't already have a saved model, then you can follow the tutorial in the AWS Neuron documentation to [create a Neuron compatible BERT-Large model](#) and upload it to S3. BERT is a popular machine learning technique used for understanding natural language tasks. For more information about compiling Neuron models, see [The AWS Inferentia Chip With DLAMI](#) in the AWS Deep Learning AMI Developer Guide.

The sample deployment manifest manages two containers: The Neuron runtime container image and the TensorFlow Serving application. For more information about the Neuron container image, see [Tutorial: Neuron container tools](#) on GitHub. The Neuron runtime runs as a sidecar container image and is used to interact with the Inferentia chips on your nodes. The two containers communicate over a Unix domain socket placed in a shared mounted volume. At start-up, the application image will fetch your model from Amazon S3, launch Neuron TensorFlow Serving with the saved model, and wait for prediction requests.

The number of Inferentia devices can be adjusted using the `aws.amazon.com/neuron` resource in the Neuron runtime container specification. The runtime expects 128 2-MB pages per Inferentia device, therefore, `hugepages-2Mi` has to be set to `256 x the number of Inferentia devices`. In order to access Inferentia devices, the Neuron runtime requires `SYS_ADMIN` and `IPC_LOCK` capabilities, however, the runtime drops these capabilities at initialization, before opening a gRPC socket.

1. Add the `AmazonS3ReadOnlyAccess` IAM policy to the node instance role that was created in step 1 of [the section called "Create a cluster"](#) (p. 77). This is necessary so that the sample application can load a trained model from Amazon S3.

```
aws iam attach-role-policy \
  --policy-arn arn:aws:iam::aws:policy/AmazonS3ReadOnlyAccess \
  --role-name eksctl-inferentia-nodegroup-ng-in-NodeInstanceRole-FI7HIYS3BS09
```

2. Create a file named `bert_deployment.yaml` with the contents below. Update `111122223333`, `region-code`, and `bert/saved_model` with your account ID, Region code, and saved model name and location. The model name is for identification purposes when a client makes a request to the TensorFlow server. This example uses a model name to match a sample BERT client script that will be used in a later step for sending prediction requests. You can also replace `1.0.7865.0` with a later version. For the latest version, see [Neuron Runtime Release Notes](#) on GitHub or enter the following command.

```
aws ecr list-images --repository-name neuron-rtd --registry-id 790709498068 --region us-west-2
```

```
kind: Deployment
apiVersion: apps/v1
metadata:
  name: eks-neuron-test
  labels:
    app: eks-neuron-test
    role: master
spec:
  replicas: 2
  selector:
    matchLabels:
      app: eks-neuron-test
      role: master
  template:
    metadata:
      labels:
```

```
    app: eks-neuron-test
    role: master
spec:
  volumes:
    - name: sock
      emptyDir: {}
  containers:
    - name: eks-neuron-test
      image: 111122223333.dkr.ecr.region-code.amazonaws.com/tensorflow-model-
server-neuron:1.15.0
      command:
        - /usr/local/bin/tensorflow_model_server_neuron
      args:
        - --port=9000
        - --rest_api_port=8500
        - --model_name=bert_mrpc_hc_gelus_b4_l24_0926_02
        - --model_base_path=s3://bert/saved_model
      ports:
        - containerPort: 8500
        - containerPort: 9000
      imagePullPolicy: IfNotPresent
      env:
        - name: AWS_REGION
          value: "region-code"
        - name: S3_USE_HTTPS
          value: "1"
        - name: S3_VERIFY_SSL
          value: "0"
        - name: AWS_LOG_LEVEL
          value: "3"
        - name: NEURON_RTD_ADDRESS
          value: unix:/sock/neuron.sock
      resources:
        limits:
          cpu: 4
          memory: 4Gi
        requests:
          cpu: "1"
          memory: 1Gi
      volumeMounts:
        - name: sock
          mountPath: /sock
    - name: neuron-rtd
      image: 790709498068.dkr.ecr.region-code.amazonaws.com/neuron-rtd:1.0.7865.0
      securityContext:
        capabilities:
          add:
            - SYS_ADMIN
            - IPC_LOCK
      volumeMounts:
        - name: sock
          mountPath: /sock
      resources:
        limits:
          hugepages-2Mi: 256Mi
          aws.amazon.com/neuron: 1
        requests:
          memory: 1024Mi
```

3. Deploy the model.

```
kubectl apply -f bert_deployment.yaml
```

4. Create a file named `bert_service.yaml` with the following contents. The HTTP and gRPC ports are opened for accepting prediction requests.



```
kind: Service
apiVersion: v1
metadata:
  name: eks-neuron-test
  labels:
    app: eks-neuron-test
spec:
  type: ClusterIP
  ports:
    - name: http-tf-serving
      port: 8500
      targetPort: 8500
    - name: grpc-tf-serving
      port: 9000
      targetPort: 9000
  selector:
    app: eks-neuron-test
    role: master
```

5. Create a Kubernetes service for your TensorFlow model Serving application.

```
kubectl apply -f bert_service.yaml
```

## (Optional) Make predictions against your TensorFlow Serving service

1. To test locally, forward the gRPC port to the eks-neuron-test service.

```
kubectl port-forward svc/eks-neuron-test 9000:9000 &
```

2. Download the sample BERT client from the Neuron GitHub repository.

```
curl https://raw.githubusercontent.com/aws/aws-neuron-sdk/master/src/examples/tensorflow/k8s_bert_demo/bert_client.py > bert_client.py
```

3. Run the script to submit predictions to your service.

```
python3 bert_client.py
```

### Output

```
...
Inference successful: 0
Inference successful: 1
Inference successful: 2
Inference successful: 3
Inference successful: 4
Inference successful: 5
Inference successful: 6
Inference successful: 7
Inference successful: 8
Inference successful: 9
...
Inference successful: 91
Inference successful: 92
Inference successful: 93
```

```
Inference successful: 94
Inference successful: 95
Inference successful: 96
Inference successful: 97
Inference successful: 98
Inference successful: 99
Ran 100 inferences successfully. Latency
```

## Viewing API server flags

You can use the control plane logging feature for Amazon EKS clusters to view the API server flags that were enabled when a cluster was created. For more information, see [Amazon EKS control plane logging \(p. 58\)](#). This topic shows you how to view the API server flags for an Amazon EKS cluster in the Amazon CloudWatch console.

When a cluster is first created, the initial API server logs include the flags that were used to start the API server. If you enable API server logs when you launch the cluster, or shortly thereafter, these logs are sent to CloudWatch Logs and you can view them there.

### To view API server flags for a cluster

1. If you have not already done so, enable API server logs for your Amazon EKS cluster.
  - a. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
  - b. Choose the name of the cluster to display your cluster information.
  - c. Under **Logging**, choose **Update**.
  - d. For **API server**, make sure that the log type is **Enabled**.
  - e. Choose **Update** to finish.
2. In the Amazon EKS console, scroll down to the **Logging** section of the cluster detail page. Choose the link under **CloudWatch** to open the CloudWatch console page for your cluster's logs.
3. In the list of log streams, find the earliest version of the kube-apiserver-*example-ID-288ec988b77a59d70ec77* log stream. Use the **Last Event Time** column to determine the log stream ages.
4. Scroll up to the earliest events (the beginning of the log stream). You should see the initial API server flags for the cluster.

#### Note

If you don't see the API server logs at the beginning of the log stream, then it is likely that the API server log file was rotated on the server before you enabled API server logging on the server. Any log files that are rotated before API server logging is enabled cannot be exported to CloudWatch.

However, you can create a new cluster with the same Kubernetes version and enable the API server logging when you create the cluster. Clusters with the same platform version have the same flags enabled, so your flags should match the new cluster's flags. When you finish viewing the flags for the new cluster in CloudWatch, you can delete the new cluster.

## Private clusters

This topic describes how to deploy a private cluster without outbound internet access. If you're not familiar with Amazon EKS networking, see [De-mystifying cluster networking for Amazon EKS worker nodes](#).

## Requirements

The following requirements must be met to run Amazon EKS in a private cluster without outbound internet access.

- A container image must be in or copied to Amazon Elastic Container Registry (Amazon ECR) or to a registry inside the VPC to be pulled. For more information, see [the section called “Creating local copies of container images”](#) (p. 84).
- Endpoint private access is required for nodes to register with the cluster endpoint. Endpoint public access is optional. For more information, see [??? \(p. 49\)](#).
- You may need to include the VPC endpoints found at [the section called “VPC endpoints for private clusters”](#) (p. 84).
- You must include the following text to the bootstrap arguments when launching self-managed nodes. This text bypasses the Amazon EKS introspection and does not require access to the Amazon EKS API from within the VPC. Replace `cluster-endpoint` and `cluster-certificate-authority` with the values from your Amazon EKS cluster.

```
--apiserver-endpoint cluster-endpoint --b64-cluster-ca cluster-certificate-authority
```

- The `aws-auth` ConfigMap must be created from within the VPC. For more information about create the `aws-auth` ConfigMap, see [??? \(p. 225\)](#).

## Considerations

Here are some things to consider when running Amazon EKS in a private cluster without outbound internet access.

- `eksctl` is not supported with private clusters.
- AWS X-Ray is not supported with private clusters.
- Amazon CloudWatch Logs is supported with private clusters, but you must use an Amazon CloudWatch Logs VPC endpoint. For more information, see [the section called “VPC endpoints for private clusters”](#) (p. 84).
- Self-managed and managed [nodes \(p. 101\)](#) are supported. The instances for nodes must have access to the VPC endpoints. If you create a managed node group, the VPC endpoint security group must allow the CIDR for the subnets, or you must add the created node security group to the VPC endpoint security group.
- [??? \(p. 268\)](#) is supported. You must include the STS VPC endpoint. For more information, see [the section called “VPC endpoints for private clusters”](#) (p. 84).
- The [??? \(p. 151\)](#) is supported. Before deploying, the `kustomization.yaml` file must be changed to set the container images to use the same Region as the Amazon EKS cluster.
- The [??? \(p. 155\)](#) is supported. Before deploying, the `kustomization.yaml` file must be changed to set the container images to use the same Region as the Amazon EKS cluster.
- The [??? \(p. 159\)](#) is not supported.
- The [??? \(p. 212\)](#) does not work in private clusters.
- [??? \(p. 118\)](#) is supported with private clusters. You must include the STS VPC endpoint. For more information, see [the section called “VPC endpoints for private clusters”](#) (p. 84). You must use a third-party ingress controller with AWS Fargate because the ALB Ingress Controller on Amazon EKS does not work in private clusters and because Classic Load Balancers and Network Load Balancers are not supported on pods running on Fargate.
- [App Mesh](#) is supported with private clusters when you use the App Mesh Envoy VPC endpoint. For more information, see [the section called “VPC endpoints for private clusters”](#) (p. 84).

- The App Mesh sidecar injector for Kubernetes is supported. For more information, see [App Mesh sidecar injector](#) on GitHub.
- The App Mesh controller for Kubernetes is not supported. For more information, see [App Mesh controller](#) on GitHub.

## Creating local copies of container images

Because a private cluster has no outbound internet access, container images cannot be pulled from external sources such as Docker Hub. Instead, container images must be copied locally to Amazon ECR or to an alternative registry accessible in the VPC. A container image can be copied to Amazon ECR from outside the private VPC. The private cluster accesses the Amazon ECR repository using the Amazon ECR VPC endpoints. You must have Docker and the AWS CLI installed on the workstation that you use to create the local copy.

### To create a local copy of a container image

1. Create an Amazon ECR repository. For more information, see [Creating a repository](#).
2. Pull the container image from the external registry using `docker pull`.
3. Tag your image with the Amazon ECR registry, repository, and optional image tag name combination using `docker tag`.
4. Authenticate to the registry. For more information, see [Registry authentication](#).
5. [Push the image to Amazon ECR](#) using `docker push`.

#### Note

Be sure to update your resource configuration to use the new image location.

The following example pulls the [amazon/aws-node-termination-handler](#) image, using tag `v1.3.1-linux-amd64`, from Docker Hub and creates a local copy in Amazon ECR.

```
aws ecr create-repository --repository-name amazon/aws-node-termination-handler
docker pull amazon/aws-node-termination-handler:v1.3.1-linux-amd64
docker tag amazon/aws-node-termination-handler:111122223333.dkr.ecr.region-code.amazonaws.com/amazon/aws-node-termination-handler:v1.3.1-linux-amd64
aws ecr get-login-password --region region-code | docker login --username AWS --password-stdin 111122223333.dkr.ecr.region-code.amazonaws.com
docker push 111122223333.dkr.ecr.region-code.amazonaws.com/amazon/aws-node-termination-handler:v1.3.1-linux-amd64
```

## VPC endpoints for private clusters

The following [VPC endpoints](#) may be required.

- `com.amazonaws.region.ec2`
- `com.amazonaws.region.ecr.api`
- `com.amazonaws.region.ecr.dkr`
- `com.amazonaws.region.s3` – For pulling container images
- `com.amazonaws.region.logs` – For CloudWatch Logs
- `com.amazonaws.region.sts` – If using AWS Fargate or IAM roles for service accounts
- `com.amazonaws.region.elasticloadbalancing` – If using Application Load Balancers
- `com.amazonaws.region.autoscaling` – If using Cluster Autoscaler
- `com.amazonaws.region.appmesh-envoy-management` – If using App Mesh

# Amazon EKS compute

Your Amazon EKS cluster can schedule pods on any combination of [the section called “Self-managed nodes” \(p. 101\)](#), Amazon EKS [the section called “Managed node groups” \(p. 88\)](#), and [the section called “AWS Fargate” \(p. 118\)](#). The following table provides several criteria to evaluate when deciding which options best meets your requirements. We recommend reviewing this page often because the data in this table changes frequently as new capabilities are introduced to Amazon EKS.

Criteria	EKS managed node groups	Self-managed nodes	AWS Fargate
Can run containers that require Windows	No	<a href="#">Yes (p. 70)</a> – Your cluster still requires at least one (two recommended for availability) Linux node though.	No
Can run containers that require Linux	Yes	Yes	Yes
Can run workloads that require the <a href="#">Inferentia chip</a>	No	<a href="#">Yes (p. 76)</a> – Linux nodes only	No
Can run workloads that require a GPU	<a href="#">Yes (p. 135)</a> – Linux nodes only	<a href="#">Yes (p. 135)</a> – Linux nodes only	No
Can run workloads that require Arm processors	<a href="#">Yes (p. 136)</a>	<a href="#">Yes (p. 136)</a>	No
Pods share a kernel runtime environment with other pods	Yes – All of your pods on each of your nodes	Yes – All of your pods on each of your nodes	No – Each pod has a dedicated kernel
Pods share CPU, memory, storage, and network resources with other pods.	Yes – Can result in unused resources on each node	Yes – Can result in unused resources on each node	No – Each pod has dedicated resources and can be sized independently to maximize resource utilization.
Pods can use more hardware and memory than requested in pod specs	Yes – If the pod requires more resources than requested, and resources are available on the node, the pod can use additional resources.	Yes – If the pod requires more resources than requested, and resources are available on the node, the pod can use additional resources.	No – The pod can be re-deployed using a larger vCPU and memory configuration though.
Must deploy and manage Amazon EC2 instances	<a href="#">Yes (p. 90)</a> – automated through Amazon EKS if you	Yes – Manual configuration or using Amazon EKS provided AWS	No

Criteria	EKS managed node groups	Self-managed nodes	AWS Fargate
	deployed an Amazon EKS optimized AMI. If you deployed a custom AMI, then you must update the instance manually.	CloudFormation templates to deploy <a href="#">Linux (x86) (p. 102)</a> , <a href="#">Linux (Arm) (p. 136)</a> , or <a href="#">Windows (p. 70)</a> nodes.	
Must secure, maintain, and patch the operating system of Amazon EC2 instances	Yes	Yes	No
Can provide bootstrap arguments at deployment of a node, such as extra kubelet arguments.	Yes – Using a <a href="#">launch template (p. 97)</a> with a custom AMI	Yes – For more information, view the <a href="#">bootstrap script usage information</a> on GitHub.	No – There is no node.
Can assign IP addresses to pods from a different CIDR block than the IP address assigned to the node.	Yes – Using a <a href="#">launch template (p. 97)</a> with a custom AMI	Yes, using <a href="#">the section called “CNI custom networking” (p. 184)</a> .	No – There is no node.
Can SSH into node	Yes	Yes	No – There is no node host operating system to SSH to.
Can deploy your own custom AMI to nodes	Yes – Using a <a href="#">launch template (p. 97)</a>	Yes	No – You don't manage nodes.
Can deploy your own custom CNI to nodes	Yes – Using a <a href="#">launch template (p. 97)</a> with a custom AMI	Yes	No – You don't manage nodes.

Criteria	EKS managed node groups	Self-managed nodes	AWS Fargate
Must update node AMI yourself	<b>Yes</b> – If you deployed an Amazon EKS optimized AMI, then you're notified in the Amazon EKS console when updates are available and can perform the update with one click in the console. If you deployed a custom AMI, then you're not notified in the Amazon EKS console when updates are available and must perform the update yourself.	<b>Yes</b> – Using tools other than the Amazon EKS console, because self-managed nodes can't be managed with the Amazon EKS console.	No – You don't manage nodes.
Must update node Kubernetes version yourself	<b>Yes</b> – If you deployed an Amazon EKS optimized AMI, then you're notified in the Amazon EKS console when updates are available and can perform the update with one click in the console. If you deployed a custom AMI, then you're not notified in the Amazon EKS console when updates are available and must perform the update yourself.	<b>Yes</b> – Using tools other than the Amazon EKS console, because self-managed nodes can't be managed with the Amazon EKS console.	No – You don't manage nodes.
Can use <a href="#">Amazon EBS storage</a> with pods	<b>Yes</b> (p. 151)	<b>Yes</b> (p. 151)	No
Can use <a href="#">Amazon EFS storage</a> with pods	<b>Yes</b> (p. 155)	<b>Yes</b> (p. 155)	<b>Yes</b> (p. 155)
Can use <a href="#">Amazon FSx for Lustre storage</a> with pods	<b>Yes</b> (p. 159)	<b>Yes</b> (p. 159)	No

Criteria	EKS managed node groups	Self-managed nodes	AWS Fargate
Can use Network Load Balancer for services	Yes	Yes	No
Pods can run in a public subnet	Yes	Yes	No
Can run Kubernetes DaemonSet	Yes	Yes	No
Support <code>HostPort</code> and <code>HostNetwork</code> in the pod manifest	Yes	Yes	No
Region availability	<a href="#">All Amazon EKS supported regions</a>	<a href="#">All Amazon EKS supported regions</a>	<a href="#">Some Amazon EKS supported regions (p. 118)</a>
Pricing	Cost of Amazon EC2 instance that runs multiple pods. For more information, see <a href="#">Amazon EC2 pricing</a> .	Cost of Amazon EC2 instance that runs multiple pods. For more information, see <a href="#">Amazon EC2 pricing</a> .	Cost of an individual Fargate memory and CPU configuration. Each pod has its own cost. For more information, see <a href="#">AWS Fargate pricing</a> .

## Managed node groups

Amazon EKS managed node groups automate the provisioning and lifecycle management of nodes (Amazon EC2 instances) for Amazon EKS Kubernetes clusters.

### Note

[Managed node groups \(p. 88\)](#) are supported on Amazon EKS clusters beginning with Kubernetes version 1.14 and [platform version \(p. 64\)](#) `eks . 3`. Existing clusters can update to version 1.14 or later to take advantage of this feature. For more information, see [Updating an Amazon EKS cluster Kubernetes version \(p. 36\)](#).

With Amazon EKS managed node groups, you don't need to separately provision or register the Amazon EC2 instances that provide compute capacity to run your Kubernetes applications. You can create, update, or terminate nodes for your cluster with a single operation. Nodes run using the latest Amazon EKS optimized AMIs in your AWS account while node updates and terminations gracefully drain nodes to ensure that your applications stay available.

All managed nodes are provisioned as part of an Amazon EC2 Auto Scaling group that is managed for you by Amazon EKS. All resources including the instances and Auto Scaling groups run within your AWS account. Each node group uses the Amazon EKS optimized Amazon Linux 2 AMI and can run across multiple Availability Zones that you define.

You can add a managed node group to new or existing clusters using the Amazon EKS console, `eksctl`, AWS CLI, AWS API, or infrastructure as code tools including AWS CloudFormation. Nodes launched as part of a managed node group are automatically tagged for auto-discovery by the Kubernetes cluster autoscaler and you can use the node group to apply Kubernetes labels to nodes and update them at any time.

There are no additional costs to use Amazon EKS managed node groups, you only pay for the AWS resources you provision. These include Amazon EC2 instances, Amazon EBS volumes, Amazon EKS cluster hours, and any other AWS infrastructure. There are no minimum fees and no upfront commitments.



To get started with a new Amazon EKS cluster and managed node group, see [Getting started with the AWS Management Console \(p. 14\)](#).

To add a managed node group to an existing cluster, see [Creating a managed node group \(p. 90\)](#).

## Managed node groups concepts

- Amazon EKS managed node groups create and manage Amazon EC2 instances for you.
- All managed nodes are provisioned as part of an Amazon EC2 Auto Scaling group that is managed for you by Amazon EKS and all resources including Amazon EC2 instances and Auto Scaling groups run within your AWS account.
- A managed node group's Auto Scaling group spans all of the subnets that you specify when you create the group.
- Amazon EKS tags managed node group resources so that they are configured to use the Kubernetes [Cluster Autoscaler \(p. 54\)](#).

### Important

If you are running a stateful application across multiple Availability Zones that is backed by Amazon EBS volumes and using the Kubernetes [Cluster Autoscaler \(p. 54\)](#), you should configure multiple node groups, each scoped to a single Availability Zone. In addition, you should enable the `--balance-similar-node-groups` feature.

- Instances in a managed node group use the latest version of the Amazon EKS optimized Amazon Linux 2 AMI for its cluster's Kubernetes version, by default. You can choose between standard and GPU variants of the Amazon EKS optimized Amazon Linux 2 AMI. You can also use a custom AMI if you deploy using a launch template. For more information, see [the section called "Launch template support" \(p. 97\)](#).
- Amazon EKS follows the shared responsibility model for CVEs and security patches on managed node groups. When managed nodes run an Amazon EKS optimized AMI, Amazon EKS is responsible for building patched versions of the AMI when bugs or issues are reported and we are able to publish a fix. However, you are responsible for deploying these patched AMI versions to your managed node groups. When managed nodes run a custom AMI, you are responsible for building patched versions of the AMI when bugs or issues are reported and then deploying the AMI. For more information, see [Updating a managed node group \(p. 93\)](#).
- Amazon EKS managed node groups can be launched in both public and private subnets. If you launch a managed node group in a public subnet on or after 04/22/2020, the subnet must have `MapPublicIpOnLaunch` set to true for the instances to be able to successfully join a cluster. If the public subnet was created using `eksctl` or the [Amazon EKS vendored AWS CloudFormation templates \(p. 166\)](#) on or after 03/26/2020, then this setting is already set to true. If the public subnets were created before 03/26/2020, then you need to change the setting manually. For more information, see [Modifying the public IPv4 addressing attribute for your subnet](#).
- When using VPC endpoints in private subnets, you must create endpoints for `com.amazonaws.region.ecr.api`, `com.amazonaws.region.ecr.dkr`, and a gateway endpoint for Amazon S3. For more information, see [Amazon ECR interface VPC endpoints \(AWS PrivateLink\)](#).
- You can create multiple managed node groups within a single cluster. For example, you could create one node group with the standard Amazon EKS optimized Amazon Linux 2 AMI for some workloads and another with the GPU variant for workloads that require GPU support.
- If your managed node group encounters a health issue, Amazon EKS returns an error message to help you to diagnose the issue. For more information, see [Managed node group errors \(p. 315\)](#).
- Amazon EKS adds Kubernetes labels to managed node group instances. These Amazon EKS provided labels are prefixed with `eks.amazonaws.com`.
- Amazon EKS automatically drains nodes using the Kubernetes API during terminations or updates. Updates respect the pod disruption budgets that you set for your pods.
- There are no additional costs to use Amazon EKS managed node groups. You only pay for the AWS resources that you provision.

## Creating a managed node group

This topic helps you to launch an Amazon EKS managed node group of Linux nodes that register with your Amazon EKS cluster. After the nodes join the cluster, you can deploy Kubernetes applications to them.

[Managed node groups](#) (p. 88) are supported on Amazon EKS clusters beginning with Kubernetes version 1.14 and [platform version](#) (p. 64) `eks . 3`. Existing clusters can update to version 1.14 or later to take advantage of this feature. For more information, see [Updating an Amazon EKS cluster Kubernetes version](#) (p. 36).

If this is your first time launching an Amazon EKS managed node group, we recommend that you follow one of our [Getting started with Amazon EKS](#) (p. 3) guides instead. The guides provide complete end-to-end walkthroughs for creating an Amazon EKS cluster with nodes.

### Important

Amazon EKS nodes are standard Amazon EC2 instances, and you are billed for them based on normal Amazon EC2 prices. For more information, see [Amazon EC2 Pricing](#).

Select the tab with the name of the tool that you'd like to create your managed node group with.

eksctl

### To create a managed node group with eksctl

This procedure requires eksctl version `0.26.0-rc.1` or later. You can check your version with the following command:

```
eksctl version
```

For more information on installing or upgrading eksctl, see [Installing or upgrading eksctl](#) (p. 234).

You can create your node group with or without a launch template. A launch template allows for greater customization of a node group, to include deploying a custom AMI. Complete one of the following steps.

1. Create your managed node group **without** a launch template with the following eksctl command, replacing the *variable text* with your own values.

```
eksctl create nodegroup \
  --cluster my-cluster \
  --region us-west-2 \
  --name my-mng \
  --node-type m5.large \
  --nodes 3 \
  --nodes-min 2 \
  --nodes-max 4 \
  --ssh-access \
  --ssh-public-key my-public-key.pub \
  --managed
```

2. Create your managed node group **with** a launch template. The launch template must already exist and must meet the requirements specified in [??? \(p. 97\)](#).
  - a. Create a file named *node-group-lt.yaml* with the following contents, replacing the *variable text* with your own values. Several settings that you specify when deploying without a launch template are moved into the launch template. If you don't specify a version, the template's default version is used.

```
apiVersion: eksctl.io/v1alpha5
kind: ClusterConfig
metadata:
  name: my-cluster
  region: region-code
managedNodeGroups:
- name: node-group-lt
  launchTemplate:
    id: lt-id
    version: "1"
```

- b. Deploy the nodegroup with the following command.

```
eksctl create nodegroup --config-file node-group-lt.yaml
```

## AWS Management Console

### To launch your managed node group using the AWS Management Console

1. Wait for your cluster status to show as **ACTIVE**. You cannot create a managed node group for a cluster that is not yet **ACTIVE**.
2. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
3. Choose the name of the cluster that you want to create your managed node group in.
4. On the cluster page, select the **Compute** tab, and then choose **Add Node Group**.
5. On the **Configure node group** page, fill out the parameters accordingly, and then choose **Next**.
  - **Name** – Enter a unique name for your managed node group.
  - **Node IAM role name** – Choose the node instance role to use with your node group. For more information, see [Amazon EKS node IAM role](#) (p. 265).

#### Important

We recommend using a role that is not currently in use by any self-managed node group, or that you plan to use with a new self-managed node group. For more information, see [??? \(p. 100\)](#).

- **Use launch template** – (Optional) Choose if you want to use an existing launch template and then select a **Launch template version** (Optional). If you don't select a version, then Amazon EKS uses the template's default version. Launch templates allow for more customization of your node group, including allowing you to deploy a custom AMI. The launch template must meet the requirements in [the section called "Launch template support"](#) (p. 97).
  - **Kubernetes labels** – (Optional) You can choose to apply Kubernetes labels to the nodes in your managed node group.
  - **Tags** – (Optional) You can choose to tag your Amazon EKS managed node group. These tags do not propagate to other resources in the node group, such as Auto Scaling groups or instances. For more information, see [Tagging your Amazon EKS resources](#) (p. 243).
6. On the **Set compute and scaling configuration** page, fill out the parameters accordingly, and then choose **Next**.

### Node group compute configuration

- **AMI type** – Choose **Amazon Linux 2 (AL2\_x86\_64)** for non-GPU instances, **Amazon Linux 2 GPU Enabled (AL2\_x86\_64\_GPU)** for GPU instances, or **Amazon Linux 2 (AL2\_ARM\_64)** for Arm.

If you are deploying Arm instances, be sure to review the considerations in [the section called "Arm"](#) (p. 136) before deploying.

If you specified a launch template on the previous page, and specified an AMI in the launch template, then you cannot select a value. The value from the template is displayed. The AMI specified in the template must meet the requirements in [the section called "Using a custom AMI" \(p. 100\)](#).

- **Instance type** – Choose the instance type to use in your managed node group. Each Amazon EC2 instance type supports a maximum number of elastic network interfaces (ENIs) and each ENI supports a maximum number of IP addresses. Since each worker node and pod is assigned its own IP address it's important to choose an instance type that will support the maximum number of pods that you want to run on each worker node. For a list of the number of ENIs and IP addresses supported by instance types, see [IP addresses per network interface per instance type](#). For example, the `t3.medium` instance type supports a maximum of 18 IP addresses for the worker node and pods. Some instance types might not be available in all Regions.

If you specified a launch template on the previous page, then you cannot select a value because it must be specified in the launch template. The value from the launch template is displayed.

- **Disk size** – Enter the disk size (in GiB) to use for your node's root volume.

If you specified a launch template on the previous page, then you cannot select a value because it must be specified in the launch template.

## Node group scaling configuration

### Note

Amazon EKS does not automatically scale your node group in or out. However, you can configure the Kubernetes [Cluster Autoscaler \(p. 54\)](#) to do this for you.

- **Minimum size** – Specify the minimum number of nodes that the managed node group can scale in to.
  - **Maximum size** – Specify the maximum number of nodes that the managed node group can scale out to.
  - **Desired size** – Specify the current number of nodes that the managed node group should maintain at launch.
7. On the **Specify networking** page, fill out the parameters accordingly, and then choose **Next**.
- **Subnets** – Choose the subnets to launch your managed nodes into.

### Important

If you are running a stateful application across multiple Availability Zones that is backed by Amazon EBS volumes and using the Kubernetes [Cluster Autoscaler \(p. 54\)](#), you should configure multiple node groups, each scoped to a single Availability Zone. In addition, you should enable the `--balance-similar-node-groups` feature.

### Important

If you choose a public subnet, then the subnet must have `MapPublicIpOnLaunch` set to true for the instances to be able to successfully join a cluster. If the subnet was created using `eksctl` or the [Amazon EKS vendored AWS CloudFormation templates \(p. 166\)](#) on or after 03/26/2020, then this setting is already set to true. If the subnets were created with `eksctl` or the AWS CloudFormation templates before 03/26/2020, then you need to change the setting manually. For more information, see [Modifying the public IPv4 addressing attribute for your subnet](#).

- **Allow remote access to nodes** (Optional, but default). Enabling SSH allows you to connect to your instances and gather diagnostic information if there are issues. Complete the following steps to enable remote access. We highly recommend enabling remote access when you create your node group. You cannot enable remote access after the node group is created.

If you chose to use a launch template, then this option isn't shown. To enable remote access to your nodes, specify a key pair in the launch template and ensure that the proper port is open to the nodes in the security groups that you specify in the launch template. For more information, see [the section called "Using custom security groups" \(p. 98\)](#).

- For **SSH key pair** (Optional), choose an Amazon EC2 SSH key to use. For more information, see [Amazon EC2 key pairs](#) in the Amazon EC2 User Guide for Linux Instances. If you chose to use a launch template, then you can't select one.
  - For **Allow remote access from**, if you want to limit access to specific instances, then select the security groups that are associated to those instances. If you don't select specific security groups, then SSH access is allowed from anywhere on the internet (0.0.0.0/0).
8. On the **Review and create** page, review your managed node group configuration and choose **Create**.

#### Note

- If specifying an Arm node type, then review the considerations in [the section called "Arm" \(p. 136\)](#) before deploying.
- If nodes fail to join the cluster, see [??? \(p. 313\)](#) in the Troubleshooting guide.
- For more information on the available options for `eksctl` commands, enter the following command.

```
eksctl command -help
```

9. Watch the status of your nodes and wait for them to reach the Ready status.

```
kubectl get nodes --watch
```

10. (GPU nodes only) If you chose a GPU instance type and the Amazon EKS optimized accelerated AMI, then you must apply the [NVIDIA device plugin for Kubernetes](#) as a DaemonSet on your cluster with the following command.

```
kubectl apply -f https://raw.githubusercontent.com/NVIDIA/k8s-device-plugin/v0.6.0/nvidia-device-plugin.yml
```

11. (Optional) [Deploy a sample Linux application \(p. 200\)](#) – Deploy a sample application to test your cluster and Linux nodes.

Now that you have a working Amazon EKS cluster with nodes, you are ready to start installing Kubernetes add-ons and deploying applications to your cluster. The following documentation topics help you to extend the functionality of your cluster.

- [the section called "Cluster Autoscaler" \(p. 54\)](#) – Configure the Kubernetes Cluster Autoscaler to automatically adjust the number of nodes in your node groups.
- [the section called "Sample deployment" \(p. 200\)](#) – Deploy a sample application to test your cluster and Linux nodes.
- [Deploy a Windows sample application \(p. 75\)](#) – Deploy a sample application to test your cluster and Windows nodes.
- [Cluster management \(p. 229\)](#) – Learn how to use important tools for managing your cluster.

## Updating a managed node group

There are several scenarios where it's useful to update your Amazon EKS managed node group's version or configuration:

- You have updated the Kubernetes version for your Amazon EKS cluster and want to update your nodes to use the same Kubernetes version.
- A new AMI release version is available for your managed node group. For more information about AMI versions, see [Amazon EKS optimized Amazon Linux AMI versions \(p. 137\)](#).
- You want to adjust the minimum, maximum, or desired count of the instances in your managed node group.
- You want to add or remove Kubernetes labels from the instances in your managed node group.
- You want to add or remove AWS tags from your managed node group.
- You need to deploy a new version of a launch template with configuration changes, such as an updated custom AMI.

If there is a newer AMI release version for your managed node group's Kubernetes version, you can update your node group's version to use the newer AMI version. Similarly, if your cluster is running a Kubernetes version that is newer than your node group, you can update the node group to use the latest AMI release version to match your cluster's Kubernetes version.

**Note**

You can't roll back a node group to an earlier Kubernetes version or AMI version.

When a node in a managed node group is terminated due to a scaling action or update, the pods in that node are drained first. For more information, see [Managed node update behavior \(p. 96\)](#).

## Update a node group version

### To update a node group version

1. (Optional) If you are using the Kubernetes [Cluster Autoscaler](#), scale the deployment down to zero replicas to avoid conflicting scaling actions.

```
kubectl scale deployments/cluster-autoscaler --replicas=0 -n kube-system
```

2. Select the tab with the name of the tool that you'd like to upgrade the version with.

#### AWS Management Console

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose the cluster that contains the node group to update.
3. If at least one of your node groups that was deployed with an Amazon EKS optimized AMI has an update available, you'll see a notification under the cluster name. The notification lets you know how many of your node groups have an update available. In the **Node Groups** table on the **Compute** tab, you will see **Update now** to the right of:
  - The value in the **AMI release version** column for each node group that has an Amazon EKS optimized AMI update available. If a node group is deployed with a custom AMI, this option won't appear. If your nodes are deployed with a custom AMI, you should follow these steps to deploy a new updated custom AMI. First, create a new version of your AMI, then create a new launch template version with the new AMI ID, and last upgrade the nodes to the new version of the launch template. To do this, select **Update now** for a node group that you want to update.
  - The value in the **Launch template** column for each node group that is deployed with a launch template. Select **Update now** for a node group that you want to update the launch template version for.

If you select a node group from the table and an update is available for it, you'll receive a notification on the **Node Group configuration** page. On this page, you can choose **Update now**.

4. On the **Update Node Group version** page, select:
  - **Update Node Group version** – This option is unavailable if you deployed a custom AMI or your EKS optimized AMI is already currently on the latest version for your cluster.
  - **Launch template version** – This option is unavailable if the node group is deployed without a launch template. You can only update the launch template version for a node group that has been deployed with the launch template. Select the version that you want to update the node group to. If your node group is configured with a custom AMI, then the version that you select must also specify an AMI. When you upgrade to a newer version of your launch template, all of your nodes are recycled to match the new configuration of the launch template version specified.
5. For **Update strategy**, select one of the following options and then choose **Update**.
  - **Rolling update** – This option respects the pod disruption budgets for your cluster. Updates fail if there is a pod disruption budget issue that causes Amazon EKS to be unable to gracefully drain the pods that are running on this node group.
  - **Force update** – This option does not respect pod disruption budgets. Updates occur regardless of pod disruption budget issues by forcing node restarts to occur.

eksctl

Upgrade a managed node group to the latest AMI release of the same Kubernetes version that is currently deployed on the nodes with the following command.

```
eksctl upgrade nodegroup --name=node-group-name --cluster=cluster-name
```

#### Note

If you're upgrading a node group that is deployed with a launch template to a new launch template version, add `--launch-template=version` to the preceding command. The launch template must meet the requirements described in [the section called "Launch template support" \(p. 97\)](#). If the launch template includes a custom AMI, the AMI must meet the requirements in [the section called "Using a custom AMI" \(p. 100\)](#). When you upgrade your node group to a newer version of your launch template, all of your nodes are recycled to match the new configuration of the launch template version that is specified.

You can't directly upgrade a node group that is deployed without a launch template to a new launch template version. Instead, you must deploy a new node group using the launch template to update the node group to a new launch template version.

You can upgrade a node group to a version that is one minor release later than the node group's current Kubernetes version, but the version can't be later than the cluster's Kubernetes version. For example, if you have a cluster running Kubernetes 1.17, you can upgrade nodes currently running Kubernetes 1.16 to version 1.17 with the following command.

```
eksctl upgrade nodegroup --name=node-group-name --cluster=cluster-name --  
kubernetes-version=1.17
```

3. (Optional) If you use the Kubernetes [Cluster Autoscaler](#), scale the deployment back to your desired number of replicas.



```
kubectl scale deployments/cluster-autoscaler --replicas=1 -n kube-system
```

## Edit a node group configuration

You can modify some of the configurations of a managed node group.

### To edit a node group configuration

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose the cluster that contains the node group to edit.
3. Select the node group to edit, and choose **Edit**.
4. (Optional) On the **Edit node group** page, edit the **Group configuration**.
  - **Tags** – Add tags to or remove tags from your node group resource. These tags are only applied to the Amazon EKS node group. They do not propagate to other resources, such as subnets or Amazon EC2 instances in the node group.
  - **Kubernetes labels** – Add or remove Kubernetes labels to the nodes in your node group. The labels shown here are only the labels that you have applied with Amazon EKS. Other labels may exist on your nodes that are not shown here.
5. (Optional) On the **Edit node group** page, edit the **Group size**.
  - **Minimum size** – Specify the current number of nodes that the managed node group should maintain.
  - **Maximum size** – Specify the maximum number of nodes that the managed node group can scale out to. Managed node groups can support up to 100 nodes by default.
  - **Desired size** – Specify the current number of nodes that the managed node group should maintain.
6. When you are finished editing, choose **Save changes**.

## Managed node update behavior

When you update a managed node group version to the latest AMI release version for your node group's Kubernetes version or to a newer Kubernetes version to match your cluster, Amazon EKS triggers the following logic:

1. Amazon EKS creates a new Amazon EC2 launch template version for the Auto Scaling group associated with your node group. The new template uses the target AMI for the update.
2. The Auto Scaling group is updated to use the latest launch template with the new AMI.
3. The Auto Scaling group maximum size and desired size are incremented by one up to twice the number of Availability Zones in the Region that the Auto Scaling group is deployed in. This is to ensure that at least one new instance comes up in every Availability Zone in the Region that your node group is deployed in.
4. Amazon EKS checks the nodes in the node group for the `eks.amazonaws.com/nodegroup-image` label, and applies a `eks.amazonaws.com/nodegroup=unschedulable:NoSchedule` taint on all of the nodes in the node group that are not labeled with the latest AMI ID. This prevents nodes that have already been updated from a previous failed update from being tainted.
5. Amazon EKS randomly selects a node in the node group and evicts all pods from it.
6. After all of the pods are evicted, Amazon EKS cordons the node. This is done so that the service controller doesn't send any new request to this node and removes this node from its list of healthy, active nodes.



7. Amazon EKS sends a termination request to the Auto Scaling group for the cordoned node.
8. Steps 5-7 are repeated until there are no nodes in the node group that are deployed with the earlier version of the launch template.
9. The Auto Scaling group maximum size and desired size are decremented by 1 to return to your pre-update values.

## Launch template support

You can deploy a managed node group using an Amazon EC2 launch template. Launch templates have the benefit of providing you with a greater level of flexibility and customization when deploying managed nodes. For the highest level of customization, you can deploy managed nodes using a launch template and a custom AMI.

After you've deployed a managed node group with a launch template, you can then update it with a different version of the same launch template. When you update your node group to a different version of your launch template, all of the nodes in the group are recycled to match the new configuration of the specified launch template version. Existing node groups that do not use launch templates cannot be updated directly. Rather, you must create a new node group with a launch template to do so.

## Launch template configuration basics

You can create an Amazon EC2 Auto Scaling launch template with the AWS Management Console, AWS CLI, or an AWS SDK. For more information, see [Creating a Launch Template for an Auto Scaling Group](#) in the Amazon EC2 User Guide. Some of the settings in a launch template are similar to the settings used for managed node configuration. When deploying or updating a node group with a launch template, some settings must be specified in the node group configuration or the launch template, but not both. If a setting exists where it shouldn't, then operations such as creating or updating a node group fail.

The following table lists the settings that are prohibited in a launch template and which similar settings (if any) are required in the managed node group configuration. The listed settings are the settings that appear in the console. They might have similar but different names in the AWS CLI and SDK.

Launch template – Prohibited	Amazon EKS node group configuration
<b>IAM instance profile</b> under <b>Advanced details</b>	<b>Node IAM Role</b> under <b>Node Group configuration</b> on the <b>Configure Node Group</b> page
<b>Subnet</b> under <b>Network interfaces (Add network interface)</b>	<b>Subnets</b> under <b>Node Group network configuration</b> on the <b>Specify networking</b> page
<b>Request Spot Instances</b> under <b>Advanced details, Purchasing options</b>	No equivalent is available because Spot Instances are not supported in node groups.
<b>Shutdown behavior</b> and <b>Stop - Hibernate behavior</b> under <b>Advanced details</b> . Retain default <b>Don't include in launch template setting</b> in launch template for both settings.	No equivalent. Amazon EKS must control the instance lifecycle, not the Auto Scaling group.

The following table lists the settings that are prohibited in a managed node group configuration and which similar settings (if any) are required in a launch template. The listed settings are the settings that appear in the console. They might have similar names in the AWS CLI and SDK.

Amazon EKS node group configuration – Prohibited	Launch template
<p>(Only if you specified a custom AMI in a launch template) <b>AMI type</b> under <b>Node Group compute configuration</b> on <b>Set compute and scaling configuration</b> page – Console displays <b>Specified in launch template</b> and the AMI ID that was specified.</p> <p>If an AMI type was not specified in the launch template, then you can select an AMI in the node group configuration.</p>	<p><b>AMI</b> under <b>Launch template contents</b> – You must specify if you are using a custom AMI. If you specify an AMI that doesn't meet the requirements listed in <a href="#">the section called “Using a custom AMI” (p. 100)</a>, the node group deployment will fail.</p>
<p><b>Instance type</b> on <b>Set compute and scaling configuration</b> page – Console displays <b>Specified in launch template</b> and the instance type that was specified.</p>	<p><b>Instance type</b> under <b>Launch template contents</b> – You must specify this setting in a launch template version to be able to select the version when creating the node group.</p>
<p><b>Disk size</b> under <b>Node Group compute configuration</b> on <b>Set compute and scaling configuration</b> page – Console displays <b>Specified in launch template</b>.</p>	<p><b>Size</b> under <b>Storage (Volumes) (Add new volume)</b>. You must specify this in the launch template.</p>
<p><b>SSH key pair</b> under <b>Node Group configuration</b> on the <b>Specify Networking</b> page – The console displays the key that was specified in the launch template or displays <b>Not specified in launch template</b>.</p>	<p><b>Key pair name</b> under <b>Key pair (login)</b>.</p>
<p>You can't specify source security groups that are allowed remote access when using a launch template.</p>	<p><b>Security groups</b> under <b>Network settings</b> for the instance or <b>Security groups</b> under <b>Network interfaces (Add network interface)</b>, but not both. For more information, see <a href="#">the section called “Using custom security groups” (p. 98)</a>.</p>

#### Note

If any containers that you deploy to the node group use the Instance Metadata Service Version 2, then make sure to set the **Metadata response hop limit** to 2 in your launch template. For more information, see [Instance metadata and user data](#) in the Amazon EC2 User Guide. If you deploy a managed node group without using a launch template, this value is automatically set for the node group.

## Tagging Amazon EC2 instances

You can use the `TagSpecification` parameter of a launch template to specify which tags to apply to Amazon EC2 instances in your node group. The IAM entity calling the `CreateNodegroup` or `UpdateNodegroupVersion` APIs must have permissions for `ec2:RunInstances` and `ec2:CreateTags`, and the tags must be added to the launch template.

## Using custom security groups

You can use a launch template to specify custom Amazon EC2 [security groups](#) to apply to instances in your node group. This can be either in the instance level security groups parameter or as part of the network interface configuration parameters. However, you can't create a launch template that specifies

both instance level and network interface security groups. Consider the following conditions that apply to using custom security groups with managed node groups:

- Amazon EKS only allows launch templates with a single network interface specification.
- By default, Amazon EKS applies the [cluster security group](#) to the instances in your node group to facilitate communication between nodes and the control plane. If you specify custom security groups in the launch template using either option mentioned earlier, Amazon EKS doesn't add the cluster security group. Therefore, you must ensure that the inbound and outbound rules of your security groups enable communication with your cluster's endpoint. Incorrect security group rules result in worker nodes being unable to join the cluster. To learn about the security group rules that you should need to apply, see [the section called "Amazon EKS security group considerations" \(p. 173\)](#).
- If you need SSH access to the instances in your node group, be sure to include a security group that allows that access.

## Amazon EC2 user data

You can supply Amazon EC2 user data in your launch template using `cloud-init` when launching your instances. For more information, see the [cloud-init](#) documentation. Your user data can be used to perform common configuration operations. This includes the following operations:

- [Including users or groups](#)
- [Installing packages](#)

Amazon EC2 user data in launch templates that are used with managed node groups must be in the [MIME multi-part archive](#) format. This is because your user data is merged with Amazon EKS user data required for nodes to join the cluster.

### Note

Amazon EKS doesn't merge user data when a custom AMI is used. For more information, see [the section called "Using a custom AMI" \(p. 100\)](#).

You can combine multiple user data blocks together into a single MIME multi-part file. For example, you can combine a cloud boothook that configures the Docker daemon with a user data shell script that installs a custom package. A MIME multi-part file consists of the following components:

- The content type and part boundary declaration – `Content-Type: multipart/mixed; boundary="==BOUNDARY=="`
- The MIME version declaration – `MIME-Version: 1.0`
- One or more user data blocks, which contain the following components:
  - The opening boundary, which signals the beginning of a user data block – `===BOUNDARY==`
  - The content type declaration for the block: `Content-Type: text/cloud-config; charset="us-ascii"`. For more information about content types, see the [cloud-init](#) documentation.
  - The content of the user data, for example, a list of shell commands or `cloud-init` directives.
  - The closing boundary, which signals the end of the MIME multi-part file: `===BOUNDARY===`

The following is an example of a MIME multi-part file that you can use to create your own.

```
MIME-Version: 1.0
Content-Type: multipart/mixed; boundary="==MYBOUNDARY=="

===MYBOUNDARY==
Content-Type: text/x-shellscript; charset="us-ascii"

#!/bin/bash
```

```
echo "Running custom user data script"

---MYBOUNDARY---\
```

## Using a custom AMI

If your organization needs to run a custom AMI due to specific security, compliance, or internal policy requirements, you can deploy such AMIs to managed node groups by using a launch template. For more information, see [Amazon Machine Images \(AMI\)](#) in the Amazon EC2 User Guide for Linux Instances. The Amazon EKS AMI build specification contains resources and configuration scripts for building a custom Amazon EKS AMI based on Amazon Linux 2. For more information, see [Amazon EKS AMI Build Specification](#) on GitHub. To build custom AMIs installed with other operating systems, see [Amazon EKS Sample Custom AMIs](#) on GitHub.

### Note

When using a custom AMI, Amazon EKS doesn't merge any user data. Rather, you are responsible for supplying the required bootstrap commands for nodes to join the cluster. If your nodes fail to join the cluster, the Amazon EKS `CreateNodegroup` and `UpdateNodegroupVersion` actions also fail.

To use a custom AMI with managed node groups, specify an AMI ID in the `imageId` field of the launch template. To update your node group to a newer version of a custom AMI, create a new version of the launch template with an updated AMI ID, and update the node group with the new launch template version.

### Limitations of using custom AMIs with managed node groups

- You must create a new node group to switch between using custom AMIs and Amazon EKS optimized AMIs.
- The following fields can't be set in the API if you're using a custom AMI
  - `amiType`
  - `releaseVersion`
  - `version`

## Deleting a managed node group

This topic describes how you can delete an Amazon EKS managed node group.

When you delete a managed node group, Amazon EKS randomly selects a node in your node group and sends a termination signal to the Auto Scaling group. After which, Amazon EKS then sends a signal to drain the pods from the node. If pods don't drain from a node for 15 minutes, then the pods are deleted. This can happen, for example, when a pod disruption budget is too restrictive. After the node is drained, it is terminated. This step is repeated until all of the nodes in the Auto Scaling group are terminated, and then the Auto Scaling group is deleted.

### Important

If you delete a managed node group that uses a node IAM role that isn't used by any other managed node group in the cluster, the role is removed from the [aws-auth ConfigMap \(p. 225\)](#). If any self-managed node groups in the cluster are using the same node IAM role, the self-managed nodes move to the `NotReady` status, and the cluster operation are also disrupted. You can add the mapping back to the ConfigMap to minimize disruption.

### To delete a managed node group

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.

2. Choose the cluster that contains the node group to delete.
3. On the **Compute** tab, select the node group to delete, and choose **Delete**.
4. On the **Delete Node group: *node group name*** page, type the name of the node group in the text field and choose **Delete**.

## Self-managed nodes

Worker machines in Kubernetes are called nodes. Amazon EKS nodes run in your AWS account and connect to your cluster's control plane via the cluster API server endpoint. You deploy one or more nodes into a node group. A node group is one or more Amazon EC2 instances that are deployed in an [Amazon EC2 Auto Scaling group](#). All instances in a node group must:

- Be the same instance type
- Be running the same Amazon Machine Image (AMI)
- Use the same [Amazon EKS node IAM role](#) (p. 265)

A cluster can contain several node groups, and each node group can contain several nodes.

Amazon EKS nodes are standard Amazon EC2 instances, and you are billed for them based on normal EC2 prices. For more information, see [Amazon EC2 pricing](#).

Amazon EKS provides a specialized Amazon Machine Image (AMI) called the Amazon EKS optimized AMI. This AMI is built on top of Amazon Linux 2, and is configured to serve as the base image for Amazon EKS nodes. The AMI is configured to work with Amazon EKS out of the box, and it includes Docker, `kubelet`, and the AWS IAM Authenticator. The AMI also contains a specialized [bootstrap script](#) that allows it to discover and connect to your cluster's control plane automatically.

### Note

You can track security or privacy events for Amazon Linux 2 at the [Amazon Linux security center](#) or subscribe to the associated [RSS feed](#). Security and privacy events include an overview of the issue, what packages are affected, and how to update your instances to correct the issue.

If you restrict access to your cluster's public endpoint using CIDR blocks, it is recommended that you also enable private endpoint access so that nodes can communicate with the cluster. Without the private endpoint enabled, the CIDR blocks that you specify for public access must include the egress sources from your VPC. For more information, see [Amazon EKS cluster endpoint access control](#) (p. 49).

To add self-managed nodes to your Amazon EKS cluster, see [Launching self-managed Amazon Linux nodes](#) (p. 102). If you follow the steps in the guide, the required tag is added to the node for you. If you launch self-managed nodes manually, then you must add the following tag to each node. For more information, see [Adding and deleting tags on an individual resource](#).

Key	Value
<code>kubernetes.io/cluster/&lt;cluster-name&gt;</code>	owned

For more information about nodes from a general Kubernetes perspective, see [Nodes](#) in the Kubernetes documentation.

### Topics

- [Launching self-managed Amazon Linux nodes](#) (p. 102)

- [Launching self-managed Windows nodes \(p. 106\)](#)
- [Self-managed node updates \(p. 110\)](#)

## Launching self-managed Amazon Linux nodes

This topic helps you to launch an Auto Scaling group of Linux nodes that register with your Amazon EKS cluster. After the nodes join the cluster, you can deploy Kubernetes applications to them.

If this is your first time launching Amazon EKS Linux nodes, we recommend that you follow one of our [Getting started with Amazon EKS \(p. 3\)](#) guides instead. The guides provide complete end-to-end walkthroughs for creating an Amazon EKS cluster with nodes.

### Important

Amazon EKS nodes are standard Amazon EC2 instances, and you are billed for them based on normal Amazon EC2 instance prices. For more information, see [Amazon EC2 pricing](#).

Choose the tab below that corresponds to your desired node creation method.

eksctl

### To launch self-managed Linux nodes using eksctl

This procedure requires eksctl version 0.26.0-rc.1 or later. You can check your version with the following command:

```
eksctl version
```

For more information on installing or upgrading eksctl, see [Installing or upgrading eksctl \(p. 234\)](#).

### Note

This procedure only works for clusters that were created with eksctl.

1. Create your node group with the following command. Replace the *example values* with your own values.

```
eksctl create nodegroup \
--cluster default \
--version auto \
--name standard-nodes \
--node-type t3.medium \
--node-ami auto \
--nodes 3 \
--nodes-min 1 \
--nodes-max 4
```

### Note

- If specifying an Arm node type, then review the considerations in [the section called "Arm" \(p. 136\)](#) before deploying.
- If nodes fail to join the cluster, see [??? \(p. 313\)](#) in the Troubleshooting guide.
- For more information on the available options for eksctl commands, enter the following command.

```
eksctl command -help
```

Output:

You'll see several lines of output as the nodes are created. The last line of output is similar to the following example line.

```
[#] all nodegroups have up-to-date configuration
```

2. (Optional) [Deploy a sample Linux application \(p. 200\)](#) – Deploy a sample application to test your cluster and Linux nodes.

## AWS Management Console

These procedures have the following prerequisites:

- You have created a VPC and security group that meet the requirements for an Amazon EKS cluster. For more information, see [Cluster VPC considerations \(p. 170\)](#) and [Amazon EKS security group considerations \(p. 173\)](#). The [Getting started with Amazon EKS \(p. 3\)](#) guide creates a VPC that meets the requirements, or you can also follow [Creating a VPC for your Amazon EKS cluster \(p. 166\)](#) to create one manually.
- You have created an Amazon EKS cluster and specified that it use the VPC and security group that meet the requirements of an Amazon EKS cluster. For more information, see [Creating an Amazon EKS cluster \(p. 30\)](#).

## To launch self-managed nodes using the AWS Management Console

1. Wait for your cluster status to show as **ACTIVE**. If you launch your nodes before the cluster is active, the nodes will fail to register with the cluster and you will have to relaunch them.
2. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>
3. Choose **Create stack**.
4. For **Specify template**, select **Amazon S3 URL**, then copy the following URL, paste it into **Amazon S3 URL**, and select **Next** twice.

```
https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/amazon-eks-nodegroup.yaml
```

5. On the **Quick create stack** page, fill out the following parameters accordingly:
  - **Stack name:** Choose a stack name for your AWS CloudFormation stack. For example, you can call it **<cluster-name>-nodes**.
  - **ClusterName:** Enter the name that you used when you created your Amazon EKS cluster.  
**Important**  
This name must exactly match the name you used in [Step 1: Create your Amazon EKS cluster \(p. 22\)](#); otherwise, your nodes cannot join the cluster.
  - **ClusterControlPlaneSecurityGroup:** Choose the **SecurityGroups** value from the AWS CloudFormation output that you generated with [Create your Amazon EKS cluster VPC \(p. 19\)](#).
  - **NodeGroupName:** Enter a name for your node group. This name can be used later to identify the Auto Scaling node group that is created for your nodes.
  - **NodeAutoScalingGroupMinSize:** Enter the minimum number of nodes that your node Auto Scaling group can scale in to.
  - **NodeAutoScalingGroupDesiredCapacity:** Enter the desired number of nodes to scale to when your stack is created.

- **NodeAutoScalingGroupMaxSize:** Enter the maximum number of nodes that your node Auto Scaling group can scale out to.
- **NodeInstanceType:** Choose an instance type for your nodes. Before choosing an Arm instance type, make sure to review the considerations in [the section called “Arm” \(p. 136\)](#).

**Note**

The supported instance types for the latest version of the [Amazon VPC CNI plugin for Kubernetes](#) are shown [here](#). You may need to update your CNI version to take advantage of the latest supported instance types. For more information, see [Amazon VPC CNI plugin for Kubernetes upgrades \(p. 190\)](#).

**Important**

Some instance types might not be available in all Regions.

- **NodeImageIdSSMParam:** Pre-populated with the Amazon EC2 Systems Manager parameter of the current recommended Amazon EKS optimized Amazon Linux AMI ID for a Kubernetes version. If you want to use the Amazon EKS optimized accelerated AMI, then replace *amazon-linux-2* with *amazon-linux-2-gpu*. If you want to use the Amazon EKS optimized Arm AMI, then replace *amazon-linux-2* with *amazon-linux-2-arm64*. If you want to use a different Kubernetes minor version supported with Amazon EKS, then you can replace *1.x* with a different [supported version \(p. 61\)](#). We recommend specifying the same Kubernetes version as your cluster.

**Note**

The Amazon EKS node AMI is based on Amazon Linux 2. You can track security or privacy events for Amazon Linux 2 at the [Amazon Linux Security Center](#) or subscribe to the associated [RSS feed](#). Security and privacy events include an overview of the issue, what packages are affected, and how to update your instances to correct the issue.

- **NodeImageId:** (Optional) If you are using your own custom AMI (instead of the Amazon EKS optimized AMI), enter a node AMI ID for your Region. If you specify a value here, it overrides any values in the **NodeImageIdSSMParam** field.
- **NodeVolumeSize:** Specify a root volume size for your nodes, in GiB.
- **KeyName:** Enter the name of an Amazon EC2 SSH key pair that you can use to connect using SSH into your nodes with after they launch. If you don't already have an Amazon EC2 keypair, you can create one in the AWS Management Console. For more information, see [Amazon EC2 key pairs](#) in the *Amazon EC2 User Guide for Linux Instances*.

**Note**

If you do not provide a keypair here, the AWS CloudFormation stack creation fails.

- **BootstrapArguments:** Specify any optional arguments to pass to the node bootstrap script, such as extra `kubelet` arguments. For more information, view the [bootstrap script usage information](#) on GitHub.

**Note**

- If you are launching nodes into a private VPC without outbound internet access, then you need to include the following arguments.

```
--apiserver-endpoint cluster-endpoint --b64-cluster-ca cluster-certificate-authority
```

- If you want to assign IP addresses to pods that are from a different CIDR block than the block that includes the IP address for the node, then you may need to add a CIDR block to your VPC and specify an argument to support the capability. For more information, see [the section called “CNI custom networking” \(p. 184\)](#).
- **DisableIMDSv1:** Each node supports the Instance Metadata Service Version 1 (IMDSv1) and IMDSv2 by default, but you can disable IMDSv1. Select **true** if you don't want any nodes in the



node group, or any pods scheduled on the nodes in the node group to use IMDSv1. For more information about IMDS, see [Configuring the instance metadata service](#).

- **VpcId:** Enter the ID for the VPC that you created in [Create your Amazon EKS cluster VPC \(p. 19\)](#).
- **Subnets:** Choose the subnets that you created in [Create your Amazon EKS cluster VPC \(p. 19\)](#). If you created your VPC using the steps described at [Creating a VPC for your Amazon EKS cluster \(p. 166\)](#), then specify only the private subnets within the VPC for your nodes to launch into.

#### Important

If any of the subnets are public subnets, then they must have the automatic public IP address assignment setting enabled. If the setting is not enabled for the public subnet, then any nodes that you deploy to that public subnet will not be assigned a public IP address and will not be able to communicate with the cluster or other AWS services. If the subnet was deployed before 03/26/2020 using either of the [Amazon EKS AWS CloudFormation VPC templates \(p. 166\)](#), or by using `eksctl`, then automatic public IP address assignment is disabled for public subnets. For information about how to enable public IP address assignment for a subnet, see [Modifying the Public IPv4 Addressing Attribute for Your Subnet](#). If the node is deployed to a private subnet, then it is able to communicate with the cluster and other AWS services through a NAT gateway.

#### Important

If the subnets do not have internet access, then make sure that you're aware of the considerations and extra steps in [??? \(p. 82\)](#).

6. Acknowledge that the stack might create IAM resources, and then choose **Create stack**.
7. When your stack has finished creating, select it in the console and choose **Outputs**.
8. Record the **NodeInstanceRole** for the node group that was created. You need this when you configure your Amazon EKS nodes.

### To enable nodes to join your cluster

#### Note

If you launched nodes inside a private VPC without outbound internet access, then you must enable nodes to join your cluster from within the VPC.

1. Download, edit, and apply the AWS IAM Authenticator configuration map.
  - a. Use the following command to download the configuration map:

```
curl -o aws-auth-cm.yaml https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/aws-auth-cm.yaml
```

- b. Open the file with your favorite text editor. Replace the *<ARN of instance role (not instance profile)>* snippet with the **NodeInstanceRole** value that you recorded in the previous procedure, and save the file.

#### Important

Do not modify any other lines in this file.

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: aws-auth
  namespace: kube-system
data:
  mapRoles: |
    - rolearn: <ARN of instance role (not instance profile)>
```

```
username: system:node:{{EC2PrivateDNSName}}
groups:
- system:bootstrappers
- system:nodes
```

- c. Apply the configuration. This command may take a few minutes to finish.

```
kubectl apply -f aws-auth-cm.yaml
```

#### Note

If you receive any authorization or resource type errors, see [Unauthorized or access denied \(kubectl\)](#) (p. 314) in the troubleshooting section.

#### Note

- If specifying an Arm node type, then review the considerations in [the section called "Arm"](#) (p. 136) before deploying.
- If nodes fail to join the cluster, see [???](#) (p. 313) in the Troubleshooting guide.
- For more information on the available options for `eksctl` commands, enter the following command.

```
eksctl command -help
```

2. Watch the status of your nodes and wait for them to reach the Ready status.

```
kubectl get nodes --watch
```

3. (GPU nodes only) If you chose a GPU instance type and the Amazon EKS optimized accelerated AMI, you must apply the [NVIDIA device plugin for Kubernetes](#) as a DaemonSet on your cluster with the following command.

```
kubectl apply -f https://raw.githubusercontent.com/NVIDIA/k8s-device-plugin/v0.6.0/nvidia-device-plugin.yml
```

4. (Optional) [Deploy a sample Linux application](#) (p. 200) – Deploy a sample application to test your cluster and Linux nodes.

## Launching self-managed Windows nodes

This topic helps you to launch an Auto Scaling group of Windows nodes that register with your Amazon EKS cluster. After the nodes join the cluster, you can deploy Kubernetes applications to them.

#### Important

Amazon EKS nodes are standard Amazon EC2 instances, and you are billed for them based on normal Amazon EC2 instance prices. For more information, see [Amazon EC2 pricing](#).

You must enable Windows support for your cluster and we recommend that you review important considerations before you launch a Windows node group. For more information, see [Enabling Windows support](#) (p. 71).

Choose the tab below that corresponds to your desired node creation method:

eksctl

If you don't already have an Amazon EKS cluster and a Linux node group to add a Windows node group to, then we recommend that you follow the [Getting started with eksctl](#) (p. 3) guide instead. The guide provides a complete end-to-end walkthrough for creating an Amazon EKS cluster with

Linux and Windows nodes. If you have an existing Amazon EKS cluster and a Linux node group to add a Windows node group to, then complete the following steps to add the Windows node group.

### To launch self-managed Windows nodes using `eksctl`

This procedure assumes that you have installed `eksctl`, and that your `eksctl` version is at least `0.26.0-rc.1`. You can check your version with the following command:

```
eksctl version
```

For more information on installing or upgrading `eksctl`, see [Installing or upgrading eksctl \(p. 234\)](#).

#### Note

This procedure only works for clusters that were created with `eksctl`.

1. Create your node group with the following command. Replace the *example values* with your own values.

```
eksctl create nodegroup \
--region region-code \
--cluster windows \
--name windows-ng \
--node-type t2.large \
--nodes 3 \
--nodes-min 1 \
--nodes-max 4 \
--node-ami-family WindowsServer2019FullContainer
```

#### Note

- If nodes fail to join the cluster, see [??? \(p. 313\)](#) in the Troubleshooting guide.
- For more information on the available options for `eksctl` commands, enter the following command.

```
eksctl command -help
```

Output:

You'll see several lines of output as the nodes are created. The last line of output is similar to the following example line.

```
[#] all nodegroups have up-to-date configuration
```

2. (Optional) [Deploy a Windows sample application \(p. 75\)](#) – Deploy a sample application to test your cluster and Windows nodes.

## AWS Management Console

### To launch self-managed Windows nodes using the AWS Management Console

These procedures have the following prerequisites:

- You have an existing Amazon EKS cluster and a Linux node group. If you don't have these resources, we recommend that you follow one of our [Getting started with Amazon EKS \(p. 3\)](#) guides to create them. The guides provide a complete end-to-end walkthrough for creating an Amazon EKS cluster with Linux nodes.

- You have created a VPC and security group that meet the requirements for an Amazon EKS cluster. For more information, see [Cluster VPC considerations \(p. 170\)](#) and [Amazon EKS security group considerations \(p. 173\)](#). The [Getting started with Amazon EKS \(p. 3\)](#) guide creates a VPC that meets the requirements, or you can also follow [Creating a VPC for your Amazon EKS cluster \(p. 166\)](#) to create one manually.

1. Wait for your cluster status to show as **ACTIVE**. If you launch your nodes before the cluster is active, the nodes will fail to register with the cluster and you will have to relaunch them.
2. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>
3. Choose **Create stack**.
4. For **Specify template**, select **Amazon S3 URL**, then copy the following URL, paste it into **Amazon S3 URL**, and select **Next** twice.

```
https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/amazon-eks-windows-nodegroup.yaml
```

5. On the **Quick create stack** page, fill out the following parameters accordingly:
  - **Stack name**: Choose a stack name for your AWS CloudFormation stack. For example, you can call it **cluster-name-nodes**.
  - **ClusterName**: Enter the name that you used when you created your Amazon EKS cluster.

**Important**

This name must exactly match the name you used in [Step 1: Create your Amazon EKS cluster \(p. 22\)](#); otherwise, your nodes cannot join the cluster.

- **ClusterControlPlaneSecurityGroup**: Choose the **SecurityGroups** value from the AWS CloudFormation output that you generated with [Create your Amazon EKS cluster VPC \(p. 19\)](#).
- **NodeGroupName**: Enter a name for your node group. This name can be used later to identify the Auto Scaling node group that is created for your nodes.
- **NodeAutoScalingGroupMinSize**: Enter the minimum number of nodes that your node Auto Scaling group can scale in to.
- **NodeAutoScalingGroupDesiredCapacity**: Enter the desired number of nodes to scale to when your stack is created.
- **NodeAutoScalingGroupMaxSize**: Enter the maximum number of nodes that your node Auto Scaling group can scale out to.
- **NodeInstanceType**: Choose an instance type for your nodes.

**Note**

The supported instance types for the latest version of the [Amazon VPC CNI plugin for Kubernetes](#) are shown [here](#). You may need to update your CNI version to take advantage of the latest supported instance types. For more information, see [Amazon VPC CNI plugin for Kubernetes upgrades \(p. 190\)](#).

- **NodeImageIdSSMParam**: Pre-populated with the Amazon EC2 Systems Manager parameter of the current recommended Amazon EKS optimized Windows Core AMI ID. If you want to use the full version of Windows, then replace **Core** with **Full**.
- **NodeImageId**: (Optional) If you are using your own custom AMI (instead of the Amazon EKS optimized AMI), enter a node AMI ID for your Region. If you specify a value here, it overrides any values in the **NodeImageIdSSMParam** field.
- **NodeVolumeSize**: Specify a root volume size for your nodes, in GiB.
- **KeyName**: Enter the name of an Amazon EC2 SSH key pair that you can use to connect using SSH into your nodes with after they launch. If you don't already have an Amazon EC2 keypair, you can create one in the AWS Management Console. For more information, see [Amazon EC2 key pairs](#) in the *Amazon EC2 User Guide for Windows Instances*.

### Note

If you do not provide a keypair here, the AWS CloudFormation stack creation fails.

- **BootstrapArguments:** Specify any optional arguments to pass to the node bootstrap script, such as extra kubelet arguments using `-KubeletExtraArgs`.
- **DisableIMDSv1:** Each node supports the Instance Metadata Service Version 1 (IMDSv1) and IMDSv2 by default, but you can disable IMDSv1. Select **true** if you don't want any nodes in the node group, or any pods scheduled on the nodes in the node group to use IMDSv1. For more information about IMDS, see [Configuring the instance metadata service](#).
- **VpcId:** Select the ID for the VPC that you created in [Create your Amazon EKS cluster VPC \(p. 19\)](#).
- **NodeSecurityGroups:** Select the security group that was created for your Linux node group in [Create your Amazon EKS cluster VPC \(p. 19\)](#). If your Linux nodes have more than one security group attached to them (for example, if the Linux node group was created with `eksctl`), specify all of them here.
- **Subnets:** Choose the subnets that you created in [Create your Amazon EKS cluster VPC \(p. 19\)](#). If you created your VPC using the steps described at [Creating a VPC for your Amazon EKS cluster \(p. 166\)](#), then specify only the private subnets within the VPC for your nodes to launch into.

### Important

If any of the subnets are public subnets, then they must have the automatic public IP address assignment setting enabled. If the setting is not enabled for the public subnet, then any nodes that you deploy to that public subnet will not be assigned a public IP address and will not be able to communicate with the cluster or other AWS services. If the subnet was deployed before 03/26/2020 using either of the [Amazon EKS AWS CloudFormation VPC templates \(p. 166\)](#), or by using `eksctl`, then automatic public IP address assignment is disabled for public subnets. For information about how to enable public IP address assignment for a subnet, see [Modifying the Public IPv4 Addressing Attribute for Your Subnet](#). If the node is deployed to a private subnet, then it is able to communicate with the cluster and other AWS services through a NAT gateway.

6. Acknowledge that the stack might create IAM resources, and then choose **Create stack**.
7. When your stack has finished creating, select it in the console and choose **Outputs**.
8. Record the **NodeInstanceRole** for the node group that was created. You need this when you configure your Amazon EKS Windows nodes.

## To enable nodes to join your cluster

1. Download, edit, and apply the AWS IAM Authenticator configuration map.
  - a. Use the following command to download the configuration map:

```
curl -o aws-auth-cm-windows.yaml https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/aws-auth-cm-windows.yaml
```

- b. Open the file with your favorite text editor. Replace the *<ARN of instance role (not instance profile) of \*\*Linux\*\* node>* and *<ARN of instance role (not instance profile) of \*\*Windows\*\* node>* snippets with the **NodeInstanceRole** values that you recorded for your Linux and Windows nodes, and save the file.

### Important

Do not modify any other lines in this file.

```
apiVersion: v1
kind: ConfigMap
```

```
metadata:
  name: aws-auth
  namespace: kube-system
data:
  mapRoles: |
    - rolearn: <ARN of instance role (not instance profile) of **Linux** node>
      username: system:node:{{EC2PrivateDNSName}}
      groups:
        - system:bootstrappers
        - system:nodes
    - rolearn: <ARN of instance role (not instance profile) of **Windows**
node>
      username: system:node:{{EC2PrivateDNSName}}
      groups:
        - system:bootstrappers
        - system:nodes
        - eks:kube-proxy-windows
```

- c. Apply the configuration. This command may take a few minutes to finish.

```
kubectl apply -f aws-auth-cm-windows.yaml
```

#### Note

If you receive any authorization or resource type errors, see [Unauthorized or access denied \(kubectl\)](#) (p. 314) in the troubleshooting section.

#### Note

- If specifying an Arm node type, then review the considerations in [the section called “Arm”](#) (p. 136) before deploying.
- If nodes fail to join the cluster, see [??? \(p. 313\)](#) in the Troubleshooting guide.
- For more information on the available options for `eksctl` commands, enter the following command.

```
eksctl command -help
```

2. Watch the status of your nodes and wait for them to reach the Ready status.

```
kubectl get nodes --watch
```

3. (Optional) [Deploy a Windows sample application](#) (p. 75) – Deploy a sample application to test your cluster and Windows nodes.

## Self-managed node updates

When a new Amazon EKS optimized AMI is released, you should consider replacing the nodes in your self-managed node group with the new AMI. Likewise, if you have updated the Kubernetes version for your Amazon EKS cluster, you should also update the nodes to use nodes with the same Kubernetes version.

#### Important

This topic covers node updates for self-managed nodes. If you are using [Managed node groups](#) (p. 88), see [Updating a managed node group](#) (p. 93).

There are two basic ways to update self-managed node groups in your clusters to use a new AMI:

- [the section called “Migrating to a new node group”](#) (p. 111) – Create a new node group and migrate your pods to that group. Migrating to a new node group is more graceful than simply updating the AMI

ID in an existing AWS CloudFormation stack, because the migration process taints the old node group as `NoSchedule` and drains the nodes after a new stack is ready to accept the existing pod workload.

- the section called “Updating an existing self-managed node group” (p. 115) – Update the AWS CloudFormation stack for an existing node group to use the new AMI. This method is not supported for node groups that were created with `eksctl`.

## Migrating to a new node group

This topic helps you to create a new node group, gracefully migrate your existing applications to the new group, and then remove the old node group from your cluster.

`eksctl`

### To migrate your applications to a new node group with `eksctl`

This procedure requires `eksctl` version `0.26.0-rc.1` or later. You can check your version with the following command:

```
eksctl version
```

For more information on installing or upgrading `eksctl`, see [Installing or upgrading eksctl](#) (p. 234).

#### Note

This procedure only works for clusters and node groups that were created with `eksctl`.

1. Retrieve the name of your existing node groups, substituting `default` with your cluster name.

```
eksctl get nodegroups --cluster=default
```

Output:

CLUSTER	NODEGROUP	CREATED	MIN SIZE	MAX SIZE
DESIRED CAPACITY	INSTANCE TYPE	IMAGE ID		
default	standard-nodes	2019-05-01T22:26:58Z	1	4
	t3.medium	ami-05a71d034119ffc12		3

2. Launch a new node group with `eksctl` with the following command, substituting the `example` values with your own values.

#### Note

For more available flags and their descriptions, see <https://eksctl.io/>.

```
eksctl create nodegroup \  
--cluster default \  
--version 1.17 \  
--name standard-nodes-new \  
--node-type t3.medium \  
--nodes 3 \  
--nodes-min 1 \  
--nodes-max 4 \  
--node-ami auto
```

3. When the previous command completes, verify that all of your nodes have reached the Ready state with the following command:

```
kubectl get nodes
```

4. Delete the original node group with the following command, substituting the *example* values with your cluster and nodegroup names:

```
eksctl delete nodegroup --cluster default --name standard-nodes
```

## AWS Management Console

### To migrate your applications to a new node group with the AWS Management Console

1. Launch a new node group by following the steps outlined in [Launching self-managed Amazon Linux nodes \(p. 102\)](#).
2. When your stack has finished creating, select it in the console and choose **Outputs**.
3. Record the **NodeInstanceRole** for the node group that was created. You need this to add the new Amazon EKS nodes to your cluster.

#### Note

If you have attached any additional IAM policies to your old node group IAM role, such as adding permissions for the Kubernetes [Cluster Autoscaler](#), you should attach those same policies to your new node group IAM role to maintain that functionality on the new group.

4. Update the security groups for both node groups so that they can communicate with each other. For more information, see [Amazon EKS security group considerations \(p. 173\)](#).
  - a. Record the security group IDs for both node groups. This is shown as the **NodeSecurityGroup** value in the AWS CloudFormation stack outputs.

You can use the following AWS CLI commands to get the security group IDs from the stack names. In these commands, `oldNodes` is the AWS CloudFormation stack name for your older node stack, and `newNodes` is the name of the stack that you are migrating to.

```
oldNodes="<old_node_CFN_stack_name>"
newNodes="<new_node_CFN_stack_name>"

oldSecGroup=$(aws cloudformation describe-stack-resources --stack-name
  $oldNodes \
  --query 'StackResources[?
    ResourceType==`AWS::EC2::SecurityGroup`.PhysicalResourceId' \
  --output text)
newSecGroup=$(aws cloudformation describe-stack-resources --stack-name
  $newNodes \
  --query 'StackResources[?
    ResourceType==`AWS::EC2::SecurityGroup`.PhysicalResourceId' \
  --output text)
```

- b. Add ingress rules to each node security group so that they accept traffic from each other.

The following AWS CLI commands add ingress rules to each security group that allow all traffic on all protocols from the other security group. This configuration allows pods in each node group to communicate with each other while you are migrating your workload to the new group.

```
aws ec2 authorize-security-group-ingress --group-id $oldSecGroup \
  --source-group $newSecGroup --protocol -1
aws ec2 authorize-security-group-ingress --group-id $newSecGroup \
  --source-group $oldSecGroup --protocol -1
```

5. Edit the `aws-auth` configmap to map the new node instance role in RBAC.



```
kubectl edit configmap -n kube-system aws-auth
```

Add a new mapRoles entry for the new node group.

```
apiVersion: v1
data:
  mapRoles: |
    - rolearn: <ARN of instance role (not instance profile)>
      username: system:node:{{EC2PrivateDNSName}}
      groups:
        - system:bootstrappers
        - system:nodes
    - rolearn: arn:aws:iam::111122223333:role/nodes-1-16-NodeInstanceRole-
      U11V27W93CX5
      username: system:node:{{EC2PrivateDNSName}}
      groups:
        - system:bootstrappers
        - system:nodes
```

Replace the *<ARN of instance role (not instance profile)>* snippet with the **NodeInstanceRole** value that you recorded in [Step 3 \(p. 112\)](#), then save and close the file to apply the updated configmap.

6. Watch the status of your nodes and wait for your new nodes to join your cluster and reach the Ready status.

```
kubectl get nodes --watch
```

7. (Optional) If you are using the Kubernetes [Cluster Autoscaler](#), scale the deployment down to 0 replicas to avoid conflicting scaling actions.

```
kubectl scale deployments/cluster-autoscaler --replicas=0 -n kube-system
```

8. Use the following command to taint each of the nodes that you want to remove with `NoSchedule` so that new pods are not scheduled or rescheduled on the nodes you are replacing:

```
kubectl taint nodes node_name key=value:NoSchedule
```

If you are upgrading your nodes to a new Kubernetes version, you can identify and taint all of the nodes of a particular Kubernetes version (in this case, 1.15) with the following code snippet.

```
K8S_VERSION=1.15
nodes=$(kubectl get nodes -o jsonpath="{.items[?(@.status.nodeInfo.kubeletVersion==\
'v${K8S_VERSION}\')].metadata.name}")
for node in ${nodes[@]}
do
  echo "Tainting $node"
  kubectl taint nodes $node key=value:NoSchedule
done
```

9. Determine your cluster's DNS provider.

```
kubectl get deployments -l k8s-app=kube-dns -n kube-system
```

Output (this cluster is using `kube-dns` for DNS resolution, but your cluster may return `coredns` instead):

NAME	DESIRED	CURRENT	UP-TO-DATE	AVAILABLE	AGE
<code>kube-dns</code>	1	1	1	1	31m

10. If your current deployment is running fewer than two replicas, scale out the deployment to two replicas. Substitute `coredns` for `kube-dns` if your previous command output returned that instead.

```
kubectl scale deployments/kube-dns --replicas=2 -n kube-system
```

11. Drain each of the nodes that you want to remove from your cluster with the following command:

```
kubectl drain node_name --ignore-daemonsets --delete-local-data
```

If you are upgrading your nodes to a new Kubernetes version, you can identify and drain all of the nodes of a particular Kubernetes version (in this case, 1.15) with the following code snippet.

```
K8S_VERSION=1.15
nodes=$(kubectl get nodes -o jsonpath="{.items[?(@.status.nodeInfo.kubeletVersion==\v$K8S_VERSION\)].metadata.name}")
for node in ${nodes[@]}
do
    echo "Draining $node"
    kubectl drain $node --ignore-daemonsets --delete-local-data
done
```

12. After your old nodes have finished draining, revoke the security group ingress rules you authorized earlier, and then delete the AWS CloudFormation stack to terminate the instances.

#### Note

If you have attached any additional IAM policies to your old node group IAM role, such as adding permissions for the Kubernetes [Cluster Autoscaler](#), you must detach those additional policies from the role before you can delete your AWS CloudFormation stack.

- a. Revoke the ingress rules that you created for your node security groups earlier. In these commands, `oldNodes` is the AWS CloudFormation stack name for your older node stack, and `newNodes` is the name of the stack that you are migrating to.

```
oldNodes="<old_node_CFN_stack_name>"
newNodes="<new_node_CFN_stack_name>"

oldSecGroup=$(aws cloudformation describe-stack-resources --stack-name
  $oldNodes \
  --query 'StackResources[?
    ResourceType==`AWS::EC2::SecurityGroup`.PhysicalResourceId' \
  --output text)
newSecGroup=$(aws cloudformation describe-stack-resources --stack-name
  $newNodes \
  --query 'StackResources[?
    ResourceType==`AWS::EC2::SecurityGroup`.PhysicalResourceId' \
  --output text)
aws ec2 revoke-security-group-ingress --group-id $oldSecGroup \
  --source-group $newSecGroup --protocol -1
aws ec2 revoke-security-group-ingress --group-id $newSecGroup \
  --source-group $oldSecGroup --protocol -1
```

- b. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
- c. Select your old node stack.

- d. Choose **Actions**, then **Delete stack**.
13. Edit the `aws-auth` configmap to remove the old node instance role from RBAC.

```
kubectl edit configmap -n kube-system aws-auth
```

Delete the `mapRoles` entry for the old node group.

```
apiVersion: v1
data:
  mapRoles: |
    - rolearn: arn:aws:iam::111122223333:role/nodes-1-16-NodeInstanceRole-
      W70725MZQFF8
      username: system:node:{{EC2PrivateDNSName}}
      groups:
        - system:bootstrappers
        - system:nodes
    - rolearn: arn:aws:iam::111122223333:role/nodes-1-15-NodeInstanceRole-
      U11V27W93CX5
      username: system:node:{{EC2PrivateDNSName}}
      groups:
        - system:bootstrappers
        - system:nodes
```

Save and close the file to apply the updated configmap.

14. (Optional) If you are using the Kubernetes [Cluster Autoscaler](#), scale the deployment back to one replica.

**Note**

You must also tag your new Auto Scaling group appropriately (for example, `k8s.io/cluster-autoscaler/enabled,k8s.io/cluster-autoscaler/<YOUR CLUSTER NAME>`) and update your Cluster Autoscaler deployment's command to point to the newly tagged Auto Scaling group. For more information, see [Cluster Autoscaler on AWS](#).

```
kubectl scale deployments/cluster-autoscaler --replicas=1 -n kube-system
```

15. (Optional) Verify that you are using the latest version of the [Amazon VPC CNI plugin for Kubernetes](#). You may need to update your CNI version to take advantage of the latest supported instance types. For more information, see [Amazon VPC CNI plugin for Kubernetes upgrades \(p. 190\)](#).
16. If your cluster is using `kube-dns` for DNS resolution (see step [Step 9 \(p. 113\)](#)), scale in the `kube-dns` deployment to one replica.

```
kubectl scale deployments/kube-dns --replicas=1 -n kube-system
```

## Updating an existing self-managed node group

This topic helps you to update an existing AWS CloudFormation self-managed node stack with a new AMI. You can use this procedure to update your nodes to a new version of Kubernetes following a cluster update, or you can update to the latest Amazon EKS optimized AMI for an existing Kubernetes version.

**Important**

This topic covers node updates for self-managed nodes. If you are using [Managed node groups \(p. 88\)](#), see [Updating a managed node group \(p. 93\)](#).

The latest default Amazon EKS node AWS CloudFormation template is configured to launch an instance with the new AMI into your cluster before removing an old one, one at a time. This configuration ensures that you always have your Auto Scaling group's desired count of active instances in your cluster during the rolling update.

**Note**

This method is not supported for node groups that were created with `eksctl`. If you created your cluster or node group with `eksctl`, see [Migrating to a new node group \(p. 111\)](#).

**To update an existing node group**

1. Determine your cluster's DNS provider.

```
kubectl get deployments -l k8s-app=kube-dns -n kube-system
```

Output (this cluster is using `kube-dns` for DNS resolution, but your cluster may return `coredns` instead):

NAME	DESIRED	CURRENT	UP-TO-DATE	AVAILABLE	AGE
<code>kube-dns</code>	1	1	1	1	31m

2. If your current deployment is running fewer than two replicas, scale out the deployment to two replicas. Substitute `coredns` for `kube-dns` if your previous command output returned that instead.

```
kubectl scale deployments/kube-dns --replicas=2 -n kube-system
```

3. (Optional) If you are using the Kubernetes [Cluster Autoscaler](#), scale the deployment down to zero replicas to avoid conflicting scaling actions.

```
kubectl scale deployments/cluster-autoscaler --replicas=0 -n kube-system
```

4. Determine the instance type and desired instance count of your current node group. You will enter these values later when you update the AWS CloudFormation template for the group.
  - a. Open the Amazon EC2 console at <https://console.aws.amazon.com/ec2/>.
  - b. Choose **Launch Configurations** in the left navigation, and note the instance type for your existing node launch configuration.
  - c. Choose **Auto Scaling Groups** in the left navigation and note the **Desired** instance count for your existing node Auto Scaling group.
5. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
6. Select your node group stack, and then choose **Update**.
7. Select **Replace current template** and select **Amazon S3 URL**.
8. For **Amazon S3 URL**, paste the following URL into the text area to ensure that you are using the latest version of the node AWS CloudFormation template, and then choose **Next**:

```
https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/amazon-eks-nodegroup.yaml
```

9. On the **Specify stack details** page, fill out the following parameters, and choose **Next**:
  - **NodeAutoScalingGroupDesiredCapacity** – Enter the desired instance count that you recorded in [Step 4 \(p. 116\)](#), or enter a new desired number of nodes to scale to when your stack is updated.
  - **NodeAutoScalingGroupMaxSize** – Enter the maximum number of nodes to which your node Auto Scaling group can scale out. **This value must be at least one node greater than your desired capacity so that you can perform a rolling update of your nodes without reducing your node count during the update.**

- **NodeInstanceType** – Choose the instance type you recorded in [Step 4 \(p. 116\)](#), or choose a different instance type for your nodes. Each Amazon EC2 instance type supports a maximum number of elastic network interfaces (ENIs) and each ENI supports a maximum number of IP addresses. Since each worker node and pod is assigned its own IP address it's important to choose an instance type that will support the maximum number of pods that you want to run on each worker node. For a list of the number of ENIs and IP addresses supported by instance types, see [IP addresses per network interface per instance type](#). For example, the `t3.medium` instance type supports a maximum of 18 IP addresses for the worker node and pods. Some instance types might not be available in all Regions.

**Note**

The supported instance types for the latest version of the [Amazon VPC CNI plugin for Kubernetes](#) are shown [here](#). You may need to update your CNI version to take advantage of the latest supported instance types. For more information, see [Amazon VPC CNI plugin for Kubernetes upgrades \(p. 190\)](#).

**Important**

Some instance types might not be available in all Regions.

- **NodeImageIdSSMParam** – The Amazon EC2 Systems Manager parameter of the AMI ID that you want to update to. The following value uses the latest Amazon EKS optimized AMI for Kubernetes version 1.17.

```
/aws/service/eks/optimized-ami/1.17/amazon-linux-2/recommended/image_id
```

You can change the `1.17` value to any [supported Kubernetes version \(p. 64\)](#). If you want to use the Amazon EKS optimized accelerated AMI, then change `amazon-linux-2` to `amazon-linux-2-gpu`.

**Note**

Using the Amazon EC2 Systems Manager parameter enables you to update your nodes in the future without having to lookup and specify an AMI ID. If your AWS CloudFormation stack is using this value, any stack update will always launch the latest recommended Amazon EKS optimized AMI for your specified Kubernetes version, even if you don't change any values in the template.

- **NodeImageId** – To use your own custom AMI, enter the ID for the AMI to use.

**Important**

This value overrides any value specified for **NodeImageIdSSMParam**. If you want to use the **NodeImageIdSSMParam** value, ensure that the value for **NodeImageId** is blank.

10. (Optional) On the **Options** page, tag your stack resources. Choose **Next**.
11. On the **Review** page, review your information, acknowledge that the stack might create IAM resources, and then choose **Update stack**.

**Note**

The update of each node in the cluster takes several minutes. Wait for the update of all nodes to complete before performing the next steps.

12. If your cluster's DNS provider is `kube-dns`, scale in the `kube-dns` deployment to one replica.

```
kubectl scale deployments/kube-dns --replicas=1 -n kube-system
```

13. (Optional) If you are using the Kubernetes [Cluster Autoscaler](#), scale the deployment back to your desired amount of replicas.

```
kubectl scale deployments/cluster-autoscaler --replicas=1 -n kube-system
```

14. (Optional) Verify that you are using the latest version of the [Amazon VPC CNI plugin for Kubernetes](#). You may need to update your CNI version to take advantage of the latest supported instance types. For more information, see [Amazon VPC CNI plugin for Kubernetes upgrades \(p. 190\)](#).

## AWS Fargate

This topic discusses using Amazon EKS to run Kubernetes pods on AWS Fargate.

AWS Fargate is a technology that provides on-demand, right-sized compute capacity for [containers](#). With AWS Fargate, you no longer have to provision, configure, or scale groups of virtual machines to run containers. This removes the need to choose server types, decide when to scale your node groups, or optimize cluster packing.

You can control which pods start on Fargate and how they run with [Fargate profiles \(p. 123\)](#), which are defined as part of your Amazon EKS cluster.

Amazon EKS integrates Kubernetes with AWS Fargate by using controllers that are built by AWS using the upstream, extensible model provided by Kubernetes. These controllers run as part of the Amazon EKS managed Kubernetes control plane and are responsible for scheduling native Kubernetes pods onto Fargate. The Fargate controllers include a new scheduler that runs alongside the default Kubernetes scheduler in addition to several mutating and validating admission controllers. When you start a pod that meets the criteria for running on Fargate, the Fargate controllers running in the cluster recognize, update, and schedule the pod onto Fargate.

Each pod running on Fargate has its own isolation boundary and does not share the underlying kernel, CPU resources, memory resources, or elastic network interface with another pod.

This topic describes the different components of pods running on Fargate, and calls out special considerations for using Fargate with Amazon EKS.

AWS Fargate with Amazon EKS is currently only available in the following Regions:

Region name	Region
US East (Ohio)	us-east-2
US East (N. Virginia)	us-east-1
US West (Oregon)	us-west-2
Asia Pacific (Singapore)	ap-southeast-1
Asia Pacific (Sydney)	ap-southeast-2
Asia Pacific (Tokyo)	ap-northeast-1 (apne1-az1, apne1-az2, & apne1-az4 only)
Europe (Frankfurt)	eu-central-1
Europe (Ireland)	eu-west-1

## AWS Fargate considerations

Here's some things to consider about using Fargate on Amazon EKS.

- Classic Load Balancers and Network Load Balancers are not supported on pods running on Fargate. For ingress, we recommend that you use the [ALB Ingress Controller on Amazon EKS \(p. 212\)](#) (minimum version v1.1.4).
- Pods must match a Fargate profile at the time that they are scheduled in order to run on Fargate. Pods which do not match a Fargate profile may be stuck as `Pending`. If a matching Fargate profile exists, you can delete pending pods that you have created to reschedule them onto Fargate.
- Daemonsets are not supported on Fargate. If your application requires a daemon, you should reconfigure that daemon to run as a sidecar container in your pods.
- Privileged containers are not supported on Fargate.
- Pods running on Fargate cannot specify `HostPort` or `HostNetwork` in the pod manifest.
- GPUs are currently not available on Fargate.
- Pods running on Fargate are only supported on private subnets (with NAT gateway access to AWS services, but not a direct route to an Internet Gateway), so your cluster's VPC must have private subnets available. For clusters without outbound internet access, see [??? \(p. 82\)](#).
- You can use the [Vertical Pod Autoscaler \(p. 204\)](#) to initially right size the CPU and memory for your Fargate pods, and then use the [the section called "Horizontal Pod Autoscaler" \(p. 208\)](#) to scale those pods. If you want the Vertical Pod Autoscaler to automatically re-deploy pods to Fargate with larger CPU and memory combinations, then set the Vertical Pod Autoscaler's mode to either `Auto` or `Recreate` to ensure correct functionality. For more information, see the [Vertical Pod Autoscaler documentation on GitHub](#).
- DNS resolution and DNS hostnames must be enabled for your VPC. For more information, see [Viewing and updating DNS support for your VPC](#).
- Fargate runs each pod in a VM-isolated environment without sharing resources with other pods. However, because Kubernetes is a single-tenant orchestrator, Fargate cannot guarantee pod-level security isolation. You should run sensitive workloads or untrusted workloads that need complete security isolation using separate Amazon EKS clusters.
- Fargate profiles support specifying subnets from VPC secondary CIDR blocks. You may want to specify a secondary CIDR block because there are a limited number of IP addresses available in a subnet. As a result, there are a limited number of pods that can be created in the cluster. Using different subnets for pods allows you to increase the number of available IP addresses. For more information, see [Adding IPv4 CIDR blocks to a VPC](#).

## Getting started with AWS Fargate using Amazon EKS

This topic helps you to get started running pods on AWS Fargate with your Amazon EKS cluster.

### Note

AWS Fargate with Amazon EKS is currently only available in the following Regions:

Region name	Region
US East (Ohio)	us-east-2
US East (N. Virginia)	us-east-1
US West (Oregon)	us-west-2
Asia Pacific (Singapore)	ap-southeast-1
Asia Pacific (Sydney)	ap-southeast-2
Asia Pacific (Tokyo)	ap-northeast-1 (apne1-az1, apne1-az2, & apne1-az4 only)

Region name	Region
Europe (Frankfurt)	eu-central-1
Europe (Ireland)	eu-west-1

If you restrict access to your cluster's public endpoint using CIDR blocks, it is recommended that you also enable private endpoint access so that Fargate pods can communicate with the cluster. Without the private endpoint enabled, the CIDR blocks that you specify for public access must include the egress sources from your VPC. For more information, see [Amazon EKS cluster endpoint access control \(p. 49\)](#).

## (Optional) Create a cluster

Pods running on Fargate are supported on Amazon EKS clusters beginning with Kubernetes version 1.14 and [platform version \(p. 64\)](#) `eks . 5`. Existing clusters can update to version 1.14 or later to take advantage of this feature. For more information, see [Updating an Amazon EKS cluster Kubernetes version \(p. 36\)](#).

If you do not already have an Amazon EKS cluster that supports Fargate, you can create one with the following `eksctl` command.

### Note

This procedure requires `eksctl` version `0.26.0-rc.1` or later. You can check your version with the following command:

```
eksctl version
```

For more information on installing or upgrading `eksctl`, see [Installing or upgrading eksctl \(p. 234\)](#).

```
eksctl create cluster --name my-cluster --version 1.17 --fargate
```

Adding the `--fargate` option in the command above creates a cluster without a node group. However, `eksctl` creates a pod execution role, a Fargate profile for the `default` and `kube-system` namespaces, and it patches the `coredns` deployment so that it can run on Fargate.

## Ensure that existing nodes can communicate with Fargate pods

If you are working with a new cluster with no nodes, or a cluster with only [managed node groups \(p. 88\)](#), you can skip to [Create a Fargate pod execution role \(p. 121\)](#).

If you are working with an existing cluster that already has nodes associated with it, you need to make sure that pods on these nodes can communicate freely with pods running on Fargate. Pods running on Fargate are automatically configured to use the cluster security group for the cluster that they are associated with. You must ensure that any existing nodes in your cluster can send and receive traffic to and from the cluster security group. [Managed node groups \(p. 88\)](#) are automatically configured to use the cluster security group as well, so you do not need to modify or check them for this compatibility.

For existing node groups that were created with `eksctl` or the Amazon EKS managed AWS CloudFormation templates, you can add the cluster security group to the nodes manually, or you can modify the node group's Auto Scaling group launch template to attach the cluster security group to the instances. For more information, see [Changing an instance's security groups](#) in the *Amazon VPC User Guide*.

You can check for a cluster security group for your cluster in the AWS Management Console under the cluster's **Networking** section, or with the following AWS CLI command:



```
aws eks describe-cluster --name cluster_name --query  
cluster.resourcesVpcConfig.clusterSecurityGroupId
```

## Create a Fargate pod execution role

When your cluster creates pods on AWS Fargate, the pods need to make calls to AWS APIs on your behalf to do things like pull container images from Amazon ECR. The Amazon EKS pod execution role provides the IAM permissions to do this.

### Note

If you created your cluster with `eksctl` using the `--fargate` option, then your cluster already has a pod execution role and you can skip ahead to [Create a Fargate profile for your cluster \(p. 121\)](#). Similarly, if you use `eksctl` to create your Fargate profiles, `eksctl` will create your pod execution role if one does not already exist.

When you create a Fargate profile, you must specify a pod execution role to use with your pods. This role is added to the cluster's Kubernetes [Role based access control \(RBAC\)](#) for authorization. This allows the `kubelet` that is running on the Fargate infrastructure to register with your Amazon EKS cluster so that it can appear in your cluster as a node. For more information, see [Pod execution role \(p. 267\)](#).

### To create an AWS Fargate pod execution role with the AWS Management Console

1. Open the IAM console at <https://console.aws.amazon.com/iam/>.
2. Choose **Roles**, then **Create role**.
3. Choose **EKS** from the list of services, **EKS - Fargate pod** for your use case, and then **Next: Permissions**.
4. Choose **Next: Tags**.
5. (Optional) Add metadata to the role by attaching tags as key-value pairs. For more information about using tags in IAM, see [Tagging IAM Entities](#) in the *IAM User Guide*.
6. Choose **Next: Review**.
7. For **Role name**, enter a unique name for your role, such as `AmazonEKSFargatePodExecutionRole`, then choose **Create role**.

## Create a Fargate profile for your cluster

Before you can schedule pods running on Fargate in your cluster, you must define a Fargate profile that specifies which pods should use Fargate when they are launched. For more information, see [AWS Fargate profile \(p. 123\)](#).

### Note

If you created your cluster with `eksctl` using the `--fargate` option, then a Fargate profile has already been created for your cluster with selectors for all pods in the `kube-system` and default namespaces. Use the following procedure to create Fargate profiles for any other namespaces you would like to use with Fargate.

Choose the tab below that corresponds to your preferred Fargate profile creation method.

`eksctl`

### To create a Fargate profile for a cluster with `eksctl`

This procedure requires `eksctl` version `0.26.0-rc.1` or later. You can check your version with the following command:

```
eksctl version
```

For more information on installing or upgrading `eksctl`, see [Installing or upgrading eksctl](#) (p. 234).

- Create your Fargate profile with the following `eksctl` command, replacing the *variable text* with your own values. You must specify a namespace, but the labels option is not required.

```
eksctl create fargateprofile --cluster cluster_name --name fargate_profile_name --  
namespace kubernetes_namespace --labels key=value
```

## AWS Management Console

### To create a Fargate profile for a cluster with the AWS Management Console

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose the cluster to create a Fargate profile for.
3. Under **Fargate profiles**, choose **Add Fargate profile**.
4. On the **Configure Fargate profile** page, enter the following information and choose **Next**.
  - a. For **Name**, enter a unique name for your Fargate profile.
  - b. For **Pod execution role**, choose the pod execution role to use with your Fargate profile. Only IAM roles with the `eks-fargate-pods.amazonaws.com` service principal are shown. If you do not see any roles listed here, you must create one. For more information, see [Pod execution role](#) (p. 267).
  - c. For **Subnets**, choose the subnets to use for your pods. By default, all subnets in your cluster's VPC are selected. Only private subnets are supported for pods running on Fargate; you must deselect any public subnets.
  - d. For **Tags**, you can optionally tag your Fargate profile. These tags do not propagate to other resources associated with the profile, such as its pods.
5. On the **Configure pods selection** page, enter the following information and choose **Next**.
  - a. For **Namespace**, enter a namespace to match for pods, such as `kube-system` or `default`.
  - b. (Optional) Add Kubernetes labels to the selector that pods in the specified namespace must have to match the selector. For example, you could add the label `infrastructure: fargate` to the selector so that only pods in the specified namespace that also have the `infrastructure: fargate` Kubernetes label match the selector.
6. On the **Review and create** page, review the information for your Fargate profile and choose **Create**.

## (Optional) Update CoreDNS

By default, CoreDNS is configured to run on Amazon EC2 infrastructure on Amazon EKS clusters. If you want to *only* run your pods on Fargate in your cluster, you need to modify the CoreDNS deployment to remove the `eks.amazonaws.com/compute-type : ec2` annotation. You would also need to create a Fargate profile to target the CoreDNS pods. The following Fargate profile JSON file does this.

### Note

If you created your cluster with `eksctl` using the `--fargate` option, then `coredns` has already been patched to run on Fargate and you can skip ahead to [Next steps](#) (p. 123).

```
{  
  "fargateProfileName": "coredns",  
  "clusterName": "dev",  
  "podExecutionRoleArn": "arn:aws:iam::111122223333:role/  
AmazonEKSFargatePodExecutionRole",  
}
```

```
"subnets": [
  "subnet-0b64dd020cdf3864",
  "subnet-00b03756df55e2b87",
  "subnet-0418fcb68ed294abf"
],
"selectors": [
  {
    "namespace": "kube-system",
    "labels": {
      "k8s-app": "kube-dns"
    }
  }
]
}
```

You could apply this Fargate profile to your cluster with the following AWS CLI command. First, create a file called `coredns.json` and paste the JSON file from the previous step into it, replacing the *variable text* with your own cluster values.

```
aws eks create-fargate-profile --cli-input-json file://coredns.json
```

Then, use the following `kubectl` command to remove the `eks.amazonaws.com/compute-type` : `ec2` annotation from the CoreDNS pods.

```
kubectl patch deployment coredns -n kube-system --type json \
-p='[{"op": "remove", "path": "/spec/template/metadata/annotations/
eks.amazonaws.com-1compute-type"}]'
```

## Next steps

- You can start migrating your existing applications to run on Fargate with the following workflow.
  - Create a [Fargate profile](#) (p. 125) that matches your application's Kubernetes namespace and Kubernetes labels.
  - Delete and re-create any existing pods so that they are scheduled on Fargate. For example, the following command triggers a rollout of the `coredns` Deployment. You can modify the namespace and deployment type to update your specific pods.

```
kubectl rollout restart -n kube-system deployment coredns
```

- Deploy the [ALB Ingress Controller on Amazon EKS](#) (p. 212) (version v1.1.4 or later) to allow Ingress objects for your pods running on Fargate.
- You can use the [Vertical Pod Autoscaler](#) (p. 204) to initially right size the CPU and memory for your Fargate pods, and then use the [the section called "Horizontal Pod Autoscaler"](#) (p. 208) to scale those pods. If you want the Vertical Pod Autoscaler to automatically re-deploy pods to Fargate with larger CPU and memory combinations, then set the Vertical Pod Autoscaler's mode to either `Auto` or `Recreate` to ensure correct functionality. For more information, see the [Vertical Pod Autoscaler](#) documentation on GitHub.

## AWS Fargate profile

Before you can schedule pods on Fargate in your cluster, you must define at least one Fargate profile that specifies which pods should use Fargate when they are launched.

The Fargate profile allows an administrator to declare which pods run on Fargate. This declaration is done through the profile's selectors. Each profile can have up to five selectors that contain a namespace and optional labels. You must define a namespace for every selector. The label field consists of multiple

optional key-value pairs. Pods that match a selector (by matching a namespace for the selector and all of the labels specified in the selector) are scheduled on Fargate. If a namespace selector is defined without any labels, Amazon EKS will attempt to schedule all pods that run in that namespace onto Fargate using the profile. If a to-be-scheduled pod matches any of the selectors in the Fargate profile, then that pod is scheduled on Fargate.

If a pod matches multiple Fargate profiles, Amazon EKS picks one of the matches at random. In this case, you can specify which profile a pod should use by adding the following Kubernetes label to the pod specification: `eks.amazonaws.com/fargate-profile: profile_name`. However, the pod must still match a selector in that profile in order to be scheduled onto Fargate.

When you create a Fargate profile, you must specify a pod execution role for the pods that run on Fargate using the profile. This role is added to the cluster's Kubernetes [Role Based Access Control](#) (RBAC) for authorization so that the `kubelet` that is running on the Fargate infrastructure can register with your Amazon EKS cluster and appear in your cluster as a node. The pod execution role also provides IAM permissions to the Fargate infrastructure to allow read access to Amazon ECR image repositories. For more information, see [Pod execution role](#) (p. 267).

Fargate profiles are immutable. However, you can create a new updated profile to replace an existing profile and then delete the original after the updated profile has finished creating.

**Note**

Any pods that are running using a Fargate profile will be stopped and put into pending when the profile is deleted.

If any Fargate profiles in a cluster are in the `DELETING` status, you must wait for that Fargate profile to finish deleting before you can create any other profiles in that cluster.

## Fargate profile components

The following components are contained in a Fargate profile.

```
{
  "fargateProfileName": "",
  "clusterName": "",
  "podExecutionRoleArn": "",
  "subnets": [
    ""
  ],
  "selectors": [
    {
      "namespace": "",
      "labels": {
        "KeyName": ""
      }
    }
  ],
  "clientRequestToken": "",
  "tags": {
    "KeyName": ""
  }
}
```

### Pod execution role

When your cluster creates pods on AWS Fargate, the pod needs to make calls to AWS APIs on your behalf, for example, to pull container images from Amazon ECR. The Amazon EKS pod execution role provides the IAM permissions to do this.

When you create a Fargate profile, you must specify a pod execution role to use with your pods. This role is added to the cluster's Kubernetes [Role Based Access Control](#) (RBAC) for authorization, so that

the `kubelet` that is running on the Fargate infrastructure can register with your Amazon EKS cluster and appear in your cluster as a node. For more information, see [Pod execution role \(p. 267\)](#).

### Subnets

The IDs of subnets to launch pods into that use this profile. At this time, pods running on Fargate are not assigned public IP addresses, so only private subnets (with no direct route to an Internet Gateway) are accepted for this parameter.

### Selectors

The selectors to match for pods to use this Fargate profile. Each selector must have an associated namespace. Optionally, you can also specify labels for a namespace. You may specify up to five selectors in a Fargate profile. A pod only needs to match one selector to run using the Fargate profile.

#### Namespace

You must specify a namespace for a selector. The selector only matches pods that are created in this namespace, but you can create multiple selectors to target multiple namespaces.

#### Labels

You can optionally specify Kubernetes labels to match for the selector. The selector only matches pods that have all of the labels that are specified in the selector.

## Creating a Fargate profile

This topic helps you to create a Fargate profile. Your cluster must support Fargate (beginning with Kubernetes version 1.14 and [platform version \(p. 64\)](#) `eks . 5`). You also must have created a pod execution role to use for your Fargate profile. For more information, see [Pod execution role \(p. 267\)](#). Pods running on Fargate are only supported on private subnets (with [NAT gateway](#) access to AWS services, but not a direct route to an Internet Gateway), so your cluster's VPC must have private subnets available. Select the tab of the tool that you'd like to use to create the profile.

`eksctl`

### To create a Fargate profile for a cluster with `eksctl`

This procedure requires `eksctl` version `0.26.0-rc.1` or later. You can check your version with the following command:

```
eksctl version
```

For more information on installing or upgrading `eksctl`, see [Installing or upgrading eksctl \(p. 234\)](#).

- Create your Fargate profile with the following `eksctl` command, replacing the *variable text* with your own values. You must specify a namespace, but the labels option is not required.

```
eksctl create fargateprofile --cluster cluster_name --name fargate_profile_name --  
namespace kubernetes_namespace --labels key=value
```

AWS Management Console

### To create a Fargate profile for a cluster with the AWS Management Console

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.

2. Choose the cluster to create a Fargate profile for.
3. Under **Fargate profiles**, choose **Add Fargate profile**.
4. On the **Configure Fargate profile** page, enter the following information and choose **Next**.
  - a. For **Name**, enter a unique name for your Fargate profile.
  - b. For **Pod execution role**, choose the pod execution role to use with your Fargate profile. Only IAM roles with the `eks-fargate-pods.amazonaws.com` service principal are shown. If you do not see any roles listed here, you must create one. For more information, see [Pod execution role \(p. 267\)](#).
  - c. For **Subnets**, choose the subnets to use for your pods. By default, all subnets in your cluster's VPC are selected. Only private subnets are supported for pods running on Fargate; you must deselect any public subnets.
  - d. For **Tags**, you can optionally tag your Fargate profile. These tags do not propagate to other resources associated with the profile, such as its pods.
5. On the **Configure pods selection** page, enter the following information and choose **Next**.
  - a. For **Namespace**, enter a namespace to match for pods, such as `kube-system` or `default`.
  - b. (Optional) Add Kubernetes labels to the selector that pods in the specified namespace must have to match the selector. For example, you could add the label `infrastructure:fargate` to the selector so that only pods in the specified namespace that also have the `infrastructure:fargate` Kubernetes label match the selector.
6. On the **Review and create** page, review the information for your Fargate profile and choose **Create**.

## Deleting a Fargate profile

This topic helps you to delete a Fargate profile.

When you delete a Fargate profile, any pods that were scheduled onto Fargate with the profile are deleted. If those pods match another Fargate profile, then they are scheduled on Fargate with that profile. If they no longer match any Fargate profiles, then they are not scheduled onto Fargate and may remain as pending.

Only one Fargate profile in a cluster can be in the `DELETING` status at a time. You must wait for a Fargate profile to finish deleting before you can delete any other profiles in that cluster.

### To delete a Fargate profile from a cluster

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose the cluster that you want to delete the Fargate profile from.
3. Choose the Fargate profile to delete and then **Delete**.
4. On the **Delete *cluster\_name*** page, type the name of the cluster and choose **Confirm** to delete.

## Fargate pod configuration

This section describes some of the unique pod configuration details for running Kubernetes pods on AWS Fargate.

### Pod CPU and memory

Kubernetes allows you to define requests, a minimum amount of vCPU and memory resources that are allocated to each container in a pod. Pods are scheduled by Kubernetes to ensure that at least the

requested resources for each pod are available on the compute resource. For more information, see [Managing compute resources for containers](#) in the Kubernetes documentation.

When pods are scheduled on Fargate, the vCPU and memory reservations within the pod specification determine how much CPU and memory to provision for the pod.

- The maximum request out of any Init containers is used to determine the Init request vCPU and memory requirements.
- Requests for all long-running containers are added up to determine the long-running request vCPU and memory requirements.
- The larger of the above two values is chosen for the vCPU and memory request to use for your pod.
- Fargate adds 256 MB to each pod's memory reservation for the required Kubernetes components (kubelet, kube-proxy, and containerd).

Fargate rounds up to the compute configuration shown below that most closely matches the sum of vCPU and memory requests in order to ensure pods always have the resources that they need to run.

If you do not specify a vCPU and memory combination, then the smallest available combination is used (.25 vCPU and 0.5 GB memory).

The table below shows the vCPU and memory combinations that are available for pods running on Fargate.

vCPU value	Memory value
.25 vCPU	0.5 GB, 1 GB, 2 GB
.5 vCPU	1 GB, 2 GB, 3 GB, 4 GB
1 vCPU	2 GB, 3 GB, 4 GB, 5 GB, 6 GB, 7 GB, 8 GB
2 vCPU	Between 4 GB and 16 GB in 1-GB increments
4 vCPU	Between 8 GB and 30 GB in 1-GB increments

For pricing information on these compute configurations, see [AWS Fargate pricing](#).

## Fargate storage

When provisioned, each pod running on Fargate receives 20 GB of container image layer storage. Pod storage is ephemeral. After a pod stops, the storage is deleted. New pods launched onto Fargate on or after 5/28/2020, have encryption of the ephemeral storage volume enabled by default. The ephemeral pod storage is encrypted with an AES-256 encryption algorithm using AWS Fargate-managed keys.

### Note

The usable storage for Amazon EKS pods running on Fargate is less than 20GB because some space is used by the kubelet and other Kubernetes modules that are loaded inside the pod.

## AWS Fargate usage metrics

You can use CloudWatch usage metrics to provide visibility into your accounts usage of resources. Use these metrics to visualize your current service usage on CloudWatch graphs and dashboards.

AWS Fargate usage metrics correspond to AWS service quotas. You can configure alarms that alert you when your usage approaches a service quota. For more information about Fargate service quotas, see [Amazon EKS service quotas \(p. 247\)](#).

AWS Fargate publishes the following metrics in the `AWS/Usage` namespace.

Metric	Description
<code>ResourceCount</code>	The total number of the specified resource running on your account. The resource is defined by the dimensions associated with the metric.

The following dimensions are used to refine the usage metrics that are published by AWS Fargate.

Dimension	Description
<code>Service</code>	The name of the AWS service containing the resource. For AWS Fargate usage metrics, the value for this dimension is <code>Fargate</code> .
<code>Type</code>	The type of entity that is being reported. Currently, the only valid value for AWS Fargate usage metrics is <code>Resource</code> .
<code>Resource</code>	<p>The type of resource that is running.</p> <p>Currently, AWS Fargate returns information on your Fargate On-Demand usage. The resource value for Fargate On-Demand usage is <code>OnDemand</code>.</p> <p><b>Note</b> Fargate On-Demand usage combines Amazon EKS pods using Fargate, Amazon ECS tasks using the Fargate launch type and Amazon ECS tasks using the <code>FARGATE</code> capacity provider.</p>
<code>Class</code>	The class of resource being tracked. Currently, AWS Fargate does not use the class dimension.

## Creating a CloudWatch alarm to monitor Fargate resource usage metrics

AWS Fargate provides CloudWatch usage metrics that correspond to the AWS service quotas for Fargate On-Demand resource usage. In the Service Quotas console, you can visualize your usage on a graph and configure alarms that alert you when your usage approaches a service quota. For more information, see [AWS Fargate usage metrics \(p. 127\)](#).

Use the following steps to create a CloudWatch alarm based on the Fargate resource usage metrics.

### To create an alarm based on your Fargate usage quotas (AWS Management Console)

1. Open the Service Quotas console at <https://console.aws.amazon.com/servicequotas/>.
2. In the navigation pane, choose **AWS services**.
3. From the **AWS services** list, search for and select **AWS Fargate**.
4. In the **Service quotas** list, select the Fargate usage quota you want to create an alarm for.
5. In the Amazon CloudWatch Events alarms section, choose **Create**.
6. For **Alarm threshold**, choose the percentage of your applied quota value that you want to set as the alarm value.
7. For **Alarm name**, enter a name for the alarm and then choose **Create**.



# Amazon EKS optimized AMIs

You can deploy nodes with pre-built Amazon EKS optimized [Amazon Machine Images](#) (AMI), or your own custom AMIs. For more information about each type of Amazon EKS optimized AMI, see one of the following topics. For more information about creating your own custom AMI, see [the section called "Create a custom AMI" \(p. 141\)](#).

## Topics

- [Amazon EKS optimized Amazon Linux AMIs \(p. 129\)](#)
- [Amazon EKS optimized Ubuntu Linux AMIs \(p. 142\)](#)
- [Amazon EKS optimized Windows AMIs \(p. 142\)](#)

## Amazon EKS optimized Amazon Linux AMIs

The Amazon EKS optimized Amazon Linux AMI is built on top of Amazon Linux 2, and is configured to serve as the base image for Amazon EKS nodes. The AMI is configured to work with Amazon EKS and it includes Docker, kubelet, and the AWS IAM Authenticator.

### Note

- You can track security or privacy events for Amazon Linux 2 at the [Amazon Linux security center](#) or subscribe to the associated [RSS feed](#). Security and privacy events include an overview of the issue, what packages are affected, and how to update your instances to correct the issue.
- Before deploying an accelerated or Arm AMI, review the information in [the section called "Accelerated" \(p. 135\)](#) and [the section called "Arm" \(p. 136\)](#).

Select a link in the following table to view the latest Amazon EKS optimized Amazon Linux AMI ID for a region and Kubernetes version. You can also retrieve the IDs with an AWS Systems Manager parameter using different tools. For more information, see [Retrieving Amazon EKS optimized Amazon Linux AMI IDs \(p. 141\)](#).

Kubernetes version 1.17.9

Region	x86	x86 accelerated	Arm
US East (Ohio) (us-east-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US East (N. Virginia) (us-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US West (Oregon) (us-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Africa (Cape Town) (af-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Hong Kong) (ap-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Mumbai) (ap-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Region	x86	x86 accelerated	Arm
Asia Pacific (Tokyo) (ap-northeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Seoul) (ap-northeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Singapore) (ap-southeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Sydney) (ap-southeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Canada (Central) (ca-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Beijing) (cn-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Ningxia) (cn-northwest-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Frankfurt) (eu-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Ireland) (eu-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (London) (eu-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Milan) (eu-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Paris) (eu-west-3)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Stockholm) (eu-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Middle East (Bahrain) (me-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
South America (São Paulo) (sa-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-East) (us-gov-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-West) (us-gov-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Kubernetes version 1.16.13

Region	x86	x86 accelerated	Arm
US East (Ohio) (us-east-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US East (N. Virginia) (us-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US West (Oregon) (us-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Africa (Cape Town) (af-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Hong Kong) (ap-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Mumbai) (ap-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Tokyo) (ap-northeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Seoul) (ap-northeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Singapore) (ap-southeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Sydney) (ap-southeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Canada (Central) (ca-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Beijing) (cn-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Ningxia) (cn-northwest-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Frankfurt) (eu-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Ireland) (eu-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (London) (eu-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Milan) (eu-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Paris) (eu-west-3)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Region	x86	x86 accelerated	Arm
Europe (Stockholm) (eu-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Middle East (Bahrain) (me-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
South America (São Paulo) (sa-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-East) (us-gov-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-West) (us-gov-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Kubernetes version 1.15.11

Region	x86	x86 accelerated	Arm
US East (Ohio) (us-east-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US East (N. Virginia) (us-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US West (Oregon) (us-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Africa (Cape Town) (af-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Hong Kong) (ap-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Mumbai) (ap-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Tokyo) (ap-northeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Seoul) (ap-northeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Singapore) (ap-southeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Sydney) (ap-southeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Canada (Central) (ca-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Beijing) (cn-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Region	x86	x86 accelerated	Arm
China (Ningxia) (cn-northwest-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Frankfurt) (eu-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Ireland) (eu-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (London) (eu-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Milan) (eu-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Paris) (eu-west-3)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Stockholm) (eu-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Middle East (Bahrain) (me-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
South America (São Paulo) (sa-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-East) (us-gov-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-West) (us-gov-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

#### Kubernetes version 1.14.9

Region	x86	x86 accelerated	Arm
US East (Ohio) (us-east-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US East (N. Virginia) (us-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US West (Oregon) (us-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Africa (Cape Town) (af-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Hong Kong) (ap-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Mumbai) (ap-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Region	x86	x86 accelerated	Arm
Asia Pacific (Tokyo) (ap-northeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Seoul) (ap-northeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Singapore) (ap-southeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Sydney) (ap-southeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Canada (Central) (ca-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Beijing) (cn-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Ningxia) (cn-northwest-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Frankfurt) (eu-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Ireland) (eu-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (London) (eu-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Milan) (eu-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Paris) (eu-west-3)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Stockholm) (eu-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Middle East (Bahrain) (me-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
South America (São Paulo) (sa-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-East) (us-gov-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-West) (us-gov-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

### Important

These AMIs require the latest AWS CloudFormation node template. You can't use these AMIs with a previous version of the node template; they will fail to join your cluster. Be sure to

upgrade any existing AWS CloudFormation node stacks with the latest template (URL shown below) before you attempt to use these AMIs.

```
https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/amazon-eks-  
nodegroup.yaml
```

The AWS CloudFormation node template launches your nodes with Amazon EC2 user data that triggers a specialized [bootstrap script](#). This script allows your nodes to discover and connect to your cluster's control plane automatically. For more information, see [Launching self-managed Amazon Linux nodes](#) (p. 102).

## Amazon EKS optimized accelerated Amazon Linux AMIs

The Amazon EKS optimized accelerated Amazon Linux AMI is built on top of the standard Amazon EKS optimized Amazon Linux AMI, and is configured to serve as an optional image for Amazon EKS nodes to support GPU and [Inferentia](#) based workloads.

In addition to the standard Amazon EKS optimized AMI configuration, the accelerated AMI includes the following:

- NVIDIA drivers
- The `nvidia-container-runtime` (as the default runtime)
- AWS Neuron container runtime

### Note

- The Amazon EKS optimized accelerated AMI only supports GPU and Inferentia based instance types. Be sure to specify these instance types in your node AWS CloudFormation template. By using the Amazon EKS optimized accelerated AMI, you agree to [NVIDIA's end user license agreement \(EULA\)](#).
- The Amazon EKS optimized accelerated AMI was previously referred to as the *Amazon EKS optimized AMI with GPU support*.
- Previous versions of the Amazon EKS optimized accelerated AMI installed the `nvidia-docker` repository. The repository is no longer included in Amazon EKS AMI version `v20200529` and later.

### To enable GPU based workloads

The following procedure describes how to run a workload on a GPU based instance with the Amazon EKS optimized accelerated AMI. For more information about using Inferentia based workloads, see [??? \(p. 76\)](#).

1. After your GPU nodes join your cluster, you must apply the [NVIDIA device plugin for Kubernetes](#) as a DaemonSet on your cluster with the following command.

```
kubectl apply -f https://raw.githubusercontent.com/NVIDIA/k8s-device-plugin/v0.6.0/  
nvidia-device-plugin.yaml
```

2. You can verify that your nodes have allocatable GPUs with the following command:

```
kubectl get nodes "-o=custom-columns=NAME:.metadata.name,GPU:.status.allocatable.nvidia  
\.com/gpu"
```

## To deploy a pod to test that your GPU nodes are configured properly

1. Create a file named `nvidia-smi.yaml` with the following contents. This manifest launches a Cuda container that runs `nvidia-smi` on a node.

```
apiVersion: v1
kind: Pod
metadata:
  name: nvidia-smi
spec:
  restartPolicy: OnFailure
  containers:
  - name: nvidia-smi
    image: nvidia/cuda:9.2-devel
    args:
    - "nvidia-smi"
  resources:
    limits:
      nvidia.com/gpu: 1
```

2. Apply the manifest with the following command:

```
kubectl apply -f nvidia-smi.yaml
```

3. After the pod has finished running, view its logs with the following command:

```
kubectl logs nvidia-smi
```

Output:

```
Mon Aug 6 20:23:31 2018
+-----+
| NVIDIA-SMI 396.26                  Driver Version: 396.26                  |
+-----+-----+
| GPU  Name            Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp   Perf    Pwr:Usage/Cap|      Memory-Usage | GPU-Util  Compute M. |
|====+=====+
|  0  Tesla V100-SXM2...  On      | 00000000:00:1C:0 Off |                    0 |
| N/A   46C    P0      47W / 300W |  0MiB / 16160MiB |           0%    Default |
+-----+-----+

+-----+
| Processes:                        GPU Memory |
|  GPU       PID    Type    Process name      Usage    |
|=====+=====+
| No running processes found          |
+-----+
```

## Amazon EKS optimized Arm Amazon Linux AMIs

Arm instances deliver significant cost savings for scale-out and Arm-based applications such as web servers, containerized microservices, caching fleets, and distributed data stores. When adding Arm nodes to your cluster, review the following considerations.

### Considerations

- You can only deploy Arm AMIs in 1.15 or later clusters.



- If your cluster was deployed before August 17, 2020, then you must do a one-time upgrade of critical cluster add-on manifests so that Kubernetes can pull the correct image for each hardware architecture in use in your cluster. For more information about updating cluster add-ons, see [the section called "Update an existing cluster" \(p. 37\)](#). If you deployed your cluster on or after August 17, 2020, then your `coredns`, `kube-proxy`, and Amazon VPC CNI Plugin for Kubernetes add-ons are already multi-architecture capable.
- Applications deployed to Arm nodes must be compiled for Arm.
- You can't use any of the [Cluster Storage Interface \(p. 150\)](#) drivers with Arm.
- If you have any daemonsets deployed in an existing cluster, or you want to deploy them to a new cluster that you also want to deploy Arm nodes in, then ensure that your daemonset can run on all hardware architectures in your cluster.
- You can run Arm node groups and x86 node groups in the same cluster. If you do, consider deploying multi-architecture container images to a container repository such as Amazon Elastic Container Registry and then adding node selectors to your manifests so that Kubernetes knows what hardware architecture a pod can be deployed to. For more information, see [Pushing a multi-architecture image in the Amazon ECR User Guide](#) and the [Introducing multi-architecture container images for Amazon ECR](#) blog post.

## Amazon EKS optimized Amazon Linux AMI versions

This topic lists versions of the Amazon EKS optimized Amazon Linux AMIs and their corresponding versions of `kubernetes`, `Docker`, the Linux kernel, and the [Packer build script \(p. 141\)](#) configuration.

The Amazon EKS optimized AMI metadata, including the AMI ID, for each variant can be retrieved programmatically. For more information, see [Retrieving Amazon EKS optimized Amazon Linux AMI IDs \(p. 141\)](#).

AMIs are versioned by Kubernetes version and the release date of the AMI in the following format:

```
k8s_major_version.k8s_minor_version.k8s_patch_version-release_date
```

### Amazon EKS optimized Amazon Linux AMI

The table below lists the current and previous versions of the Amazon EKS optimized Amazon Linux AMI.

Kubernetes version 1.17

AMI version	kubernetes version	Docker version	Kernel version	Packer version
1.17.9-20200814	1.17.9	19.03.6-ce-4	4.14.186	v20200814
1.17.9-20200723	1.17.9	19.03.6-ce	4.14.181	v20200723
1.17.7-20200710	1.17.7	19.03.6-ce	4.14.181	v20200710
1.17.7-20200709	1.17.7	19.03.6-ce	4.14.181	v20200709

Kubernetes version 1.16

AMI version	kubernetes version	Docker version	Kernel version	Packer version
1.16.13-20200814	1.16.13	19.03.6-ce-4	4.14.186	v20200814
1.16.13-20200723	1.16.13	19.03.6-ce	4.14.181	v20200723

AMI version	kubelet version	Docker version	Kernel version	Packer version
1.16.12-20200710	1.16.12	19.03.6-ce	4.14.181	v20200710
1.16.12-20200709	1.16.12	19.03.6-ce	4.14.181	v20200709
1.16.8-20200615	1.16.8	19.03.6-ce	4.14.181	v20200615
1.16.8-20200609	1.16.8	19.03.6-ce	4.14.181	v20200609
1.16.8-20200531	1.16.8	18.09.9-ce	4.14.177	v20200531
1.16.8-20200507	1.16.8	18.09.9-ce	4.14.177	v20200507
1.16.8-20200423	1.16.8	18.09.9-ce	4.14.173	v20200423

#### Kubernetes version 1.15

AMI version	kubelet version	Docker version	Kernel version	Packer version
1.15.11-20200814	1.15.11	19.03.6-ce-4	4.14.186	v20200814
1.15.11-20200723	1.15.11	19.03.6-ce	4.14.181	v20200723
1.15.11-20200710	1.15.11	19.03.6-ce	4.14.181	v20200710
1.15.11-20200709	1.15.11	19.03.6-ce	4.14.181	v20200709
1.15.11-20200615	1.15.11	19.03.6-ce	4.14.181	v20200615
1.15.11-20200609	1.15.11	19.03.6-ce	4.14.181	v20200609
1.15.11-20200531	1.15.11	18.09.9-ce	4.14.177	v20200531
1.15.11-20200507	1.15.11	18.09.9-ce	4.14.177	v20200507
1.15.11-20200423	1.15.11	18.09.9-ce	4.14.173	v20200423
1.15.10-20200406	1.15.10	18.09.9-ce	4.14.173	v20200406
1.15.10-20200228	1.15.10	18.09.9-ce	4.14.165	v20200228

#### Kubernetes version 1.14

AMI version	kubelet version	Docker version	Kernel version	Packer version
1.14.9-20200814	1.14.9	19.03.6-ce-4	4.14.186	v20200814
1.14.9-20200723	1.14.9	19.03.6-ce	4.14.181	v20200723
1.14.9-20200710	1.14.9	19.03.6-ce	4.14.181	v20200710
1.14.9-20200709	1.14.9	19.03.6-ce	4.14.181	v20200709
1.14.9-20200615	1.14.9	19.03.6-ce	4.14.181	v20200615
1.14.9-20200609	1.14.9	19.03.6-ce	4.14.181	v20200609
1.14.9-20200531	1.14.9	18.09.9-ce	4.14.177	v20200531

AMI version	kubelet version	Docker version	Kernel version	Packer version
1.14.9-20200507	1.14.9	18.09.9-ce	4.14.177	v20200507
1.14.9-20200423	1.14.9	18.09.9-ce	4.14.173	v20200423
1.14.9-20200406	1.14.9	18.09.9-ce	4.14.173	v20200406
1.14.9-20200406	1.14.9	18.09.9-ce	4.14.173	v20200406
1.14.9-20200228	1.14.9	18.09.9-ce	4.14.165	v20200228
1.14.9-20200122	1.14.9	18.09.9-ce	4.14.158	v20200122
1.14.8-20191213	1.14.8	18.09.9-ce	4.14.154	v20191213
1.14.7-20191119	1.14.7	18.09.9-ce	4.14.152	v20191119
1.14.7-20190927	1.14.7	18.06.1-ce	4.14.146	v20190927

## Amazon EKS optimized accelerated Amazon Linux AMI

The table below lists the current and previous versions of the Amazon EKS-optimized accelerated Amazon Linux AMI.

Kubernetes version 1.17

AMI version	kubelet version	Docker version	Kernel version	Packer version	NVIDIA driver version
1.17.9-20200723	1.17.9	19.03.6-ce	4.14.181	v20200723	418.87.00
1.17.7-20200710	1.17.7	19.03.6-ce	4.14.181	v20200710	418.87.00
1.17.7-20200709	1.17.7	19.03.6-ce	4.14.181	v20200709	418.87.00

Kubernetes version 1.16

AMI version	kubelet version	Docker version	Kernel version	Packer version	NVIDIA driver version
1.16.13-20200723	1.16.13	19.03.6-ce	4.14.181	v20200723	418.87.00
1.16.12-20200710	1.16.12	19.03.6-ce	4.14.181	v20200710	418.87.00
1.16.12-20200709	1.16.12	19.03.6-ce	4.14.181	v20200709	418.87.00
1.16.8-20200615	1.16.8	19.03.6-ce	4.14.181	v20200615	418.87.00
1.16.8-20200609	1.16.8	19.03.6-ce	4.14.181	v20200609	418.87.00
1.16.8-20200531	1.16.8	18.09.9-ce	4.14.177	v20200531	418.87.00
1.16.8-20200507	1.16.8	18.09.9-ce	4.14.177	v20200507	418.87.00
1.16.8-20200423	1.16.8	18.09.9-ce	4.14.173	v20200423	418.87.00

Kubernetes version 1.15

AMI version	kubelet version	Docker version	Kernel version	Packer version	NVIDIA driver version
1.15.11-20200723	1.15.11	19.03.6-ce	4.14.181	v20200723	418.87.00
1.15.11-20200710	1.15.11	19.03.6-ce	4.14.181	v20200710	418.87.00
1.15.11-20200709	1.15.11	19.03.6-ce	4.14.181	v20200709	418.87.00
1.15.11-20200615	1.15.11	19.03.6-ce	4.14.181	v20200615	418.87.00
1.15.11-20200609	1.15.11	19.03.6-ce	4.14.181	v20200609	418.87.00
1.15.11-20200531	1.15.11	18.09.9-ce	4.14.177	v20200531	418.87.00
1.15.11-20200507	1.15.11	18.09.9-ce	4.14.177	v20200507	418.87.00
1.15.11-20200423	1.15.11	18.09.9-ce	4.14.173	v20200423	418.87.00
1.15.10-20200406	1.15.10	18.09.9-ce	4.14.173	v20200406	418.87.00
1.15.10-20200228	1.15.10	18.09.9-ce	4.14.165	v20200228	418.87.00

Kubernetes version 1.14

AMI version	kubelet version	Docker version	Kernel version	Packer version	NVIDIA driver version
1.14.9-20200723	1.14.9	19.03.6-ce	4.14.181	v20200723	418.87.00
1.14.9-20200710	1.14.9	19.03.6-ce	4.14.181	v20200710	418.87.00
1.14.9-20200709	1.14.9	19.03.6-ce	4.14.181	v20200709	418.87.00
1.14.9-20200615	1.14.9	19.03.6-ce	4.14.181	v20200615	418.87.00
1.14.9-20200609	1.14.9	19.03.6-ce	4.14.181	v20200609	418.87.00
1.14.9-20200531	1.14.9	18.09.9-ce	4.14.177	v20200531	418.87.00
1.14.9-20200507	1.14.9	18.09.9-ce	4.14.177	v20200507	418.87.00
1.14.9-20200423	1.14.9	18.09.9-ce	4.14.173	v20200423	418.87.00
1.14.9-20200406	1.14.9	18.09.9-ce	4.14.173	v20200406	418.87.00
1.14.9-20200228	1.14.9	18.09.9-ce	4.14.165	v20200228	418.87.00
1.14.9-20200122	1.14.9	18.09.9-ce	4.14.158	v20200122	418.87.00
1.14.8-20191213	1.14.8	18.09.9-ce	4.14.154	v20191213	418.87.00
1.14.7-20191119	1.14.7	18.09.9-ce	4.14.152	v20191119	418.87.00
1.14.7-20190927	1.14.7	18.06.1-ce	4.14.146	v20190927	418.87.00

## Retrieving Amazon EKS optimized Amazon Linux AMI IDs

You can programmatically retrieve the Amazon Machine Image (AMI) ID for Amazon EKS optimized AMIs by querying the AWS Systems Manager Parameter Store API. This parameter eliminates the need for you to manually look up Amazon EKS optimized AMI IDs. For more information about the Systems Manager Parameter Store API, see [GetParameter](#). Your user account must have the `ssm:GetParameter` IAM permission to retrieve the Amazon EKS optimized AMI metadata.

Select the name of the tool that you want to retrieve the AMI ID with.

### AWS CLI

You can retrieve the image ID of the latest recommended Amazon EKS optimized Amazon Linux AMI with the following command by using the sub-parameter `image_id`. Replace **1.17** with a [supported version \(p. 64\)](#) and **region-code** with an [Amazon EKS supported Region](#) for which you want the AMI ID. Replace **amazon-linux-2** with `amazon-linux-2-gpu` to see the accelerated AMI ID and `amazon-linux-2-arm64` to see the Arm ID.

```
aws ssm get-parameter --name /aws/service/eks/optimized-ami/1.17/amazon-linux-2/recommended/image_id --region region-code --query "Parameter.Value" --output text
```

Example output:

```
ami-abcd1234efgh5678i
```

### AWS Management Console

You can query for the recommended Amazon EKS optimized AMI ID using a URL. The URL opens the Amazon EC2 Systems Manager console with the value of the ID for the parameter. In the following URL, replace **1.17** with a [supported version \(p. 64\)](#) and **region-code** with an [Amazon EKS supported Region](#) for which you want the AMI ID. Replace **amazon-linux-2** with `amazon-linux-2-gpu` to see the accelerated AMI ID and `amazon-linux-2-arm64` to see the Arm ID.

```
https://console.aws.amazon.com/systems-manager/parameters/%252Faws%252Fservice%252Feks%252Foptimized-ami%252F1.17%252Famazon-linux-2%252Frecommended%252Fimage_id/description?region=region-code
```

## Amazon EKS optimized Amazon Linux AMI build script

Amazon Elastic Kubernetes Service (Amazon EKS) has open-sourced the build scripts that are used to build the Amazon EKS optimized AMI. These build scripts are now available [on GitHub](#).

The Amazon EKS optimized Amazon Linux AMI is built on top of Amazon Linux 2, specifically for use as a node in Amazon EKS clusters. You can use this repository to view the specifics of how the Amazon EKS team configures `kubelet`, Docker, the AWS IAM Authenticator for Kubernetes, and more.

The build scripts repository includes a [HashiCorp packer](#) template and build scripts to generate an AMI. These scripts are the source of truth for Amazon EKS optimized AMI builds, so you can follow the GitHub repository to monitor changes to our AMIs. For example, perhaps you want your own AMI to use the same version of Docker that the EKS team uses for the official AMI.

The GitHub repository also contains the specialized [bootstrap script](#) that runs at boot time to configure your instance's certificate data, control plane endpoint, cluster name, and more.

Additionally, the GitHub repository contains our Amazon EKS node AWS CloudFormation templates. These templates make it easier to spin up an instance running the Amazon EKS optimized AMI and register it with a cluster.

For more information, see the repositories on GitHub at <https://github.com/aws-labs/amazon-eks-ami>.

## Amazon EKS optimized Ubuntu Linux AMIs

Canonical has partnered with Amazon EKS to create node AMIs that you can use in your clusters.

[Canonical](#) delivers a built-for-purpose Kubernetes Node OS image. This minimized Ubuntu image is optimized for Amazon EKS and includes the custom AWS kernel that is jointly developed with AWS. For more information, see [Ubuntu and Amazon Elastic Kubernetes Service](#) and [Optimized support for Amazon EKS on Ubuntu 18.04](#).

## Amazon EKS optimized Windows AMIs

The Amazon EKS optimized AMI is built on top of Windows Server 2019, and is configured to serve as the base image for Amazon EKS nodes. The AMI is configured to work with Amazon EKS out of the box, and it includes Docker, `kubelet`, and the AWS IAM Authenticator.

### Note

You can track security or privacy events for Windows Server with the [Microsoft security update guide](#).

The AMI IDs for the latest Amazon EKS optimized AMI are shown in the following table. Windows Server 2019 is a Long-Term Servicing Channel (LTSC) release and Windows Server, versions 1909 and 2004 are Semi-Annual Channel (SAC) releases. For more information, see [Windows Server servicing channels: LTSC and SAC](#) in the Microsoft documentation. You can also retrieve the IDs with an AWS Systems Manager parameter using different tools. For more information, see [Retrieving Amazon EKS optimized Windows AMI IDs \(p. 148\)](#).

Kubernetes version 1.17.9

Region	Windows Server 2019 Full	Windows Server 2019 Core	Windows Server 1909 Core	Windows Server 2004 Core
US East (Ohio) (us-east-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US East (N. Virginia) (us-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US West (Oregon) (us-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Africa (Cape Town) (af-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Hong Kong) (ap-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Mumbai) (ap-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Tokyo) (ap-northeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Region	Windows Server 2019 Full	Windows Server 2019 Core	Windows Server 1909 Core	Windows Server 2004 Core
Asia Pacific (Seoul) (ap-northeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Singapore) (ap-southeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Sydney) (ap-southeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Canada (Central) (ca-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Beijing) (cn-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Ningxia) (cn-northwest-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Frankfurt) (eu-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Ireland) (eu-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (London) (eu-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Milan) (eu-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Paris) (eu-west-3)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Stockholm) (eu-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Middle East (Bahrain) (me-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
South America (São Paulo) (sa-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-East) (us-gov-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-West) (us-gov-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Kubernetes version 1.16.13

Region	Windows Server 2019 Full	Windows Server 2019 Core	Windows Server 1909 Core	Windows Server 2004 Core
US East (Ohio) (us-east-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US East (N. Virginia) (us-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US West (Oregon) (us-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Africa (Cape Town) (af-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Hong Kong) (ap-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Mumbai) (ap-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Tokyo) (ap-northeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Seoul) (ap-northeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Singapore) (ap-southeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Sydney) (ap-southeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Canada (Central) (ca-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Beijing) (cn-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Ningxia) (cn-northwest-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Frankfurt) (eu-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Ireland) (eu-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>



Region	Windows Server 2019 Full	Windows Server 2019 Core	Windows Server 1909 Core	Windows Server 2004 Core
Europe (London) (eu-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Milan) (eu-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Paris) (eu-west-3)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Stockholm) (eu-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Middle East (Bahrain) (me-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
South America (São Paulo) (sa-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-East) (us-gov-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-West) (us-gov-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Kubernetes version 1.15.11

Region	Windows Server 2019 Full	Windows Server 2019 Core	Windows Server 1909 Core	Windows Server 2004 Core
US East (Ohio) (us-east-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US East (N. Virginia) (us-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US West (Oregon) (us-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Africa (Cape Town) (af-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Hong Kong) (ap-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Mumbai) (ap-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Region	Windows Server 2019 Full	Windows Server 2019 Core	Windows Server 1909 Core	Windows Server 2004 Core
Asia Pacific (Tokyo) (ap-northeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Seoul) (ap-northeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Singapore) (ap-southeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Sydney) (ap-southeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Canada (Central) (ca-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Beijing) (cn-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Ningxia) (cn-northwest-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Frankfurt) (eu-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Ireland) (eu-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (London) (eu-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Milan) (eu-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Paris) (eu-west-3)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Stockholm) (eu-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Middle East (Bahrain) (me-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
South America (São Paulo) (sa-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-East) (us-gov-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Region	Windows Server 2019 Full	Windows Server 2019 Core	Windows Server 1909 Core	Windows Server 2004 Core
AWS GovCloud (US-West) (us-gov-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Kubernetes version 1.14.9

Region	Windows Server 2019 Full	Windows Server 2019 Core	Windows Server 1909 Core	Windows Server 2004 Core
US East (Ohio) (us-east-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US East (N. Virginia) (us-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
US West (Oregon) (us-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Africa (Cape Town) (af-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Hong Kong) (ap-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Mumbai) (ap-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Tokyo) (ap-northeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Seoul) (ap-northeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Singapore) (ap-southeast-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Asia Pacific (Sydney) (ap-southeast-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Canada (Central) (ca-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
China (Beijing) (cn-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

Region	Windows Server 2019 Full	Windows Server 2019 Core	Windows Server 1909 Core	Windows Server 2004 Core
China (Ningxia) (cn-northwest-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Frankfurt) (eu-central-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Ireland) (eu-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (London) (eu-west-2)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Milan) (eu-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Paris) (eu-west-3)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Europe (Stockholm) (eu-north-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
Middle East (Bahrain) (me-south-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
South America (São Paulo) (sa-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-East) (us-gov-east-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>
AWS GovCloud (US-West) (us-gov-west-1)	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>	<a href="#">View AMI ID</a>

## Retrieving Amazon EKS optimized Windows AMI IDs

You can programmatically retrieve the Amazon Machine Image (AMI) ID for Amazon EKS optimized AMIs by querying the AWS Systems Manager Parameter Store API. This parameter eliminates the need for you to manually look up Amazon EKS optimized AMI IDs. For more information about the Systems Manager Parameter Store API, see [GetParameter](#). Your user account must have the `ssm:GetParameter` IAM permission to retrieve the Amazon EKS optimized AMI metadata.

Select the name of the tool that you want to retrieve the AMI ID with.

### AWS CLI

You can retrieve the image ID of the latest recommended Amazon EKS optimized Windows AMI with the following command by using the sub-parameter `image_id`. You can replace `1.17` with any supported Amazon EKS version and can replace `region-code` with an [Amazon EKS supported](#)

[Region](#) for which you want the AMI ID. Replace **Core** with **Full** to see the Windows Server full AMI ID. You can also replace **2019** with **1909** or **2004** for the Core version only.

```
aws ssm get-parameter --name /aws/service/ami-windows-latest/Windows_Server-2019-English-Core-EKS_Optimized-1.17/image_id --region region-code --query "Parameter.Value" --output text
```

Example output:

```
ami-ami-00a053f1635fffea0
```

### AWS Management Console

You can query for the recommended Amazon EKS optimized AMI ID using a URL. The URL opens the Amazon EC2 Systems Manager console with the value of the ID for the parameter. In the following URL, you can replace **1.17** with any supported Amazon EKS version and can replace **region-code** with an [Amazon EKS supported Region](#) for which you want the AMI ID. Replace **Core** with **Full** to see the Windows Server full AMI ID. You can also replace **2019** with **1909** or **2004** for the Core version only.

```
https://console.aws.amazon.com/systems-manager/parameters/%252Faws%252Fservice%252Fami-windows-latest%252FWindows_Server-2019-English-Core-EKS_Optimized-1.17%252Fimage_id/description?region=region-code
```

# Storage

This chapter covers storage options for Amazon EKS clusters.

The [Storage classes \(p. 150\)](#) topic uses the in-tree Amazon EBS storage provisioner. The [Amazon EBS CSI driver \(p. 151\)](#) is available for managing storage in Kubernetes 1.14 and later clusters.

## Note

The existing [in-tree Amazon EBS plugin](#) is still supported, but by using a CSI driver, you benefit from the decoupling of Kubernetes upstream release cycle and CSI driver release cycle. Eventually, the in-tree plugin will be deprecated in favor of the CSI driver.

## Topics

- [Storage classes \(p. 150\)](#)
- [Amazon EBS CSI driver \(p. 151\)](#)
- [Amazon EFS CSI driver \(p. 155\)](#)
- [Amazon FSx for Lustre CSI driver \(p. 159\)](#)

## Storage classes

Amazon EKS clusters that were created prior to Kubernetes version 1.11 were not created with any storage classes. You must define storage classes for your cluster to use and you should define a default storage class for your persistent volume claims. For more information, see [Storage classes](#) in the Kubernetes documentation.

## Note

This topic uses the [in-tree Amazon EBS storage provisioner](#). For Kubernetes 1.14 and later clusters, the [Amazon EBS CSI driver \(p. 151\)](#) is available for managing storage. The existing [in-tree Amazon EBS plugin](#) is still supported, but by using a CSI driver, you benefit from the decoupling of Kubernetes upstream release cycle and CSI driver release cycle. Eventually, the in-tree plugin will be deprecated in favor of the CSI driver.

## To create an AWS storage class for your Amazon EKS cluster

1. Create an AWS storage class manifest file for your storage class. The `gp2-storage-class.yaml` example below defines a storage class called `gp2` that uses the Amazon EBS `gp2` volume type.

For more information about the options available for AWS storage classes, see [AWS EBS](#) in the Kubernetes documentation.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: gp2
  annotations:
    storageclass.kubernetes.io/is-default-class: "true"
provisioner: kubernetes.io/aws-ebs
parameters:
  type: gp2
```

```
fsType: ext4
```

2. Use `kubectl` to create the storage class from the manifest file.

```
kubectl create -f gp2-storage-class.yaml
```

Output:

```
storageclass "gp2" created
```

### To define a default storage class

1. List the existing storage classes for your cluster. A storage class must be defined before you can set it as a default.

```
kubectl get storageclass
```

Output:

NAME	PROVISIONER	AGE
gp2	kubernetes.io/aws-ebs	8m

2. Choose a storage class and set it as your default by setting the `storageclass.kubernetes.io/is-default-class=true` annotation.

```
kubectl patch storageclass gp2 -p '{"metadata": {"annotations": {"storageclass.kubernetes.io/is-default-class": "true"}}}'
```

Output:

```
storageclass "gp2" patched
```

3. Verify that the storage class is now set as default.

```
kubectl get storageclass
```

Output:

gp2 (default)	kubernetes.io/aws-ebs	12m
---------------	-----------------------	-----

## Amazon EBS CSI driver

The [Amazon EBS Container Storage Interface \(CSI\) driver](#) provides a CSI interface that allows Amazon EKS clusters to manage the lifecycle of Amazon EBS volumes for persistent volumes.

This topic shows you how to deploy the Amazon EBS CSI Driver to your Amazon EKS cluster and verify that it works. We recommend using version v0.5.0 of the driver.

### Note

This driver is only supported on Kubernetes version 1.14 and later Amazon EKS clusters and nodes. The driver is not supported on Fargate or Arm nodes. Alpha features of the Amazon EBS CSI Driver are not supported on Amazon EKS clusters. The driver is in Beta release. It is

well tested and supported by Amazon EKS for production use. Support for the driver will not be dropped, though details may change. If the schema or schematics of the driver changes, instructions for migrating to the next version will be provided.

For detailed descriptions of the available parameters and complete examples that demonstrate the driver's features, see the [Amazon EBS Container Storage Interface \(CSI\) driver](#) project on GitHub.

### To deploy the Amazon EBS CSI driver to an Amazon EKS cluster

1. Create an IAM policy called `Amazon_EBS_CSI_Driver` for your node instance profile that allows the Amazon EBS CSI Driver to make calls to AWS APIs on your behalf. Use the following AWS CLI commands to create the IAM policy in your AWS account. You can view the policy document [on GitHub](#).

- a. Download the policy document from GitHub.

```
curl -O https://raw.githubusercontent.com/kubernetes-sigs/aws-ebs-csi-driver/v0.5.0/docs/example-iam-policy.json
```

- b. Create the policy.

```
aws iam create-policy --policy-name Amazon_EBS_CSI_Driver \
--policy-document file://example-iam-policy.json
```

Take note of the policy ARN that is returned.

2. Get the IAM role name for your nodes. Use the following command to print the `aws-auth` configmap.

```
kubectl -n kube-system describe configmap aws-auth
```

Output:

```
Name:          aws-auth
Namespace:     kube-system
Labels:        <none>
Annotations:   <none>

Data
====
mapRoles:
-----
- groups:
  - system:bootstrappers
  - system:nodes
  rolearn: arn:aws:iam::111122223333:role/eksctl-alb-nodegroup-ng-b1f603c5-
NodeInstanceRole-GKNS581EASPU
  username: system:node:{{EC2PrivateDNSName}}

Events:  <none>
```

Record the role name for any `rolearn` values that have the `system:nodes` group assigned to them. In the previous example output, the role name is **`eksctl-alb-nodegroup-ng-b1f603c5-NodeInstanceRole-GKNS581EASPU`**. You should have one value for each node group in your cluster.

3. Attach the new `Amazon_EBS_CSI_Driver` IAM policy to each of the node IAM roles you identified earlier with the following command, substituting the red text with your own AWS account number and node IAM role name.



```
aws iam attach-role-policy \  
--policy-arn arn:aws:iam::111122223333:policy/Amazon_EBS_CSI_Driver \  
--role-name eksctl-alb-nodegroup-ng-b1f603c5-NodeInstanceRole-GKNS581EASPU
```

4. Deploy the Amazon EBS CSI Driver with the following command.

**Note**

This command requires version 1.14 or later of kubectl. You can see your kubectl version with the following command. To install or upgrade your kubectl version, see [Installing kubectl](#) (p. 229).

```
kubectl version --client --short
```

```
kubectl apply -k "github.com/kubernetes-sigs/aws-ebs-csi-driver/deploy/kubernetes/  
overlays/stable/?ref=master"
```

## To deploy a sample application and verify that the CSI driver is working

This procedure uses the [Dynamic volume provisioning](#) example from the [Amazon EBS Container Storage Interface \(CSI\) driver](#) GitHub repository to consume a dynamically-provisioned Amazon EBS volume.

1. Clone the [Amazon EBS Container Storage Interface \(CSI\) driver](#) GitHub repository to your local system.

```
git clone https://github.com/kubernetes-sigs/aws-ebs-csi-driver.git
```

2. Navigate to the dynamic-provisioning example directory.

```
cd aws-ebs-csi-driver/examples/kubernetes/dynamic-provisioning/
```

3. Deploy the ebs-sc storage class, ebs-claim persistent volume claim, and app sample application from the specs directory.

```
kubectl apply -f specs/
```

4. Describe the ebs-sc storage class.

```
kubectl describe storageclass ebs-sc
```

Output:

```
Name:                ebs-sc  
IsDefaultClass:      No  
Annotations:         kubectl.kubernetes.io/last-applied-  
configuration={"apiVersion":"storage.k8s.io/v1", "kind":"StorageClass", "metadata":  
{ "annotations": {}, "name": "ebs-  
sc"}, "provisioner": "ebs.csi.aws.com", "volumeBindingMode": "WaitForFirstConsumer"}  
  
Provisioner:         ebs.csi.aws.com  
Parameters:          <none>  
AllowVolumeExpansion: <unset>  
MountOptions:        <none>  
ReclaimPolicy:       Delete  
VolumeBindingMode:   WaitForFirstConsumer  
Events:              <none>
```

Note that the storage class uses the `WaitForFirstConsumer` volume binding mode. This means that volumes are not dynamically provisioned until a pod makes a persistent volume claim. For more information, see [Volume Binding Mode](#) in the Kubernetes documentation.

5. Watch the pods in the default namespace and wait for the app pod to become ready.

```
kubectl get pods --watch
```

6. List the persistent volumes in the default namespace. Look for a persistent volume with the `default/ebs-claim` claim.

```
kubectl get pv
```

Output:

NAME	STATUS	CLAIM	STORAGECLASS	CAPACITY	ACCESS MODES	RECLAIM POLICY
pvc-37717cd6-d0dc-11e9-b17f-06fad4858a5a	Bound	default/ebs-claim	ebs-sc	4Gi	RWO	Delete

7. Describe the persistent volume.

```
kubectl describe pv pvc-37717cd6-d0dc-11e9-b17f-06fad4858a5a
```

Output:

```
Name:                pvc-37717cd6-d0dc-11e9-b17f-06fad4858a5a
Labels:              <none>
Annotations:         pv.kubernetes.io/provisioned-by: ebs.csi.aws.com
Finalizers:          [kubernetes.io/pv-protection external-attacher/ebs-csi-aws-com]
StorageClass:        ebs-sc
Status:              Bound
Claim:               default/ebs-claim
Reclaim Policy:      Delete
Access Modes:        RWO
VolumeMode:          Filesystem
Capacity:             4Gi
Node Affinity:
  Required Terms:
    Term 0:           topology.ebs.csi.aws.com/zone in [regiona]
Message:
Source:
  Type:               CSI (a Container Storage Interface (CSI) volume source)
  Driver:              ebs.csi.aws.com
  VolumeHandle:        vol-0d651e157c6d93445
  ReadOnly:            false
  VolumeAttributes:    storage.kubernetes.io/
csiProvisionerIdentity=1567792483192-8081-ebs.csi.aws.com
Events:              <none>
```

The Amazon EBS volume ID is listed as the `VolumeHandle`.

8. Verify that the pod is successfully writing data to the volume.

```
kubectl exec -it app cat /data/out.txt
```

Output:

```
Wed Jul 8 13:52:09 UTC 2020
Wed Jul 8 13:52:14 UTC 2020
Wed Jul 8 13:52:19 UTC 2020
Wed Jul 8 13:52:24 UTC 2020
Wed Jul 8 13:52:29 UTC 2020
Wed Jul 8 13:52:34 UTC 2020
```

9. When you finish experimenting, delete the resources for this sample application to clean up.

```
kubectl delete -f specs/
```

## Amazon EFS CSI driver

The [Amazon EFS Container Storage Interface \(CSI\) driver](#) provides a CSI interface that allows Kubernetes clusters running on AWS to manage the lifecycle of Amazon EFS file systems.

This topic shows you how to deploy the Amazon EFS CSI Driver to your Amazon EKS cluster and verify that it works.

### Note

Alpha features of the Amazon EFS CSI Driver are not supported on Amazon EKS clusters. The driver is not supported on Arm nodes.

For detailed descriptions of the available parameters and complete examples that demonstrate the driver's features, see the [Amazon EFS Container Storage Interface \(CSI\) driver](#) project on GitHub.

### To deploy the Amazon EFS CSI driver to an Amazon EKS cluster

- Deploy the Amazon EFS CSI driver. If your cluster contains nodes (it can also include AWS Fargate pods), then deploy the driver with the following command.

### Note

This command requires `kubectl` version 1.14 or later. You can see your `kubectl` version with the following command. To install or upgrade your `kubectl` version, see [Installing kubectl](#) (p. 229).

```
kubectl version --client --short
```

```
kubectl apply -k "github.com/kubernetes-sigs/aws-efs-csi-driver/deploy/kubernetes/overlays/stable/ecr/?ref=release-1.0"
```

If your cluster contains only Fargate pods (no nodes), then deploy the driver with the following command.

```
kubectl apply -f https://raw.githubusercontent.com/kubernetes-sigs/aws-efs-csi-driver/master/deploy/kubernetes/base/csidriver.yaml
```

### Note

- Starting with the 1.0.0 release, encryption of data in transit using TLS is enabled by default. Using [encryption in transit](#), data will be encrypted during its transition over the network to the Amazon EFS service. To disable it and mount volumes using NFSv4, set the `volumeAttributes` field `encryptInTransit` to `"false"` in your persistent volume manifest. For an example manifest, see [Encryption in Transit example](#) on GitHub.

- Only static volume provisioning is supported. This means that an Amazon EFS file system needs to be created outside of Amazon EKS before being used by pods in your cluster.

### Amazon EFS access points

The Amazon EFS CSI driver supports [Amazon EFS access points](#), which are application-specific entry points into an Amazon EFS file system that make it easier to share a file system between multiple pods. Access points can enforce a user identity for all file system requests that are made through the access point, and enforce a root directory for each pod. For more information, see [Amazon EFS access points](#) on GitHub.

### To create an Amazon EFS file system for your Amazon EKS cluster

1. Locate the VPC ID for your Amazon EKS cluster. You can find this ID in the Amazon EKS console, or you can use the following AWS CLI command.

```
aws eks describe-cluster --name cluster_name --query "cluster.resourcesVpcConfig.vpcId" --output text
```

Output:

```
vpc-exampledb76d3e813
```

2. Locate the CIDR range for your cluster's VPC. You can find this in the Amazon VPC console, or you can use the following AWS CLI command.

```
aws ec2 describe-vpcs --vpc-ids vpc-exampledb76d3e813 --query "Vpcs[0].CidrBlock" --output text
```

Output:

```
192.168.0.0/16
```

3. Create a security group that allows inbound NFS traffic for your Amazon EFS mount points.
  - a. Open the Amazon VPC console at <https://console.aws.amazon.com/vpc/>.
  - b. Choose **Security Groups** in the left navigation pane, and then choose **Create security group**.
  - c. Enter a name and description for your security group, and choose the VPC that your Amazon EKS cluster is using.
  - d. Under **Inbound rules**, select **Add rule**.
  - e. Under **Type**, select **NFS**.
  - f. Under **Source**, select **Custom**, and paste the VPC CIDR range that you obtained in the previous step.
  - g. Choose **Create security group**.
4. Create the Amazon EFS file system for your Amazon EKS cluster.
  - a. Open the Amazon Elastic File System console at <https://console.aws.amazon.com/efs/>.
  - b. Choose **File systems** in the left navigation pane, and then choose **Create file system**.
  - c. On the **Create file system** page, choose **Customize**.
  - d. On the **File system settings** page, you don't need to enter or select any information, but can if desired, and then select **Next**.
  - e. On the **Network access** page, for **Virtual Private Cloud (VPC)**, choose your VPC.

**Note**

If you don't see your VPC, at the top right of the console, make sure that the region that your VPC is in is selected.

- f. Under **Mount targets**, if a default security group is already listed, select the **X** in the top right corner of the box with the default security group name to remove it from each mount point, select the security group that you created in a previous step for each mount target, and then select **Next**.
- g. On the **File system policy** page, select **Next**.
- h. On the **Review and create** page, select **Create**.

**Important**

By default, new Amazon EFS file systems are owned by `root:root`, and only the `root` user (UID 0) has read-write-execute permissions. If your containers are not running as `root`, you must change the Amazon EFS file system permissions to allow other users to modify the file system. For more information, see [Working with users, groups, and permissions at the Network File System \(NFS\) level](#) in the *Amazon Elastic File System User Guide*.

**To deploy a sample application and verify that the CSI driver is working**

This procedure uses the [Multiple Pods Read Write Many](#) example from the [Amazon EFS Container Storage Interface \(CSI\) driver](#) GitHub repository to consume a statically provisioned Amazon EFS persistent volume and access it from multiple pods with the `ReadWriteMany` access mode.

1. Clone the [Amazon EFS Container Storage Interface \(CSI\) driver](#) GitHub repository to your local system.

```
git clone https://github.com/kubernetes-sigs/aws-efs-csi-driver.git
```

2. Navigate to the `multiple_pods` example directory.

```
cd aws-efs-csi-driver/examples/kubernetes/multiple_pods/
```

3. Retrieve your Amazon EFS file system ID. You can find this in the Amazon EFS console, or use the following AWS CLI command.

```
aws efs describe-file-systems --query "FileSystems[*].FileSystemId" --output text
```

Output:

```
fs-582a03f3
```

4. Edit the `specs/pv.yaml` file and replace the `volumeHandle` value with your Amazon EFS file system ID.

```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: efs-pv
spec:
  capacity:
    storage: 5Gi
  volumeMode: Filesystem
  accessModes:
    - ReadWriteMany
  persistentVolumeReclaimPolicy: Retain
```

```
storageClassName: efs-sc
csi:
  driver: efs.csi.aws.com
  volumeHandle: fs-582a03f3
```

### Note

Because Amazon EFS is an elastic file system, it does not enforce any file system capacity limits. The actual storage capacity value in persistent volumes and persistent volume claims is not used when creating the file system. However, since storage capacity is a required field in Kubernetes, you must specify a valid value, such as, **5Gi** in this example. This value does not limit the size of your Amazon EFS file system.

5. Deploy the `efs-sc` storage class, `efs-claim` persistent volume claim, `efs-pv` persistent volume, and `app1` and `app2` sample applications from the `specs` directory.

```
kubectl apply -f specs/
```

6. Watch the pods in the default namespace and wait for the `app1` and `app2` pods' STATUS become Running.

```
kubectl get pods --watch
```

### Note

It may take a few minutes for the pods to reach the Running status.

7. List the persistent volumes in the default namespace. Look for a persistent volume with the `default/efs-claim` claim.

```
kubectl get pv
```

Output:

NAME	CAPACITY	ACCESS MODES	RECLAIM POLICY	STATUS	CLAIM
	STORAGECLASS	REASON	AGE		
efs-pv	5Gi	RWX	Retain	Bound	default/efs-claim
		2m50s			efs-sc

8. Describe the persistent volume.

```
kubectl describe pv efs-pv
```

Output:

```
Name:          efs-pv
Labels:        <none>
Annotations:   kubernetes.io/last-applied-configuration:
                {"apiVersion":"v1","kind":"PersistentVolume","metadata":
{"annotations":{"name":"efs-pv"},"spec":{"accessModes":["ReadWriteMany"],"capaci...
                pv.kubernetes.io/bound-by-controller: yes
Finalizers:    [kubernetes.io/pv-protection]
StorageClass:  efs-sc
Status:        Bound
Claim:         default/efs-claim
Reclaim Policy: Retain
Access Modes:  RWX
VolumeMode:    Filesystem
Capacity:      5Gi
Node Affinity: <none>
Message:
```

```
Source:
  Type:          CSI (a Container Storage Interface (CSI) volume source)
  Driver:        efs.csi.aws.com
  VolumeHandle:  fs-582a03f3
  ReadOnly:      false
  VolumeAttributes: <none>
Events:         <none>
```

The Amazon EFS file system ID is listed as the `VolumeHandle`.

9. Verify that the `app1` pod is successfully writing data to the volume.

```
kubectl exec -ti app1 -- tail /data/out1.txt
```

Output:

```
Thu Jul 23 21:44:02 UTC 2020
Thu Jul 23 21:44:07 UTC 2020
Thu Jul 23 21:44:12 UTC 2020
Thu Jul 23 21:44:17 UTC 2020
Thu Jul 23 21:44:22 UTC 2020
Thu Jul 23 21:44:27 UTC 2020
```

10. Verify that the `app2` pod is shows the same data in the volume.

```
kubectl exec -ti app2 -- tail /data/out1.txt
```

Output:

```
Thu Jul 23 21:44:47 UTC 2020
Thu Jul 23 21:44:52 UTC 2020
Thu Jul 23 21:44:57 UTC 2020
Thu Jul 23 21:45:02 UTC 2020
Thu Jul 23 21:45:07 UTC 2020
Thu Jul 23 21:45:12 UTC 2020
```

11. When you finish experimenting, delete the resources for this sample application to clean up.

```
kubectl delete -f specs/
```

## Amazon FSx for Lustre CSI driver

The [Amazon FSx for Lustre Container Storage Interface \(CSI\) driver](#) provides a CSI interface that allows Amazon EKS clusters to manage the lifecycle of Amazon FSx for Lustre file systems.

This topic shows you how to deploy the Amazon FSx for Lustre CSI Driver to your Amazon EKS cluster and verify that it works. We recommend using version 0.3.0 of the driver.

### Note

This driver is supported on Kubernetes version 1.17 and later Amazon EKS clusters and nodes. The driver is not supported on Fargate or Arm nodes. Alpha features of the Amazon FSx for Lustre CSI Driver are not supported on Amazon EKS clusters. The driver is in Beta release. It is well tested and supported by Amazon EKS for production use. Support for the driver will not be dropped, though details may change. If the schema or schematics of the driver changes, instructions for migrating to the next version will be provided.

For detailed descriptions of the available parameters and complete examples that demonstrate the driver's features, see the [Amazon FSx for Lustre Container Storage Interface \(CSI\) driver](#) project on GitHub.

## Prerequisites

You must have:

- Version 1.18.120 or later of the AWS CLI installed. You can check your currently-installed version with the `aws --version` command. To install or upgrade the AWS CLI, see [Installing the AWS CLI](#).
- An existing Amazon EKS cluster. If you don't currently have a cluster, see [??? \(p. 3\)](#) to create one.
- Version 0.26.0-rc.1 or later of `eksctl` installed. You can check your currently-installed version with the `eksctl version` command. To install or upgrade `eksctl`, see [Installing or upgrading eksctl \(p. 234\)](#).
- The latest version of `kubectl` installed that aligns to your cluster version. You can check your currently-installed version with the `kubectl version --short --client` command. For more information, see [Installing kubectl \(p. 229\)](#).

## To deploy the Amazon FSx for Lustre CSI driver to an Amazon EKS cluster

1. Create an AWS Identity and Access Management OIDC provider and associate it with your cluster.

```
eksctl utils associate-iam-oidc-provider \
  --region region-code \
  --cluster prod \
  --approve
```

2. Create an IAM policy and service account that allows the driver to make calls to AWS APIs on your behalf.
  - a. Copy the following text and save it to a file named `fsx-csi-driver.json`.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "iam:CreateServiceLinkedRole",
        "iam:AttachRolePolicy",
        "iam:PutRolePolicy"
      ],
      "Resource": "arn:aws:iam::*:role/aws-service-role/s3.data-
source.lustre.fsx.amazonaws.com/*"
    },
    {
      "Action": "iam:CreateServiceLinkedRole",
      "Effect": "Allow",
      "Resource": "*",
      "Condition": {
        "StringLike": {
          "iam:AWSServiceName": [
            "fsx.amazonaws.com"
          ]
        }
      }
    }
  ],
  {
    "Effect": "Allow",
    "Action": [
```



```
        "s3:ListBucket",
        "fsx:CreateFileSystem",
        "fsx:DeleteFileSystem",
        "fsx:DescribeFileSystems"
    ],
    "Resource": [
        "*"
    ]
  }
}
```

- b. Create the policy.

```
aws iam create-policy \
  --policy-name Amazon_FSx_Lustre_CSI_Driver \
  --policy-document file://fsx-csi-driver.json
```

Take note of the policy Amazon Resource Name (ARN) that is returned.

3. Create a Kubernetes service account for the driver and attach the policy to the service account. Replacing the ARN of the policy with the ARN returned in the previous step.

```
eksctl create iamserviceaccount \
  --region region-code \
  --name fsx-csi-controller-sa \
  --namespace kube-system \
  --cluster prod \
  --attach-policy-arn arn:aws:iam::111122223333:policy/Amazon_FSx_Lustre_CSI_Driver \
  --approve
```

Output:

You'll see several lines of output as the service account is created. The last line of output is similar to the following example line.

```
[#] created serviceaccount "kube-system/fsx-csi-controller-sa"
```

Note the name of the AWS CloudFormation stack that was deployed. In the example output above, the stack is named `eksctl-prod-addon-iamserviceaccount-kube-system-fsx-csi-controller-sa`.

4. Note the **Role ARN** for the role that was created.
  - a. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
  - b. Ensure that the console is set to the region that you created your IAM role in and then select **Stacks**.
  - c. Select the stack named `eksctl-prod-addon-iamserviceaccount-kube-system-fsx-csi-controller-sa`.
  - d. Select the **Outputs** tab. The **Role ARN** is listed on the **Output(1)** page.
5. Deploy the driver with the following command.

```
kubectl apply -k "github.com/kubernetes-sigs/aws-fsx-csi-driver/deploy/kubernetes/overlays/stable/?ref=master"
```

Output

```
Warning: kubectl apply should be used on resource created by either kubectl create --save-config or kubectl apply
serviceaccount/fsx-csi-controller-sa configured
clusterrole.rbac.authorization.k8s.io/fsx-csi-external-provisioner-role created
clusterrolebinding.rbac.authorization.k8s.io/fsx-csi-external-provisioner-binding created
deployment.apps/fsx-csi-controller created
daemonset.apps/fsx-csi-node created
csidriver.storage.k8s.io/fsx.csi.aws.com created
```

6. Patch the driver deployment to add the service account that you created in step 3, replacing the ARN with the ARN that you noted in step 4.

```
kubectl annotate serviceaccount -n kube-system fsx-csi-controller-sa \
eks.amazonaws.com/role-arn=arn:aws:iam::111122223333:role/eksctl-prod-addon-
iamserviceaccount-kube-sys-Role1-NPFTLHJ5PJF5 --overwrite=true
```

### To deploy a Kubernetes storage class, persistent volume claim, and sample application to verify that the CSI driver is working

This procedure uses the [Dynamic volume provisioning for Amazon S3](#) from the [Amazon FSx for Lustre Container Storage Interface \(CSI\) driver](#) GitHub repository to consume a dynamically-provisioned Amazon FSx for Lustre volume.

1. Create an Amazon S3 bucket and a folder within it named `export` by creating and copying a file to the bucket.

```
aws s3 mb s3://fsx-csi
echo test-file >> testfile
aws s3 cp testfile s3://fsx-csi/export/testfile
```

2. Download the storageclass manifest with the following command.

```
curl -o storageclass.yaml https://raw.githubusercontent.com/kubernetes-sigs/aws-fsx-csi-driver/master/examples/kubernetes/dynamic_provisioning_s3/specs/storageclass.yaml
```

3. Edit the file and replace the existing, alternate-colored values with your own.

```
parameters:
  subnetId: subnet-056da83524edbe641
  securityGroupIds: sg-086f61ea73388fb6b
  s3ImportPath: s3://ml-training-data-000
  s3ExportPath: s3://ml-training-data-000/export
  deploymentType: SCRATCH_2
```

- **subnetId** – The subnet ID that the Amazon FSx for Lustre file system should be created in. Amazon FSx for Lustre is not supported in all Availability Zones. Open the Amazon FSx for Lustre console at <https://console.aws.amazon.com/fsx/> to confirm that the subnet that you want to use is in a supported Availability Zone. The subnet can include your nodes, or can be a different subnet or VPC. If the subnet that you specify is not the same subnet that you have nodes in, then your VPCs must be [connected](#), and you must ensure that you have the necessary ports open in your security groups.
- **securityGroupIds** – The security group ID for your nodes.
- **s3ImportPath** – The Amazon Simple Storage Service data repository that you want to copy data from to the persistent volume. Specify the `fsx-csi` bucket that you created in step 1.

- **s3ExportPath** – The Amazon S3 data repository that you want to export new or modified files to. Specify the `fsx-csi/export` folder that you created in step 1.
- **deploymentType** – The file system deployment type. Valid values are `SCRATCH_1`, `SCRATCH_2`, and `PERSISTENT_1`. For more information about deployment types, see [Create your Amazon FSx for Lustre file system](#).

**Note**

The Amazon S3 bucket for `s3ImportPath` and `s3ExportPath` must be the same, otherwise the driver cannot create the Amazon FSx for Lustre file system. The `s3ImportPath` can stand alone. A random path will be created automatically like `s3://ml-training-data-000/FSxLustre20190308T012310Z`. The `s3ExportPath` cannot be used without specifying a value for `s3ImportPath`.

4. Create the storageclass.

```
kubectl apply -f storageclass.yaml
```

5. Download the persistent volume claim manifest.

```
curl -o claim.yaml https://raw.githubusercontent.com/kubernetes-sigs/aws-fsx-csi-driver/master/examples/kubernetes/dynamic_provisioning_s3/specs/claim.yaml
```

6. (Optional) Edit the `claim.yaml` file. Change the following **value** to one of the increment values listed below, based on your storage requirements and the `deploymentType` that you selected in a previous step.

```
storage: 1200Gi
```

- `SCRATCH_2` and `PERSISTENT` – 1.2 TiB, 2.4 TiB, or increments of 2.4 TiB over 2.4 TiB.
- `SCRATCH_1` – 1.2 TiB, 2.4 TiB, 3.6 TiB, or increments of 3.6 TiB over 3.6 TiB.

7. Create the persistent volume claim.

```
kubectl apply -f claim.yaml
```

8. Confirm that the file system is provisioned.

```
kubectl get pvc
```

Output.

NAME	STATUS	VOLUME	CAPACITY	ACCESS MODES
STORAGECLASS	AGE			
fsx-claim	Bound	pvc-15dad3c1-2365-11ea-a836-02468c18769e	1200Gi	RWX
fsx-sc		7m37s		

**Note**

The `STATUS` may show as `Pending` for 5-10 minutes, before changing to `Bound`. Don't continue with the next step until the `STATUS` is `Bound`.

9. Deploy the sample application.

```
kubectl apply -f https://raw.githubusercontent.com/kubernetes-sigs/aws-fsx-csi-driver/master/examples/kubernetes/dynamic_provisioning_s3/specs/pod.yaml
```

10. Verify that the sample application is running.

```
kubectl get pods
```

#### Output

NAME	READY	STATUS	RESTARTS	AGE
fsx-app	1/1	Running	0	8s

### Access Amazon S3 files from the Amazon FSx for Lustre file system

If you only want to import data and read it without any modification and creation, then you don't need a value for `s3ExportPath` in your `storageclass.yaml` file. Verify that data was written to the Amazon FSx for Lustre file system by the sample app.

```
kubectl exec -it fsx-app ls /data
```

#### Output.

```
export out.txt
```

The sample app wrote the `out.txt` file to the file system.

### Archive files to the `s3ExportPath`

For new files and modified files, you can use the Lustre user space tool to archive the data back to Amazon S3 using the value that you specified for `s3ExportPath`.

1. Export the file back to Amazon S3.

```
kubectl exec -ti fsx-app -- lfs hsm_archive /data/out.txt
```

#### Note

- New files aren't synced back to Amazon S3 automatically. In order to sync files to the `s3ExportPath`, you need to [install the Lustre client](#) in your container image and manually run the `lfs hsm_archive` command. The container should run in privileged mode with the `CAP_SYS_ADMIN` capability.
  - This example uses a lifecycle hook to install the Lustre client for demonstration purpose. A normal approach is building a container image with the Lustre client.
2. Confirm that the `out.txt` file was written to the `s3ExportPath` folder in Amazon S3.

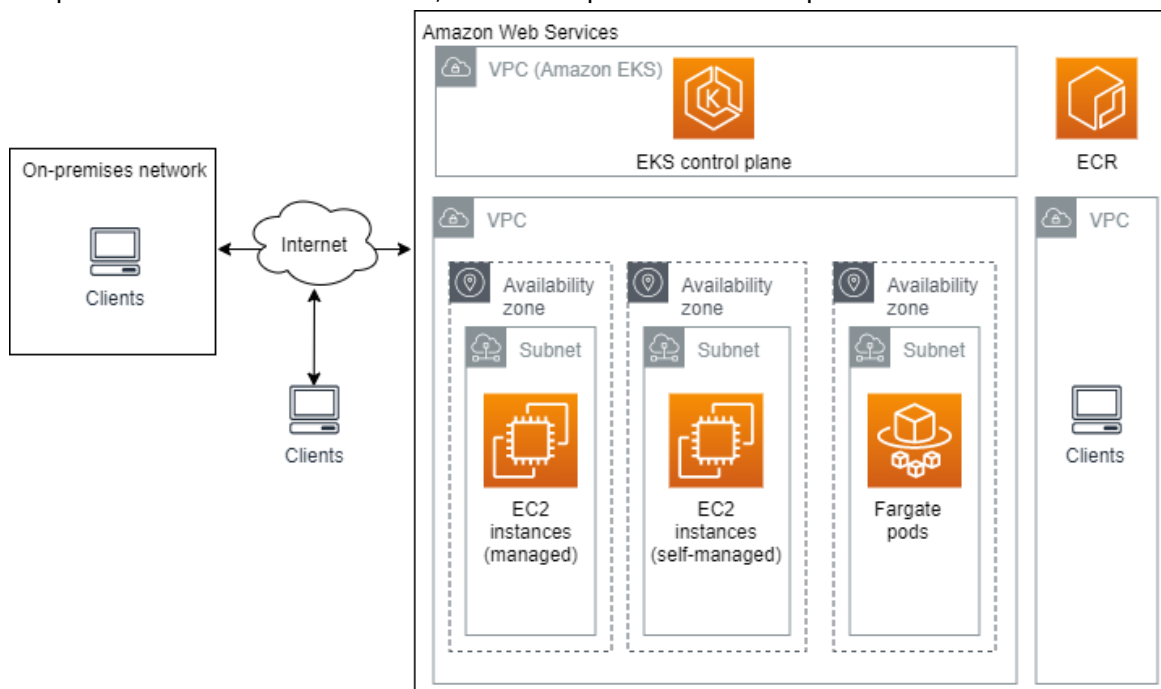
```
aws s3 ls fsx-csi/export/
```

#### Output

```
2019-12-23 12:11:35      4553 out.txt
2019-12-23 11:41:21         10 testfile
```

# Amazon EKS networking

This chapter provides an overview of Amazon EKS networking. The following diagram shows key components of an Amazon EKS cluster, and the components' relationship to a VPC.



The following explanations help you understand how components of the diagram relate to each other and which topics in this guide and other AWS guides that you can reference for more information.

- **Amazon VPC and subnets** – All Amazon EKS resources are deployed to one Region in an existing subnet in an existing VPC. For more information, see [VPCs and subnets](#) in the Amazon VPC User Guide. Each subnet exists in one Availability Zone. The VPC and subnets must meet requirements such as the following:
  - VPCs and subnets must be tagged appropriately, so that Kubernetes knows that it can use them for deploying resources, such as load balancers. For more information, see [the section called “VPC tagging requirement”](#) (p. 172) and [the section called “Subnet tagging requirement”](#) (p. 172). If you deploy the VPC using an Amazon EKS provided [AWS CloudFormation template](#) (p. 168) or using `eksctl`, then the VPC and subnets are tagged appropriately for you.
  - A subnet may or may not have internet access. If a subnet does not have internet access, the pods deployed within it must be able to access other AWS services, such as Amazon ECR, to pull container images. For more information about using subnets that don't have internet access, see [??? \(p. 82\)](#).
  - Any public subnets that you use must be configured to auto-assign public IP addresses for Amazon EC2 instances launched within them. For more information, see [the section called “VPC IP addressing”](#) (p. 171).
  - The nodes and control plane must be able to communicate over all ports through appropriately tagged [security groups](#). For more information, see [the section called “Amazon EKS security group considerations”](#) (p. 173).
  - You can implement a network segmentation and tenant isolation network policy. Network policies are similar to AWS security groups in that you can create network ingress and egress rules. Instead of assigning instances to a security group, you assign network policies to pods using pod selectors and labels. For more information, see [the section called “Installing Calico on Amazon EKS”](#) (p. 194).

You can deploy a VPC and subnets that meet the Amazon EKS requirements through manual configuration, or by deploying the VPC and subnets using [eksctl](#) (p. 234), or an Amazon EKS provided AWS CloudFormation template. Both [eksctl](#) and the AWS CloudFormation template create the VPC and subnets with the required configuration. For more information, see [the section called “Creating a VPC for Amazon EKS”](#) (p. 168).

- **Amazon EKS control plane** – Deployed and managed by Amazon EKS in an Amazon EKS managed VPC. When you create the cluster, Amazon EKS creates and manages [requester-managed network interfaces](#) in a separate VPC from the control plane VPC that you specify, which allows AWS Fargate and Amazon EC2 instances to communicate with the control plane.

By default, the control plane exposes a public endpoint so that clients and nodes can communicate with the cluster. You can limit the internet client source IP addresses that can communicate with the public endpoint. Alternatively, you can enable a private endpoint and disable the public endpoint or enable both the public and private endpoints. To learn more about cluster endpoints, see [??? \(p. 49\)](#).

Clients in your on-premises network or other VPCs can communicate with the public or private-only endpoint, if you've configured connectivity between the VPC that the cluster is deployed to and the other networks. For more information about connecting your VPC to other networks, see the AWS [Network-to-Amazon VPC connectivity options](#) and [Amazon VPC-to-Amazon VPC connectivity options](#) technical papers.

- **Amazon EC2 instances** – Each Amazon EC2 node is deployed to one subnet. Each node is assigned a [private IP address](#) from a CIDR block assigned to the subnet. If the subnets were created using one of the [Amazon EKS provided AWS CloudFormation templates](#) (p. 168), then nodes deployed to public subnets are automatically assigned a [public IP address](#) by the subnet. Each node is deployed with the [the section called “Pod networking \(CNI\)”](#) (p. 176) which, by default, assigns each pod a private IP address from the CIDR block assigned to the subnet that the node is in and adds the IP address as a secondary IP address to one of the [elastic network interfaces](#) (ENI) attached to the instance.

For self-managed nodes, you can change this behavior by assigning additional CIDR blocks to your VPC and enabling [the section called “CNI custom networking”](#) (p. 184), which assigns IP addresses to pods from different subnets than the node is deployed to. To use custom networking, you must enable it when you launch your self-managed nodes.

By default, the source IP address of each pod that communicates with resources outside of the VPC is translated through network address translation (NAT) to the primary IP address of the primary ENI attached to the node. You can change this behavior to instead have a NAT device in a private subnet translate each pod's IP address to the NAT device's IP address. For more information, see [the section called “External SNAT”](#) (p. 183).

- **Fargate pods** – Deployed to private subnets only. Each pod is assigned a private IP address from the CIDR block assigned to the subnet. Fargate does not support all pod networking options. For more information, see [??? \(p. 118\)](#).

## Creating a VPC for your Amazon EKS cluster

Amazon Virtual Private Cloud (Amazon VPC) enables you to launch AWS resources into a virtual network that you've defined. This virtual network closely resembles a traditional network that you'd operate in your own data center, with the benefits of using the scalable infrastructure of AWS. For more information, see the [Amazon VPC User Guide](#) and [De-mystifying cluster networking for Amazon EKS nodes](#).

If you want to use an existing VPC, then it must meet specific requirements for use with Amazon EKS. For more information, see [??? \(p. 170\)](#). This topic guides you through creating a VPC for your cluster using one of the following configurations:

- **Public and private subnets** – This VPC has two public and two private [subnets](#). One public and one private subnet are deployed to the same [Availability Zone](#). The other public and private subnets are deployed to a second Availability Zone in the same Region. We recommend this option for all production deployments. This option allows you to deploy your nodes to private subnets and allows Kubernetes to deploy load balancers to the public subnets that can load balance traffic to pods running on nodes in the private subnets.

[Public IP addresses](#) are automatically assigned to resources deployed to one of the public subnets, but public IP addresses are not assigned to any resources deployed to the private subnets. The nodes in private subnets can communicate with the cluster and other AWS services, and pods can communicate outbound to the internet through a [NAT gateway](#) that is deployed in each Availability Zone. A [security group](#) is deployed that denies all inbound traffic and allows all outbound traffic. The subnets are tagged so that Kubernetes is able to deploy load balancers to them. For more information about subnet tagging, see [??? \(p. 172\)](#). For more information about this type of VPC, see [VPC with public and private subnets \(NAT\)](#).

- **Only public subnets** – This VPC has three public subnets that are deployed into different Availability Zones in the region. All nodes are automatically assigned public IP addresses and can send and receive internet traffic through an internet gateway. A [security group](#) is deployed that denies all inbound traffic and allows all outbound traffic. The subnets are tagged so that Kubernetes can deploy load balancers to them. For more information about subnet tagging, see [??? \(p. 172\)](#). For more information about this type of VPC, see [VPC with a single public subnet](#).
- **Only private subnets** – This VPC has three private subnets that are deployed into different Availability Zones in the Region. All nodes can optionally send and receive internet traffic through a NAT instance or NAT gateway. A [security group](#) is deployed that denies all inbound traffic and allows all outbound traffic. The subnets are tagged so that Kubernetes can deploy internal load balancers to them. For more information about subnet tagging, see [??? \(p. 172\)](#). For more information about this type of VPC, see [VPC with a private subnet only and AWS Site-to-Site VPN access](#).

#### Important

There are additional requirements if the VPC does not have outbound internet access, such as via a NAT Instance, NAT Gateway, VPN, or Direct Connect. You must bypass the EKS cluster introspection by providing the cluster certificate authority and cluster API endpoint to the nodes. You also may need to configure VPC endpoints listed in [??? \(p. 49\)](#).

#### Important

If you deployed a VPC using `eksctl` or by using either of the Amazon EKS AWS CloudFormation VPC templates:

- On or after 03/26/2020 – Public IPv4 addresses are automatically assigned by public subnets to new nodes deployed to public subnets.
- Before 03/26/2020 – Public IPv4 addresses are not automatically assigned by public subnets to new nodes deployed to public subnets.

This change impacts new node groups deployed to public subnets in the following ways:

- [Managed node groups \(p. 90\)](#) – If the node group is deployed to a public subnet on or after 04/22/2020, the public subnet must have automatic assignment of public IP addresses enabled. For more information, see [Modifying the public IPv4 addressing attribute for your subnet](#).
- [Linux \(p. 102\)](#), [Windows \(p. 106\)](#), or [Arm \(p. 136\)](#) self-managed node groups – If the node group is deployed to a public subnet on or after 03/26/2020, the public subnet must have automatic assignment of public IP addresses enabled or the nodes must be launched with a public IP address. For more information, see [Modifying the public IPv4 addressing attribute for your subnet](#) or [Assigning a public IPv4 address during instance launch](#).

Choose the tab below that represents your desired VPC configuration.

## Creating a VPC for your Amazon EKS cluster

### Public and private subnets

#### To create your cluster VPC with public and private subnets

1. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
2. From the navigation bar, select a Region that supports Amazon EKS.
3. Choose **Create stack**.
4. For **Choose a template**, select **Specify an Amazon S3 template URL**.
5. Paste the following URL into the text area and choose **Next**:

```
https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/amazon-eks-vpc-private-subnets.yaml
```

6. On the **Specify Details** page, fill out the parameters accordingly, and then choose **Next**.
  - **Stack name**: Choose a stack name for your AWS CloudFormation stack. For example, you can call it **eks-vpc**.
  - **VpcBlock**: Choose a CIDR range for your VPC. Each worker node, pod, and load balancer that you deploy is assigned an IP address from this block. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it. For more information, see [VPC and subnet sizing](#) in the Amazon VPC User Guide. You can also add additional CIDR blocks to the VPC once it's created.
  - **PublicSubnet01Block**: Specify a CIDR block for public subnet 1. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **PublicSubnet02Block**: Specify a CIDR block for public subnet 2. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **PrivateSubnet01Block**: Specify a CIDR block for private subnet 1. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **PrivateSubnet02Block**: Specify a CIDR block for private subnet 2. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
7. (Optional) On the **Options** page, tag your stack resources. Choose **Next**.
8. On the **Review** page, choose **Create**.
9. When your stack is created, select it in the console and choose **Outputs**.
10. Record the **SecurityGroups** value for the security group that was created. When you add nodes to your cluster, you must specify the ID of the security group. The security group is applied to the cross-account elastic network interfaces that are created in your subnets that allow the Amazon EKS control plane to communicate with your nodes.
11. Record the **VpcId** for the VPC that was created. You need this when you launch your node group template.
12. Record the **SubnetIds** for the subnets that were created and whether you created them as public or private subnets. When you add nodes to your cluster, you must specify the IDs of the subnets that you want to launch the nodes into.

### Only public subnets

#### To create your cluster VPC with only public subnets

1. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.



2. From the navigation bar, select a Region that supports Amazon EKS.
3. Choose **Create stack**.
4. For **Choose a template**, select **Specify an Amazon S3 template URL**.
5. Paste the following URL into the text area and choose **Next**:

```
https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/amazon-eks-vpc-sample.yaml
```

6. On the **Specify Details** page, fill out the parameters accordingly, and then choose **Next**.
  - **Stack name**: Choose a stack name for your AWS CloudFormation stack. For example, you can call it **eks-vpc**.
  - **VpcBlock**: Choose a CIDR block for your VPC. Each worker node, pod, and load balancer that you deploy is assigned an IP address from this block. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it. For more information, see [VPC and subnet sizing](#) in the Amazon VPC User Guide. You can also add additional CIDR blocks to the VPC once it's created.
  - **Subnet01Block**: Specify a CIDR block for subnet 1. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **Subnet02Block**: Specify a CIDR block for subnet 2. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **Subnet03Block**: Specify a CIDR block for subnet 3. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
7. (Optional) On the **Options** page, tag your stack resources. Choose **Next**.
8. On the **Review** page, choose **Create**.
9. When your stack is created, select it in the console and choose **Outputs**.
10. Record the **SecurityGroups** value for the security group that was created. When you add nodes to your cluster, you must specify the ID of the security group. The security group is applied to the cross-account elastic network interfaces that are created in your subnets that allow the Amazon EKS control plane to communicate with your nodes.
11. Record the **VpcId** for the VPC that was created. You need this when you launch your node group template.
12. Record the **SubnetIds** for the subnets that were created. When you add nodes to your cluster, you must specify the IDs of the subnets that you want to launch the nodes into.

Only private subnets

### To create your cluster VPC with only private subnets

1. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
2. From the navigation bar, select a Region that supports Amazon EKS.
3. Choose **Create stack**.
4. For **Choose a template**, select **Specify an Amazon S3 template URL**.
5. Paste the following URL into the text area and choose **Next**:

```
https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/amazon-eks-fully-private-vpc.yaml
```

6. On the **Specify Details** page, fill out the parameters accordingly, and then choose **Next**.
  - **Stack name**: Choose a stack name for your AWS CloudFormation stack. For example, you can call it **eks-vpc**.

- **VpcBlock:** Choose a CIDR block for your VPC. Each worker node, pod, and load balancer that you deploy is assigned an IP address from this block. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it. For more information, see [VPC and subnet sizing](#) in the Amazon VPC User Guide. You can also add additional CIDR blocks to the VPC once it's created.
  - **PrivateSubnet01Block:** Specify a CIDR block for subnet 1. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **PrivateSubnet02Block:** Specify a CIDR block for subnet 2. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
  - **PrivateSubnet03Block:** Specify a CIDR block for subnet 3. The default value provides enough IP addresses for most implementations, but if it doesn't, then you can change it
7. (Optional) On the **Options** page, tag your stack resources. Choose **Next**.
  8. On the **Review** page, choose **Create**.
  9. When your stack is created, select it in the console and choose **Outputs**.
  10. Record the **SecurityGroups** value for the security group that was created. When you add nodes to your cluster, you must specify the ID of the security group. The security group is applied to the cross-account elastic network interfaces that are created in your subnets that allow the Amazon EKS control plane to communicate with your nodes.
  11. Record the **VpcId** for the VPC that was created. You need this when you launch your node group template.
  12. Record the **SubnetIds** for the subnets that were created. When you add nodes to your cluster, you must specify the IDs of the subnets that you want to launch the nodes into.

## Next steps

After you have created your VPC, you can try the [Getting started with Amazon EKS \(p. 3\)](#) walkthrough, but you can skip the [Create your Amazon EKS cluster VPC \(p. 19\)](#) section and use these subnets and security groups for your cluster.

## Cluster VPC considerations

When you create an Amazon EKS cluster, you specify the VPC subnets for your cluster to use. Amazon EKS requires subnets in at least two Availability Zones. We recommend a VPC with public and private subnets so that Kubernetes can create public load balancers in the public subnets that load balance traffic to pods running on nodes that are in private subnets.

When you create your cluster, specify all of the subnets that will host resources for your cluster (such as nodes and load balancers).

### Note

Internet-facing load balancers require a public subnet in your cluster. By default, nodes also require outbound internet access to the Amazon EKS APIs for cluster introspection and node registration at launch time. For clusters without outbound internet access, see [??? \(p. 82\)](#). To pull container images, they require access to the Amazon S3 and Amazon ECR APIs (and any other container registries, such as DockerHub). For more information, see [Amazon EKS security group considerations \(p. 173\)](#) and [AWS IP Address Ranges](#) in the *AWS General Reference*.

The subnets that you pass when you create the cluster influence where Amazon EKS places elastic network interfaces that are used for the control plane to node communication.

It is possible to specify only public or private subnets when you create your cluster, but there are some limitations associated with these configurations:

- **Private-only:** Everything runs in a private subnet and Kubernetes cannot create internet-facing load balancers for your pods.
- **Public-only:** Everything runs in a public subnet, including your nodes.

Amazon EKS creates an elastic network interface in your private subnets to facilitate communication to your nodes. This communication channel supports Kubernetes functionality such as `kubectl exec` and `kubectl logs`. The security group that you specify when you create your cluster is applied to the elastic network interfaces that are created for your cluster control plane.

Your VPC must have DNS hostname and DNS resolution support. Otherwise, your nodes cannot register with your cluster. For more information, see [Using DNS with Your VPC](#) in the *Amazon VPC User Guide*.

## VPC IP addressing

Nodes must be able to communicate with the control plane and other AWS services. If your nodes are deployed in a private subnet, then you must have either:

- Setup a default route for the subnet to a [NAT gateway](#). The NAT gateway must be assigned a public IP address to provide internet access for the nodes.
- Configured several necessary settings for the subnet and taken the necessary actions listed in [??? \(p. 82\)](#).

If self-managed nodes are deployed to a public subnet, then the subnet must be configured to auto-assign public IP addresses or your node instances must be assigned a public IP address when they're [launched](#). If managed nodes are deployed to a public subnet, then the subnet must be configured to auto-assign public IP addresses or the nodes will not be assigned a public IP address. Determine whether your public subnets are configured to auto-assign public IP addresses with the following command.

```
aws ec2 describe-subnets \
  --filters "Name=vpc-id,Values=VPC-ID" | grep 'SubnetId\|MapPublicIpOnLaunch'
```

### Output

```
"MapPublicIpOnLaunch": false,
"SubnetId": "subnet-aaaaaaaaaaaaaaaa",
"MapPublicIpOnLaunch": false,
"SubnetId": "subnet-bbbbbbbbbbbbbbbbbb",
```

For any subnets that have `MapPublicIpOnLaunch` set to `false`, change the setting to `true`.

```
aws ec2 modify-subnet-attribute --map-public-ip-on-launch --subnet-id subnet-aaaaaaaaaaaaaaaa
```

### Important

If you used an [Amazon EKS AWS CloudFormation template \(p. 166\)](#) to deploy your VPC prior to 03/26/2020, then you need to change the setting for your public subnets.

You can define both private (RFC 1918), and public (non-RFC 1918) CIDR ranges within the VPC used for your Amazon EKS cluster. For more information, see [Adding IPv4 CIDR blocks to a VPC](#) in the *Amazon VPC User Guide*. When choosing the classless inter-domain routing (CIDR) blocks for your VPC and subnets, make sure that the blocks contain enough IP addresses for all of the Amazon EC2 nodes and pods that you plan to deploy (one IP address per pod). You can conserve IP address use by implementing a transit gateway with a shared services VPC. For more information, see [Isolated VPCs with shared services](#) and [EKS VPC routable IP address conservation patterns in a hybrid network](#).

The Amazon EKS control plane creates up to 4 [requester-managed network interfaces](#) in your VPC for each cluster. Be sure that the subnets that you specify have enough available IP addresses for the requester-managed network interfaces and your pods.

## VPC tagging requirement

When you create an Amazon EKS cluster earlier than version 1.15, Amazon EKS tags the VPC containing the subnets you specify in the following way so that Kubernetes can discover it:

Key	Value
kubernetes.io/cluster/<cluster-name>	shared

- **Key:** The <cluster-name> value matches your Amazon EKS cluster's name.
- **Value:** The shared value allows more than one cluster to use this VPC.

This tag is not required or created by Amazon EKS for 1.15 clusters. If you deploy a 1.15 cluster to a VPC that already has this tag, the tag is not removed.

## Subnet tagging requirement

When you create your Amazon EKS cluster, Amazon EKS tags the subnets you specify in the following way so that Kubernetes can discover them:

### Note

All subnets (public and private) that your cluster uses for resources should have this tag.

Key	Value
kubernetes.io/cluster/<cluster-name>	shared

- **Key:** The <cluster-name> value matches your Amazon EKS cluster.
- **Value:** The shared value allows more than one cluster to use this subnet.

## Private subnet tagging requirement for internal load balancers

Private subnets must be tagged in the following way so that Kubernetes knows it can use the subnets for internal load balancers. If you use an Amazon EKS AWS CloudFormation template to create your VPC after 03/26/2020, then the subnets created by the template are tagged when they're created. For more information about the Amazon EKS AWS CloudFormation VPC templates, see [??? \(p. 166\)](#).

Key	Value
kubernetes.io/role/internal-elb	1

## Public subnet tagging option for external load balancers

You must tag the public subnets in your VPC so that Kubernetes knows to use only those subnets for external load balancers instead of choosing a public subnet in each Availability Zone (in lexicographical

order by subnet ID). If you use an Amazon EKS AWS CloudFormation template to create your VPC after 03/26/2020, then the subnets created by the template are tagged when they're created. For more information about the Amazon EKS AWS CloudFormation VPC templates, see [??? \(p. 166\)](#).

Key	Value
kubernetes.io/role/elb	1

## Amazon EKS security group considerations

The following sections describe the minimum required and recommended security group settings for the cluster, control plane, and node security groups for your cluster, depending on your Kubernetes version and Amazon EKS platform version.

### Cluster security group (available starting with Amazon EKS clusters running Kubernetes 1.14 and eks . 3 platform version)

Amazon EKS clusters beginning with Kubernetes version 1.14 and [platform version \(p. 64\)](#) eks . 3 create a cluster security group as part of cluster creation (or when a cluster is upgraded to this Kubernetes version and platform version). This security group is designed to allow all traffic from the control plane and [managed node groups \(p. 88\)](#) to flow freely between each other. By assigning the cluster security group to the control plane cross-account elastic network interfaces and the managed node group instances, you do not need to configure complex security group rules to allow this communication. Any instance or network interface that is assigned this security group can freely communicate with other resources with this security group.

You can check for a cluster security group for your cluster in the AWS Management Console under the cluster's **Networking** section, or with the following AWS CLI command:

```
aws eks describe-cluster --name cluster_name --query  
cluster.resourcesVpcConfig.clusterSecurityGroupId
```

If your cluster is running Kubernetes version 1.14 and [platform version \(p. 64\)](#) eks . 3 or later, then we recommend that you add the cluster security group to all existing and future node groups. For more information, see [Security Groups for Your VPC](#) in the *Amazon VPC User Guide*. Amazon EKS [managed node groups \(p. 88\)](#) are automatically configured to use the cluster security group.

	Protocol	Ports	Source	Destination
Recommended inbound traffic	All	All	Self	
Recommended outbound traffic	All	All		0.0.0.0/0

#### Restricting cluster traffic

If you need to limit the open ports between the control plane and nodes, the default cluster security group can be modified to allow only the following required minimum ports. The required minimum ports are the same as they were in previous Amazon EKS versions.

	Protocol	Port	Source	Destination
Minimum inbound traffic	TCP	443	Cluster security group	
Minimum inbound traffic*	TCP	10250	Cluster security group	
Minimum outbound traffic	TCP	443		Cluster security group
Minimum outbound traffic*	TCP	10250		Cluster security group

\*Any protocol and ports that you expect your nodes to use for inter-node communication should be included, if required. Nodes also require outbound internet access to the Amazon EKS APIs for cluster introspection and node registration at launch time, or that you've implemented the required necessary settings in ??? (p. 82). To pull container images, they require access to Amazon S3, Amazon ECR APIs, and any other container registries that they need to pull images from, such as DockerHub. For more information, see [AWS IP address ranges](#) in the AWS General Reference.

## Control plane and node security groups (for Amazon EKS clusters earlier than Kubernetes version 1.14 and platform version (p. 64) eks . 3)

For Amazon EKS clusters earlier than Kubernetes version 1.14 and [platform version \(p. 64\) eks . 3](#), control plane to node communication is configured by manually creating a control plane security group and specifying that security group when you create the cluster. At cluster creation, this security group is then attached to the cross-account elastic network interfaces for the cluster.

### Note

If you used the API directly, or a tool such as AWS CloudFormation to create your cluster and didn't specify a security group, then the default security group for the VPC was applied to the control plane cross-account elastic network interfaces.

You can check the control plane security group for your cluster in the AWS Management Console under the cluster's **Networking** section (listed as **Additional security groups**), or with the following AWS CLI command:

```
aws eks describe-cluster --name cluster_name --query  
cluster.resourcesVpcConfig.securityGroupIds
```

If you launch nodes with the AWS CloudFormation template in the [Getting started with Amazon EKS \(p. 3\)](#) walkthrough, AWS CloudFormation modifies the control plane security group to allow communication with the nodes. **Amazon EKS strongly recommends that you use a dedicated security group for each control plane (one per cluster).** If you share a control plane security group with other Amazon EKS clusters or resources, you may block or disrupt connections to those resources.

The security group for the nodes and the security group for the control plane communication to the nodes have been set up to prevent communication to privileged ports in the nodes. If your applications require added inbound or outbound access from the control plane or nodes, you must add these rules to the security groups associated with your cluster. For more information, see [Security Groups for Your VPC](#) in the *Amazon VPC User Guide*.

**Note**

To allow proxy functionality on privileged ports or to run the CNCF conformance tests yourself, you must edit the security groups for your control plane and the nodes. The security group on the nodes' side needs to allow inbound access for ports 0-65535 from the control plane, and the control plane side needs to allow outbound access to the nodes on ports 0-65535.

**Control Plane Security Group**

	Protocol	Port range	Source	Destination
Minimum inbound traffic	TCP	443	All node security groups  <b>When <a href="#">cluster endpoint private access (p. 49)</a> is enabled:</b> Any security groups that generate API server client traffic (such as <code>kubectl</code> commands on a bastion host within your cluster's VPC)	
Recommended inbound traffic	TCP	443	All node security groups  <b>When <a href="#">cluster endpoint private access (p. 49)</a> is enabled:</b> Any security groups that generate API server client traffic (such as <code>kubectl</code> commands on a bastion host within your cluster's VPC)	
Minimum outbound traffic	TCP	10250		All node security groups
Recommended outbound traffic	TCP	1025-65535		All node security groups

**Node security group**

	Protocol	Port range	Source	Destination
Minimum inbound traffic (from other nodes)	Any protocol that you expect your nodes to use for inter-node communication	Any ports that you expect your nodes to use for inter-node communication	All node security groups	

	Protocol	Port range	Source	Destination
Minimum inbound traffic (from control plane)	TCP	10250	Control plane security group	
Recommended inbound traffic	All TCP	All 443, 1025-65535	All node security groups Control plane security group	
Minimum outbound traffic*	TCP	443		Control plane security group
Recommended outbound traffic	All	All		0.0.0.0/0

\*Nodes also require access to the Amazon EKS APIs for cluster introspection and node registration at launch time either through the internet or VPC endpoints. To pull container images, they require access to the Amazon S3 and Amazon ECR APIs (and any other container registries, such as DockerHub). For more information, see [AWS IP address ranges](#) in the *AWS General Reference* and [the section called "Private clusters"](#) (p. 82).

If you have more than one security group associated to your nodes, then one of the security groups must have the following tag applied to it. If you have only one security group associated to your nodes, then the tag is optional. For more information about tagging, see [Working with tags using the console](#) (p. 245).

Key	Value
kubernetes.io/cluster/<cluster-name>	owned

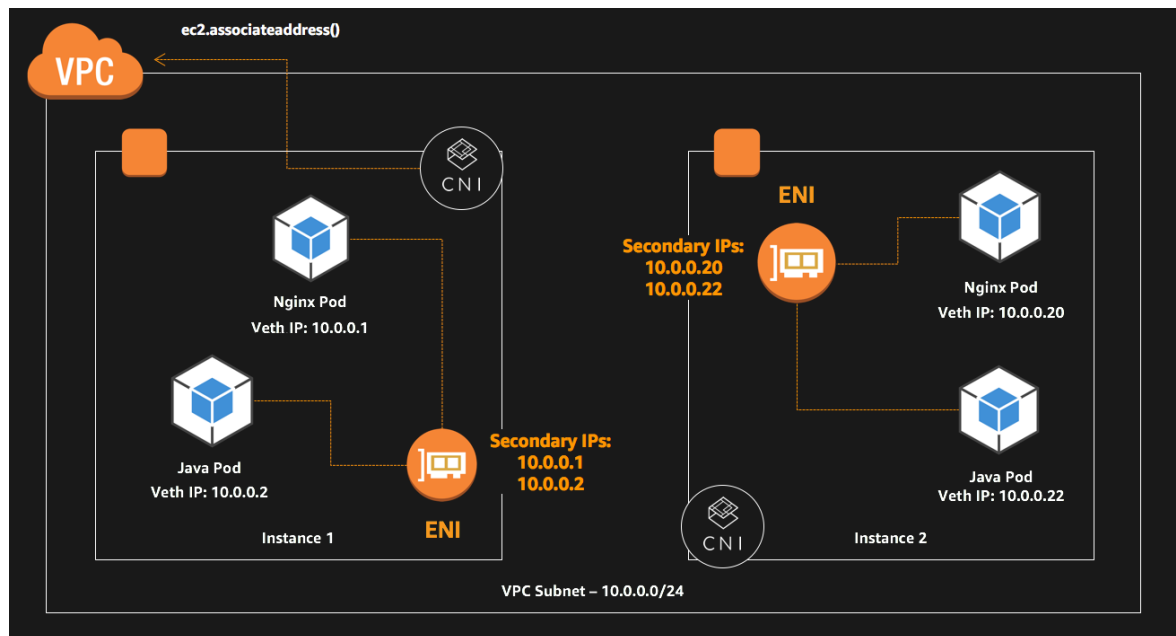
## Pod networking (CNI)

Amazon EKS supports native VPC networking via the Amazon VPC Container Network Interface (CNI) plugin for Kubernetes. Using this CNI plugin allows Kubernetes pods to have the same IP address inside the pod as they do on the VPC network. This CNI plugin is an open-source project that is maintained on [GitHub](#). The Amazon VPC CNI plugin is fully supported for use on Amazon EKS and self-managed Kubernetes clusters on AWS.

### Note

Kubernetes leverages the [Container Networking Interface \(CNI\)](#), allowing for configurable networking setups. The Amazon VPC CNI plugin may not meet requirements for all use cases. Amazon EKS maintains a network of partners that offer alternative CNI solutions with commercial support options. For more information, see [the section called "Alternate compatible CNI plugins"](#) (p. 191).





The CNI plugin is responsible for allocating VPC IP addresses to Kubernetes nodes and configuring the necessary networking for pods on each node. The plugin consists of two primary components:

- The L-IPAM daemon is responsible for attaching elastic network interfaces to instances, assigning secondary IP addresses to elastic network interfaces, and maintaining a "warm pool" of IP addresses on each node for assignment to Kubernetes pods when they are scheduled.
- The CNI plugin itself is responsible for wiring the host network (for example, configuring the interfaces and virtual Ethernet pairs) and adding the correct interface to the pod namespace.

For more information about the design and networking configuration, see [CNI plugin for Kubernetes networking over AWS VPC](#).

Elastic network interface and secondary IP address limitations by Amazon EC2 instance types are applicable. In general, larger instances can support more IP addresses. For more information, see [IP Addresses Per Network Interface Per Instance Type](#) in the *Amazon EC2 User Guide for Linux Instances*.

### Topics

- [CNI configuration variables \(p. 177\)](#)
- [External source network address translation \(SNAT\) \(p. 183\)](#)
- [CNI custom networking \(p. 184\)](#)
- [CNI metrics helper \(p. 187\)](#)
- [Amazon VPC CNI plugin for Kubernetes upgrades \(p. 190\)](#)
- [Alternate compatible CNI plugins \(p. 191\)](#)

## CNI configuration variables

The Amazon VPC CNI plugin for Kubernetes supports a number of configuration options, which are set through environment variables. The following environment variables are available, and all of them are optional.

#### **AWS\_VPC\_CNI\_NODE\_PORT\_SUPPORT**

**Type** – Boolean

**Default** – `true`

Specifies whether `NodePort` services are enabled on a node's primary network interface. This requires additional `iptables` rules and that the kernel's reverse path filter on the primary interface is set to `loose`.

#### **AWS\_VPC\_K8S\_CNI\_CUSTOM\_NETWORK\_CFG**

**Type** – Boolean

**Default** – `false`

Specifies that your pods may use subnets and security groups, within the same VPC as your control plane resources, that are independent of your cluster's `resourcesVpcConfig`. By default, pods share the same subnet and security groups as the node's primary interface. Setting this variable to `true` causes `ipamD` to use the security groups and subnets in a node's `ENIConfig` for elastic network interface allocation. You must create an `ENIConfig` custom resource definition for each subnet that your pods will reside in, and then annotate each node to use a specific `ENIConfig` (multiple nodes can be annotated with the same `ENIConfig`). Nodes can only be annotated with a single `ENIConfig` at a time, and the subnet in the `ENIConfig` must belong to the same Availability Zone that the node resides in. For more information, see [CNI custom networking \(p. 184\)](#).

#### **ENI\_CONFIG\_ANNOTATION\_DEF**

**Type** – String

**Default** – `k8s.amazonaws.com/eniConfig`

Specifies a node annotation key name. This should be used when `AWS_VPC_K8S_CNI_CUSTOM_NETWORK_CFG=true`. The annotation value will be used to set `ENIConfig` name. Annotations take precedence over labels.

#### **ENI\_CONFIG\_LABEL\_DEF**

**Type** – String

**Default** – `k8s.amazonaws.com/eniConfig`

Specifies a node label key name. This should be used when `AWS_VPC_K8S_CNI_CUSTOM_NETWORK_CFG=true`. The label value will be used to set `ENIConfig` name. Annotations will take precedence over labels. To use labels, ensure that an annotation with the key `k8s.amazonaws.com/eniConfig` is defined and that a value for the annotation key `ENI_CONFIG_ANNOTATION_DEF` is not set on the node. To select an `ENIConfig` based upon Availability Zone, set this to `failure-domain.beta.kubernetes.io/zone` and create an `ENIConfig` custom resource for each Availability Zone, such as `us-east-1a`. For more information, see [CNI custom networking \(p. 184\)](#).

#### **AWS\_VPC\_ENI\_MTU** – v1.6.0 and later

**Type** – Integer

**Default** – `9001`

Used to configure the MTU size for attached ENIs. The valid range is from 576 to 9001.

#### **AWS\_VPC\_K8S\_CNI\_EXTERNALSNAT**

**Type** – Boolean

**Default** – `false`

Specifies whether an external NAT gateway should be used to provide SNAT of secondary ENI IP addresses. If set to `true`, the SNAT `iptables` rule and off-VPC IP rule are not applied, and these rules are removed if they have already been applied.

Disable SNAT if you need to allow inbound communication to your pods from external VPNs, direct connections, and external VPCs, and your pods do not need to access the internet directly via an Internet Gateway. Your nodes must be running in a private subnet and connected to the internet through an AWS NAT Gateway or another external NAT device.

For more information, see [External source network address translation \(SNAT\) \(p. 183\)](#).

#### **AWS\_VPC\_K8S\_CNI\_RANDOMIZESNAT**

**Type** – String

**Default** – `hashrandom`

**Valid values** – `hashrandom`, `prng`, `none`

Specifies whether the SNAT `iptables` rule should randomize the outgoing ports for connections. This should be used when `AWS_VPC_K8S_CNI_EXTERNALSNAT=false`. When enabled (`hashrandom`) the `--random` flag will be added to the SNAT `iptables` rule. To use a pseudo random number generation, rather than hash-based (`--random-fully`), use `prng` for the environment variable. For old versions of `iptables` that do not support `--random-fully`, this option will fall back to `--random`. Disable (`none`) this functionality if you rely on sequential port allocation for outgoing connections.

##### **Note**

Any options other than `none` will cause outbound connections to be assigned a source port that's not necessarily part of the ephemeral port range set at the OS level (`/proc/sys/net/ipv4/ip_local_port_range`). This is relevant if you have NACLs restricting traffic based on the port range found in `ip_local_port_range`.

#### **AWS\_VPC\_K8S\_CNI\_EXCLUDE\_SNAT\_CIDRS** – v1.6.0 and later

**Type** – String

**Default** – empty

Specify a comma-separated list of IPv4 CIDRs to exclude from SNAT. For every item in the list, an `iptables` rule and off-VPC IP rule will be applied. If an item is not a valid IPv4 range it will be skipped. This should be used when `AWS_VPC_K8S_CNI_EXTERNALSNAT=false`.

#### **WARM\_ENI\_TARGET**

**Type** – Integer

**Default** – 1

Specifies the number of free elastic network interfaces (and all of their available IP addresses) that the `ipamD` daemon should attempt to keep available for pod assignment on the node. By default, `ipamD` attempts to keep one elastic network interface and all of its IP addresses available for pod assignment.

##### **Note**

The number of IP addresses per network interface varies by instance type. For more information, see [IP addresses per network interface per instance type](#) in the *Amazon EC2 User Guide for Linux Instances*.

For example, an `m4.4xlarge` launches with one network interface and 30 IP addresses. If five pods are placed on the node and five free IP addresses are removed from the IP address warm pool, then `ipamD` attempts to allocate more interfaces until `WARM_ENI_TARGET` free interfaces are available on the node.

**Note**

If `WARM_IP_TARGET` is set, then this environment variable is ignored and the `WARM_IP_TARGET` behavior is used instead.

**WARM\_IP\_TARGET**

**Type** – Integer

**Default** – None

Specifies the number of free IP addresses that the `ipamD` daemon should attempt to keep available for pod assignment on the node. For example, if `WARM_IP_TARGET` is set to 10, then `ipamD` attempts to keep 10 free IP addresses available at all times. If the elastic network interfaces on the node are unable to provide these free addresses, `ipamD` attempts to allocate more interfaces until `WARM_IP_TARGET` free IP addresses are available.

**Note**

This environment variable overrides `WARM_ENI_TARGET` behavior.

**MINIMUM\_IP\_TARGET** – v1.6.0 and later

**Type** – Integer

**Default** – None

Specifies the number of total IP addresses that the `ipamD` daemon should attempt to allocate for pod assignment on the node. `MINIMUM_IP_TARGET` behaves identically to `WARM_IP_TARGET`, except that instead of setting a target number of free IP addresses to keep available at all times, it sets a target number for a floor on how many total IP addresses are allocated.

`MINIMUM_IP_TARGET` is for pre-scaling and `WARM_IP_TARGET` is for dynamic scaling. For example, suppose a cluster has an expected pod density of approximately 30 pods per node. If `WARM_IP_TARGET` is set to 30 to ensure there are enough IPs initially allocated by the CNI, then 30 pods are deployed to the node. The CNI will allocate an additional 30 IPs, for a total of 60, accelerating IP exhaustion in the relevant subnets. If instead, `MINIMUM_IP_TARGET` is set to 30 and `WARM_IP_TARGET` to 2, after the 30 pods are deployed, the CNI would allocate an additional 2 IPs. This still provides elasticity, but uses approximately half as many IPs as using `WARM_IP_TARGET` alone (32 IP addresses versus 60 IP addresses).

This also improves reliability of the cluster by reducing the number of calls necessary to allocate or deallocate private IP addresses, which may be throttled, especially at scaling-related times.

**MAX\_ENI**

**Type** – Integer

**Default** – None

Specifies the maximum number of ENIs that will be attached to the node. When `MAX_ENI` is unset or less than or equal to 0, the setting is not used, and the maximum number of ENIs is always equal to the maximum number for the instance type in question. Even when `MAX_ENI` is a positive number, it is limited by the maximum number for the instance type.

**AWS\_VPC\_K8S\_CNI\_LOGLEVEL**

**Type** – String

**Default** – DEBUG

**Valid values** – DEBUG, INFO, WARN, ERROR, or FATAL (not case sensitive)

Specifies the loglevel for `ipamD`.

**AWS\_VPC\_K8S\_CNI\_LOG\_FILE**

**Type** – String

**Default** – Unset

Valid values: `stdout` or a file path

Specifies where to write the logging output of `ipamd`. You can specify `stdout` or override the default file, such as `/var/log/aws-routed-eni/ipamd.log`.

**AWS\_VPC\_K8S\_PLUGIN\_LOG\_FILE**

**Type** – String

**Default** – Unset

**Valid values** – `stdout` or a file path.

Specifies where to write the logging output for the `aws-cni` plugin. You can specify `stdout` or override the default file, such as `/var/log/aws-routed-eni/plugin.log`.

**AWS\_VPC\_K8S\_PLUGIN\_LOG\_LEVEL**

**Type** – String

**Default** – `DEBUG`

**Valid values** – `DEBUG`, `INFO`, `WARN`, `ERROR`, or `FATAL` (not case sensitive)

Specifies the log level for the `aws-cni` plugin.

**INTROSPECTION\_BIND\_ADDRESS**

**Type** – String

**Default** – `127.0.0.1:61679`

Specifies the bind address for the introspection endpoint. A Unix domain socket can be specified with the `unix:` prefix before the socket path.

**DISABLE\_INTROSPECTION**

**Type** – Boolean

**Default** – `false`

Specifies whether introspection endpoints are disabled on a node. Setting this to `true` will reduce the debugging information you can get from the node when running the `aws-cni-support.sh` script.

**DISABLE\_METRICS**

**Type** – Boolean

**Default** – `false`

Specifies whether the Prometheus metrics endpoint is disabled or not for `ipamd`. By default metrics are published on `:61678/metrics`.

**AWS\_VPC\_K8S\_CNI\_VETHPREFIX**

**Type** – String

**Default** – `eni`

Specifies the `veth` prefix used to generate the host-side `veth` device name for the CNI. The prefix can be a maximum of four characters long.

**ADDITIONAL\_ENI\_TAGS** – v1.6.0 and later

**Type** – String

**Default** – `{ }`

**Example values** – `{ "tag_key": "tag_val" }`

Metadata applied to ENIs help you categorize and organize your resources for billing or other purposes. Each tag consists of a custom-defined key and an optional value. Tag keys can have a maximum character length of 128 characters. Tag values can have a maximum length of 256 characters. The tags will be added to all ENIs on the host.

### Important

Custom tags should not contain the `k8s.amazonaws.com` prefix, because it is reserved. If the tag contains `k8s.amazonaws.com`, the tag addition will be ignored.

## CLUSTER\_NAME

**Type** – String

**Default** – `" "`

Specifies the cluster name to tag allocated ENIs with.

## ENI tags related to allocation

This plugin interacts with the following tags on ENIs:

- `cluster.k8s.amazonaws.com/name`
- `node.k8s.amazonaws.com/instance_id`
- `node.k8s.amazonaws.com/no_manage`

### Cluster name tag

The tag `cluster.k8s.amazonaws.com/name` will be set to the cluster name of the `aws-node` daemonset which created the ENI.

### Instance ID tag

The tag `node.k8s.amazonaws.com/instance_id` will be set to the instance ID of the `aws-node` instance that allocated this ENI.

### No manage tag

The `node.k8s.amazonaws.com/no_manage` tag is read by the `aws-node` daemonset to determine whether an ENI attached to the machine should not be configured or used for private IP addresses. This tag is not set by the CNI plugin itself, but rather may be set by a user to indicate that an ENI is intended for host networking pods, or for some other process unrelated to Kubernetes.

### Note

Attaching an ENI with the `no_manage` tag will result in an incorrect value for the `kubelet`'s `--max-pods` configuration option. Consider also updating the `MAX_ENI` and `--max-pods` configuration options on this plugin and the `kubelet`, respectively, if you are using of this tag.

## Notes

The `L-IPAMD` (`aws-node` daemonSet) running on every node requires access to the Kubernetes API server. If it can not reach the Kubernetes API server, `ipamd` will exit and the CNI will not be able to get any IP addresses for pods. To confirm whether `L-IPAMD` has access to the Kubernetes API server.

```
kubectl get svc kubernetes
```

Output

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
------	------	------------	-------------	---------	-----

```
kubernetes ClusterIP 10.0.0.1 <none> 443/TCP 29d
```

SSH into a node to check whether the node can reach the API server.

```
telnet 10.0.0.1 443
```

Output

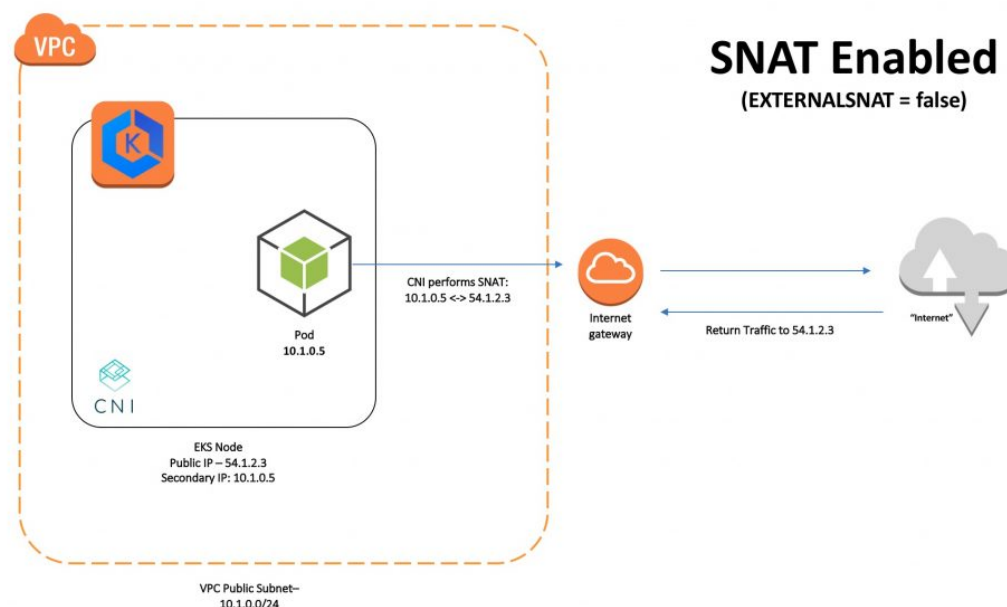
```
Trying 10.0.0.1...
Connected to 10.0.0.1.
Escape character is '^['.
```

If you receive the last line of output, then the Kubernetes API server is reachable.

## External source network address translation (SNAT)

Communication within a VPC (such as pod to pod) is direct between private IP addresses and requires no source network address translation (SNAT). When traffic is destined for an address outside of the VPC, the [Amazon VPC CNI plugin for Kubernetes](#) translates the private IP address of each pod to the primary private IP address assigned to the primary [elastic network interface](#) (network interface) of the Amazon EC2 node that the pod is running on, by default. SNAT:

- Enables pods to communicate bi-directionally with the internet. The node must be in a [public subnet](#) and have a [public](#) or [elastic IP](#) address assigned to the primary private IP address of its primary network interface. The traffic is translated to and from the public or elastic IP address and routed to and from the internet by an [internet gateway](#), as shown in the following picture.



SNAT is necessary because the internet gateway only knows how to translate between the primary private and public or elastic IP address assigned to the primary elastic network interface of the Amazon EC2 instance node that pods are running on.

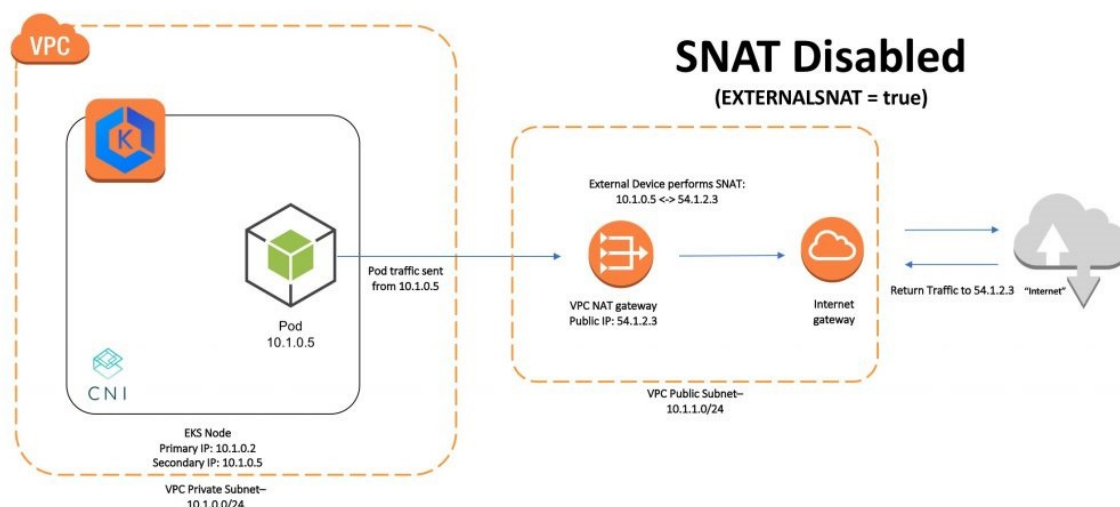
- Prevents a device in other private IP address spaces (for example, [VPC peering](#), [Transit VPC](#), or [Direct Connect](#)) from communicating directly to a pod that is not assigned the primary private IP address of the primary elastic network interface of the Amazon EC2 instance node.

If the internet or devices in other private IP address spaces need to communicate with a pod that isn't assigned the primary private IP address assigned to the primary elastic network interface of the Amazon EC2 instance node that the pod is running on, then:

- The node must be deployed in a private subnet that has a route to a [NAT device](#) in a public subnet.
- You need to enable external SNAT in the CNI plugin `aws-node` DaemonSet with the following command:

```
kubectl set env daemonset -n kube-system aws-node AWS_VPC_K8S_CNI_EXTERNALSNAT=true
```

Once external SNAT is enabled, the CNI plugin does not translate a pod's private IP address to the primary private IP address assigned to the primary elastic network interface of the Amazon EC2 instance node that the pod is running on when traffic is destined for an address outside of the VPC. Traffic from the pod to the internet is externally translated to and from the public IP address of the NAT device and routed to and from the internet by an internet gateway, as shown in the following picture.



## CNI custom networking

By default, when new network interfaces are allocated for pods, [ipamD](#) uses the node's primary elastic network interface's (ENI) security groups and subnet. However, there are use cases where your pod network interfaces should use a different security group or subnet, within the same VPC as your control plane security group. For example:

- There are a limited number of IP addresses available in a subnet. This limits the number of pods that can be created in the cluster. Using different subnets for pods allows you to increase the number of available IP addresses.
- For security reasons, your pods must use different security groups or subnets than the node's primary network interface.
- The nodes are configured in public subnets and you want the pods to be placed in private subnets using a NAT Gateway. For more information, see [External source network address translation \(SNAT\)](#) (p. 183).

### Note

You can configure custom networking for self-managed node groups or for managed node groups that were created with a launch [template that uses a custom AMI](#) (p. 100). The use cases



discussed in this topic require the [Amazon VPC CNI plugin for Kubernetes](#) version 1.4.0 or later. To check your CNI version, and upgrade if necessary, see [Amazon VPC CNI plugin for Kubernetes upgrades \(p. 190\)](#).

Enabling a custom network effectively removes an available elastic network interface (and all of its available IP addresses for pods) from each node that uses it. The primary network interface for the node is not used for pod placement when a custom network is enabled.

### To configure CNI custom networking

1. Associate a secondary CIDR block to your cluster's VPC. For more information, see [Associating a Secondary IPv4 CIDR Block with Your VPC](#) in the *Amazon VPC User Guide*.
2. Create a subnet in your VPC for each Availability Zone, using your secondary CIDR block. Your custom subnets must be from a different VPC CIDR block than the subnet that your nodes were launched into. For more information, see [Creating a Subnet in Your VPC](#) in the *Amazon VPC User Guide*.
3. Set the `AWS_VPC_K8S_CNI_CUSTOM_NETWORK_CFG=true` environment variable to `true` in the `aws-node` DaemonSet:

```
kubectl set env daemonset aws-node -n kube-system  
AWS_VPC_K8S_CNI_CUSTOM_NETWORK_CFG=true
```

4. View the currently-installed CNI version.

```
kubectl describe daemonset aws-node --namespace kube-system | grep Image | cut -d "/" -  
f 2
```

Output:

```
amazon-k8s-cni:1.6.3
```

5. If you have version 1.3 or later of the CNI installed, you can skip to step 6. Define a new `ENIConfig` custom resource for your cluster.
  - a. Create a file called `ENIConfig.yaml` and paste the following content into it:

```
apiVersion: apiextensions.k8s.io/v1beta1  
kind: CustomResourceDefinition  
metadata:  
  name: eniconfigs.crd.k8s.amazonaws.com  
spec:  
  scope: Cluster  
  group: crd.k8s.amazonaws.com  
  version: v1alpha1  
  names:  
    plural: eniconfigs  
    singular: eniconfig  
    kind: ENIConfig
```

- b. Apply the file to your cluster with the following command:

```
kubectl apply -f ENIConfig.yaml
```

6. Create an `ENIConfig` custom resource for each subnet that you want to schedule pods in.
  - a. Create a unique file for each elastic network interface configuration. Each file must include the contents below with a unique value for `name`. We highly recommend using a value for `name` that matches the Availability Zone of the subnet, as this makes deployment of multi-AZ Auto Scaling

groups simpler (see step 6c below). In this example, a file named `us-west-2a.yaml` is created. Replace the *example values* for name, subnet, and securityGroups with your own values. In this example, we follow best practices and set the value for name to the Availability Zone that the subnet is in. If you don't have a specific security group that you want to attach for your pods, you can leave that value empty for now. Later, you will specify the node security group in the ENIConfig.

**Note**

Each subnet and security group combination requires its own custom resource.

```
apiVersion: crd.k8s.amazonaws.com/v1alpha1
kind: ENIConfig
metadata:
  name: us-west-2a
spec:
  securityGroups:
    - sg-0dff111a1d11c1c11
  subnet: subnet-011b111c1f11fdf11
```

- b. Apply each custom resource file that you created to your cluster with the following command:

```
kubectl apply -f us-west-2a.yaml
```

- c. (Optional, but recommended for multi-Availability Zone node groups) By default, Kubernetes applies the Availability Zone of a node to the `failure-domain.beta.kubernetes.io/zone` label. If you named your ENIConfig custom resources after each Availability Zone in your VPC, as recommended in step 6a above, then you can enable Kubernetes to automatically apply the corresponding ENIConfig for the node's Availability Zone with the following command.

```
kubectl set env daemonset aws-node -n kube-system ENI_CONFIG_LABEL_DEF=failure-domain.beta.kubernetes.io/zone
```

**Note**

Ensure that an annotation with the key `k8s.amazonaws.com/eniConfig` for the `ENI_CONFIG_ANNOTATION_DEF` environment variable doesn't exist in the container spec for the `aws-node` daemonset. If it exists, it overrides the `ENI_CONFIG_LABEL_DEF` value, and should be removed. You can check to see if the variable is set with the `kubectl describe daemonset aws-node -n kube-system | grep ENI_CONFIG_ANNOTATION_DEF` command. If no output is returned, then the variable is not set.

7. Create a new self-managed node group for each ENIConfig that you configured.

- a. Determine the maximum number of pods that can be scheduled on each node using the following formula.

```
maxPods = (number of interfaces - 1) * (max IPv4 addresses per interface - 1) + 2
```

For example, the `m5.large` instance type supports three network interfaces and ten IPv4 addresses per interface. Inserting the values into the formula, the instance can support a maximum of 20 pods, as shown in the following calculation.

```
maxPods = (3 - 1) * (10 - 1) + 2 = 20
```

For more information about the the maximum number of network interfaces per instance type, see [IP addresses per network interface per instance type](#) in the Amazon EC2 User Guide for Linux Instances.

- b. Follow the steps in the **Self-managed nodes** tab of [Launching self-managed Amazon Linux nodes \(p. 102\)](#) to create each new self-managed node group. After you've opened the AWS CloudFormation template, enter values as described in the instructions. For the **BootstrapArguments** field, enter the following value.

```
--use-max-pods false --kubelet-extra-args '--max-pods=20'
```

8. After your node groups are created, record the security group that was created for each node group and apply it to its associated ENIConfig. Edit each ENIConfig with the following command, replacing *eniconfig-name* with your value:

```
kubectl edit eniconfig.crd.k8s.amazonaws.com/eniconfig-name
```

If you followed best practices from steps 6a and 6c above, the *eniconfig-name* corresponds to the Availability Zone name.

The spec section should look like this:

```
spec:
  securityGroups:
  - sg-0dff222a2d22c2c22
  subnet: subnet-022b222c2f22fdf22
```

9. If you have any nodes in your cluster that had pods placed on them before you completed this procedure, you should terminate them. Only new nodes that are registered with the `k8s.amazonaws.com/eniConfig` label will use the new custom networking feature.

## CNI metrics helper

The CNI metrics helper is a tool that you can use to scrape elastic network interface and IP address information, aggregate metrics at the cluster level, and publish the metrics to Amazon CloudWatch.

When managing an Amazon EKS cluster, you may want to know how many IP addresses have been assigned and how many are available. The CNI metrics helper helps you to:

- Track these metrics over time
- Troubleshoot and diagnose issues related to IP assignment and reclamation
- Provide insights for capacity planning

When a node is provisioned, the CNI plugin automatically allocates a pool of secondary IP addresses from the node's subnet to the primary elastic network interface (`eth0`). This pool of IP addresses is known as the *warm pool*, and its size is determined by the node's instance type. For example, a `c4.large` instance can support three elastic network interfaces and nine IP addresses per interface. The number of IP addresses available for a given pod is one less than the maximum (of ten) because one of the IP addresses is reserved for the elastic network interface itself. For more information, see [IP Addresses Per Network Interface Per Instance Type](#) in the *Amazon EC2 User Guide for Linux Instances*.

As the pool of IP addresses is depleted, the plugin automatically attaches another elastic network interface to the instance and allocates another set of secondary IP addresses to that interface. This process continues until the node can no longer support additional elastic network interfaces.

The following metrics are collected for your cluster and exported to CloudWatch:

- The maximum number of elastic network interfaces that the cluster can support

- The number of elastic network interfaces have been allocated to pods
- The number of IP addresses currently assigned to pods
- The total and maximum numbers of IP addresses available
- The number of ipamD errors

## Deploying the CNI metrics helper

The CNI metrics helper requires `cloudwatch:PutMetricData` permissions to send metric data to CloudWatch. This section helps you to create an IAM policy with those permissions, apply it to your node instance role, and then deploy the CNI metrics helper.

### To create an IAM policy for the CNI metrics helper

1. Create a file called `allow_put_metrics_data.json` and populate it with the following policy document.

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

2. Create an IAM policy called `CNIMetricsHelperPolicy` for your node instance profile that allows the CNI metrics helper to make calls to AWS APIs on your behalf. Use the following AWS CLI command to create the IAM policy in your AWS account.

```
aws iam create-policy --policy-name CNIMetricsHelperPolicy \
--description "Grants permission to write metrics to CloudWatch" \
--policy-document file://allow_put_metrics_data.json
```

Take note of the policy ARN that is returned.

3. Get the IAM role name for your nodes. Use the following command to print the `aws-auth` configmap.

```
kubectl -n kube-system describe configmap aws-auth
```

Output:

```
Name:          aws-auth
Namespace:     kube-system
Labels:        <none>
Annotations:   <none>

Data
====
mapRoles:
-----
- groups:
  - system:bootstrappers
  - system:nodes
  rolearn: arn:aws:iam::111122223333:role/eksctl-prod-nodegroup-standard-wo-
NodeInstanceRole-GKNS581EASPU
```

```
username: system:node:{{EC2PrivateDNSName}}  
Events: <none>
```

Record the role name for any `role:arn` values that have the `system:nodes` group assigned to them. In the above example output, the role name is `eksctl-prod-nodegroup-standard-wo-NodeInstanceRole-GKNS581EASPU`. You should have one value for each node group in your cluster.

4. Attach the new `CNIMetricsHelperPolicy` IAM policy to each of the node IAM roles you identified earlier with the following command, substituting the red text with your own AWS account number and node IAM role name.

```
aws iam attach-role-policy \  
--policy-arn arn:aws:iam::111122223333:policy/CNIMetricsHelperPolicy \  
--role-name eksctl-prod-nodegroup-standard-wo-NodeInstanceRole-GKNS581EASPU
```

### To deploy the CNI metrics helper

- Apply the CNI metrics helper manifest with the following command.

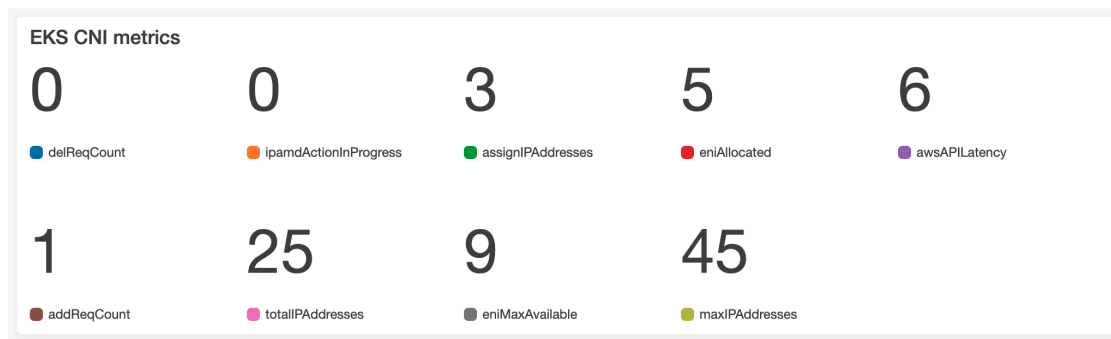
```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/release-1.6/  
config/v1.6/cni-metrics-helper.yaml
```

## Creating a metrics dashboard

After you have deployed the CNI metrics helper, you can view the CNI metrics in the CloudWatch console. This topic helps you to create a dashboard for viewing your cluster's CNI metrics.

### To create a CNI metrics dashboard

1. Open the CloudWatch console at <https://console.aws.amazon.com/cloudwatch/>.
2. In the left navigation, choose **Metrics**.
3. Under **Custom Namespaces**, choose **Kubernetes**.
4. Choose **CLUSTER\_ID**.
5. On the **All metrics** tab, select the metrics you want to add to the dashboard.
6. Choose **Actions**, and then **Add to dashboard**.
7. In the **Select a dashboard** section, choose **Create new** and enter a name for your dashboard, such as "EKS-CNI-metrics".
8. In the **Select a widget type** section, choose **Number**.
9. In the **Customize the widget title** section, enter a logical name for your dashboard title, such as "EKS CNI metrics".
10. Choose **Add to dashboard** to finish. Now your CNI metrics are added to a dashboard that you can monitor, as shown below.



## Amazon VPC CNI plugin for Kubernetes upgrades

When you launch an Amazon EKS cluster, we apply a recent version of the [Amazon VPC CNI plugin for Kubernetes](#) to your cluster. The absolute latest version of the plugin is available on [GitHub](#) for a short grace period before new clusters are switched over to use it. Amazon EKS does not automatically upgrade the CNI plugin on your cluster when new versions are released. To get a newer version of the CNI plugin on existing clusters, you must manually upgrade the plugin.

The latest version that we recommend is version 1.6.3. You can view the different releases available for the plugin, and read the release notes for each version [on GitHub](#).

Use the following procedures to check your CNI plugin version and upgrade to the latest recommended version.

### To check your Amazon VPC CNI plugin for Kubernetes version

- Use the following command to print your cluster's CNI version:

```
kubectl describe daemonset aws-node --namespace kube-system | grep Image | cut -d "/" -f 2
```

Output:

```
amazon-k8s-cni:1.6.2
```

In this example output, the CNI version is 1.6.2, which is earlier than the current recommended version, 1.6.3. Use the following procedure to upgrade the CNI.

### To upgrade the Amazon VPC CNI plugin for Kubernetes

- If your CNI version is earlier than 1.6.3, then use the appropriate command below to update your CNI version to the latest recommended version:

- US West (Oregon) (us-west-2)

```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/release-1.6/config/v1.6/aws-k8s-cni.yaml
```

- China (Beijing) (cn-north-1) or China (Ningxia) (cn-northwest-1)

```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/release-1.6/config/v1.6/aws-k8s-cni-cn.yaml
```

- AWS GovCloud (US-East) (us-gov-east-1)

```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/  
release-1.6/config/v1.6/aws-k8s-cni-us-gov-east-1.yaml
```

- AWS GovCloud (US-West) (us-gov-west-1)

```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/  
release-1.6/config/v1.6/aws-k8s-cni-us-gov-west-1.yaml
```

- For all other Regions
  - Download the manifest file.

```
curl -o aws-k8s-cni.yaml https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/  
release-1.6/config/v1.6/aws-k8s-cni.yaml
```

- Replace *region-code* in the following command with the Region that your cluster is in and then run the modified command to replace the Region code in the file (currently us-west-2).

```
sed -i -e 's/us-west-2/region-code/' aws-k8s-cni.yaml
```

- Apply the manifest file to your cluster.

```
kubectl apply -f aws-k8s-cni.yaml
```

## Alternate compatible CNI plugins

Amazon EKS only officially supports the [Amazon VPC CNI plugin \(p. 176\)](#). Amazon EKS runs upstream Kubernetes and is certified Kubernetes conformant however, so alternate CNI plugins will work with Amazon EKS clusters. If you plan to use an alternate CNI plugin in production, then we strongly recommend that you either obtain commercial support, or have the in-house expertise to troubleshoot and contribute fixes to the open source CNI plugin project.

Amazon EKS maintains relationships with a network of partners that offer support for alternate compatible CNI plugins. Refer to the following partners' documentation for details on supported Kubernetes versions and qualifications and testing performed.

Partner	Product	Documentation
Tigera	<a href="#">Calico</a>	<a href="#">Installation instructions</a>
Isovalent	<a href="#">Cilium</a>	<a href="#">Installation instructions</a>
Weaveworks	<a href="#">Weave Net</a>	<a href="#">Installation instructions</a>

Amazon EKS aims to give you a wide selection of options to cover all use cases. If you develop a commercially supported Kubernetes CNI plugin that is not listed here, then please contact our partner team at [aws-container-partners@amazon.com](mailto:aws-container-partners@amazon.com) for more information.

## Installing or upgrading CoreDNS

CoreDNS is supported on Amazon EKS clusters with Kubernetes version 1.14 or later. Clusters that were created with Kubernetes version 1.10 shipped with kube-dns as the default DNS and service discovery

provider. If you have updated from a 1.10 cluster and you want to use CoreDNS for DNS and service discovery, then you must install CoreDNS and remove kube-dns.

To check if your cluster is already running CoreDNS, use the following command.

```
kubectl get pod -n kube-system -l k8s-app=kube-dns
```

If the output shows `coredns` in the pod names, then you're already running CoreDNS in your cluster. If not, use the following procedure to update your DNS and service discovery provider to CoreDNS.

#### Note

The service for CoreDNS is still called `kube-dns` for backward compatibility.

### To install CoreDNS on an updated Amazon EKS cluster with `kubectl`

1. Add the `{"eks.amazonaws.com/component": "kube-dns"}` selector to the `kube-dns` deployment for your cluster. This prevents the two DNS deployments from competing for control of the same set of labels.

```
kubectl patch -n kube-system deployment/kube-dns --patch \
'{"spec":{"selector":{"matchLabels":{"eks.amazonaws.com/component":"kube-dns"}}}}'
```

2. Deploy CoreDNS to your cluster.
  - a. Set your cluster's DNS IP address to the `DNS_CLUSTER_IP` environment variable.

```
export DNS_CLUSTER_IP=$(kubectl get svc -n kube-system kube-dns -o
jsonpath='{.spec.clusterIP}')
```

- b. Set the `REGION` environment variable to your cluster's AWS *region-code*.

```
export REGION="region-code"
```

- c. Download the CoreDNS manifest from the Amazon EKS resource bucket.

```
curl -o dns.yaml https://amazon-eks.s3.us-west-2.amazonaws.com/
cloudformation/2020-08-12/dns.yaml
```

- d. Replace the variable placeholders in the `dns.yaml` file with your environment variable values and apply the updated manifest to your cluster. The following command completes this in one step.

```
cat dns.yaml | sed -e "s/REGION/$REGION/g" | sed -e "s/DNS_CLUSTER_IP/
$DNS_CLUSTER_IP/g" | kubectl apply -f -
```

- e. Fetch the `coredns` pod name from your cluster.

```
COREDNS_POD=$(kubectl get pod -n kube-system -l eks.amazonaws.com/component=coredns
\
-o jsonpath='{.items[0].metadata.name}')
```

- f. Query the `coredns` pod to ensure that it's receiving requests.

```
kubectl get --raw /api/v1/namespaces/kube-system/pods/$COREDNS_POD:9153/proxy/
metrics \
| grep 'coredns_dns_request_count_total'
```



### Note

It might take several minutes for the expected output to return properly, depending on the rate of DNS requests in your cluster.

In the following expected output, the number 23 is the DNS request count total.

```
# HELP coredns_dns_request_count_total Counter of DNS requests made per zone,
# TYPE coredns_dns_request_count_total counter
coredns_dns_request_count_total{family="1",proto="udp",server="dns://:53",zone="."}
23
```

3. Upgrade CoreDNS to the recommended version for your cluster by completing the steps in [the section called “Upgrading CoreDNS” \(p. 193\)](#).
4. Scale down the kube-dns deployment to zero replicas.

```
kubectl scale -n kube-system deployment/kube-dns --replicas=0
```

5. Clean up the old kube-dns resources.

```
kubectl delete -n kube-system deployment/kube-dns serviceaccount/kube-dns configmap/
kube-dns
```

## Upgrading CoreDNS

1. Check the current version of your cluster's coredns deployment.

```
kubectl describe deployment coredns --namespace kube-system | grep Image | cut -d "/" -
f 3
```

Output:

```
coredns:v1.1.3
```

The recommended coredns versions for the corresponding Kubernetes versions are as follows:

Kubernetes version	1.17	1.16	1.15	1.14
CoreDNS	1.6.6	1.6.6	1.6.6	1.6.6

2. If your current coredns version is 1.5.0 or later, but earlier than the recommended version, then skip this step. If your current version is earlier than 1.5.0, then you need to modify the config map for coredns to use the *forward* plug-in, rather than the *proxy* plug-in.

- a. Open the configmap with the following command.

```
kubectl edit configmap coredns -n kube-system
```

- b. Replace *proxy* in the following line with *forward*. Save the file and exit the editor.

```
proxy . /etc/resolv.conf
```

3. Retrieve your current coredns image:

```
kubectl get deployment coredns --namespace kube-system -o=jsonpath='{$.spec.template.spec.containers[:1].image}'
```

4. Update `coredns` to the recommended version by taking the output from the previous step and replacing the version tag with your cluster's recommended `coredns` version:

```
kubectl set image --namespace kube-system deployment.apps/coredns \
  coredns=602401143452.dkr.ecr.us-west-2.amazonaws.com/eks/coredns:v1.6.6-eksbuild.1
```

#### Note

If you're updating to the latest 1.14 version, then remove `-eksbuild.1` from the end of the image above.

## Installing Calico on Amazon EKS

[Project Calico](#) is a network policy engine for Kubernetes. With Calico network policy enforcement, you can implement network segmentation and tenant isolation. This is useful in multi-tenant environments where you must isolate tenants from each other or when you want to create separate environments for development, staging, and production. Network policies are similar to AWS security groups in that you can create network ingress and egress rules. Instead of assigning instances to a security group, you assign network policies to pods using pod selectors and labels. The following procedure shows you how to install Calico on Linux nodes in your Amazon EKS cluster. To install Calico on Windows nodes, see [Using Calico on Amazon EKS Windows Containers](#).

#### Note

- Calico is not supported when using Fargate with Amazon EKS.
- Calico adds rules to `iptables` on the node that may be higher priority than existing rules that you've already implemented outside of Calico. Consider adding existing `iptables` rules to your Calico policies to avoid having rules outside of Calico policy overridden by Calico.

### To install Calico on your Amazon EKS Linux nodes

1. Apply the Calico manifest from the [aws/amazon-vpc-cni-k8s GitHub project](#). This manifest creates DaemonSets in the `kube-system` namespace.

```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/release-1.6/config/v1.6/calico.yaml
```

2. Watch the `kube-system` DaemonSets and wait for the `calico-node` DaemonSet to have the DESIRED number of pods in the READY state. When this happens, Calico is working.

```
kubectl get daemonset calico-node --namespace kube-system
```

Output:

NAME	DESIRED	CURRENT	READY	UP-TO-DATE	AVAILABLE	NODE SELECTOR
calico-node	3	3	3	3	3	<none>

## To delete Calico from your Amazon EKS cluster

- If you are done using Calico in your Amazon EKS cluster, you can delete the DaemonSet with the following command:

```
kubectl delete -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/release-1.6/config/v1.6/calico.yaml
```

## Stars policy demo

This section walks through the [Stars policy demo](#) provided by the Project Calico documentation. The demo creates a frontend, backend, and client service on your Amazon EKS cluster. The demo also creates a management GUI that shows the available ingress and egress paths between each service.

Before you create any network policies, all services can communicate bidirectionally. After you apply the network policies, you can see that the client can only communicate with the frontend service, and the backend only accepts traffic from the frontend.

## To run the Stars policy demo

1. Apply the frontend, backend, client, and management UI services:

```
kubectl apply -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/manifests/00-namespace.yaml
kubectl apply -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/manifests/01-management-ui.yaml
kubectl apply -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/manifests/02-backend.yaml
kubectl apply -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/manifests/03-frontend.yaml
kubectl apply -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/manifests/04-client.yaml
```

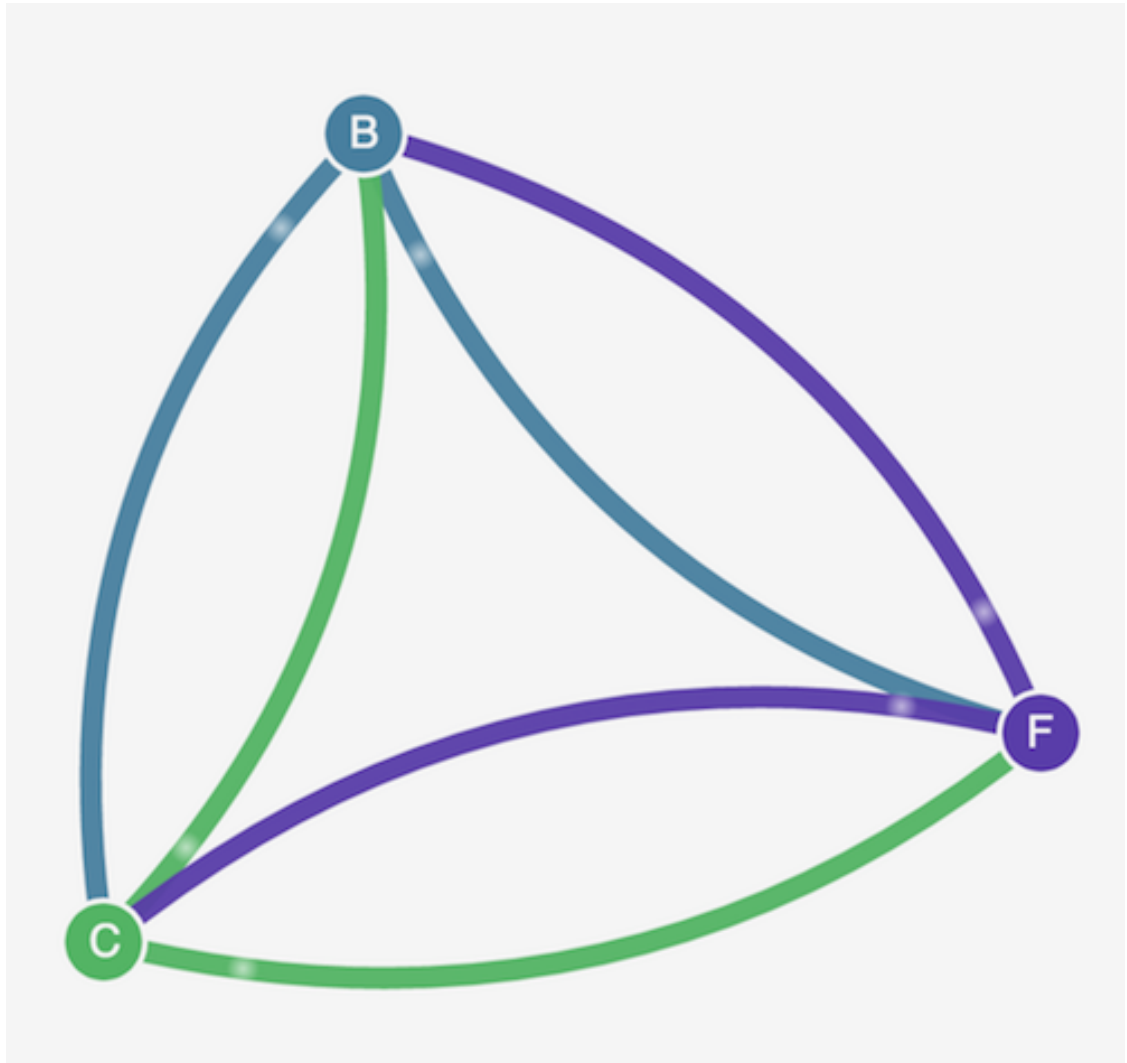
2. Wait for all of the pods to reach the Running status:

```
kubectl get pods --all-namespaces --watch
```

3. To connect to the management UI, forward your local port 9001 to the management-ui service running on your cluster:

```
kubectl port-forward service/management-ui -n management-ui 9001
```

4. Open a browser on your local system and point it to <http://localhost:9001/>. You should see the management UI. The **C** node is the client service, the **F** node is the frontend service, and the **B** node is the backend service. Each node has full communication access to all other nodes (as indicated by the bold, colored lines).



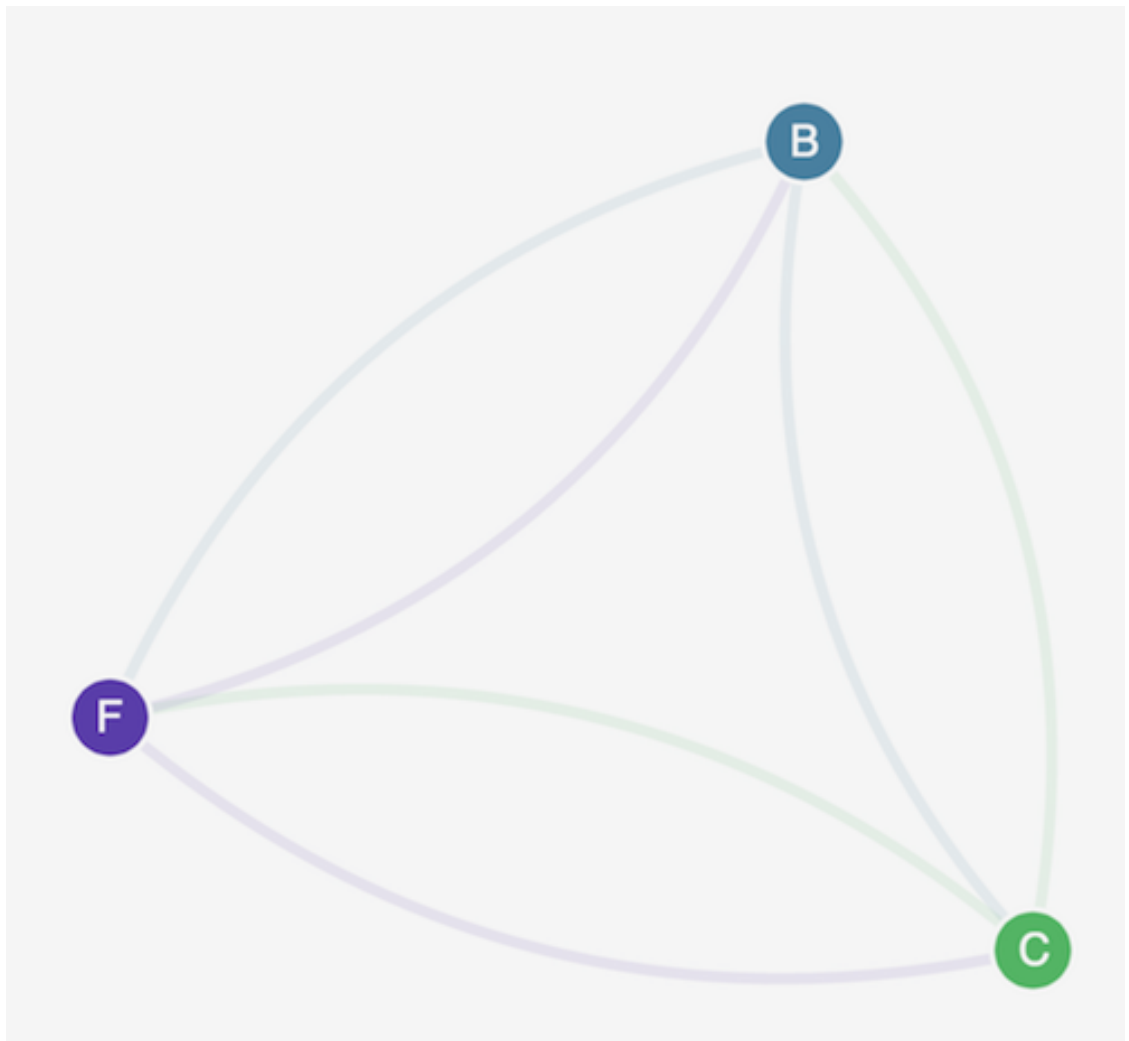
5. Apply the following network policies to isolate the services from each other:

```
kubectl apply -n stars -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/policies/default-deny.yaml
kubectl apply -n client -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/policies/default-deny.yaml
```

6. Refresh your browser. You see that the management UI can no longer reach any of the nodes, so they don't show up in the UI.
7. Apply the following network policies to allow the management UI to access the services:

```
kubectl apply -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/policies/allow-ui.yaml
kubectl apply -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/policies/allow-ui-client.yaml
```

8. Refresh your browser. You see that the management UI can reach the nodes again, but the nodes cannot communicate with each other.

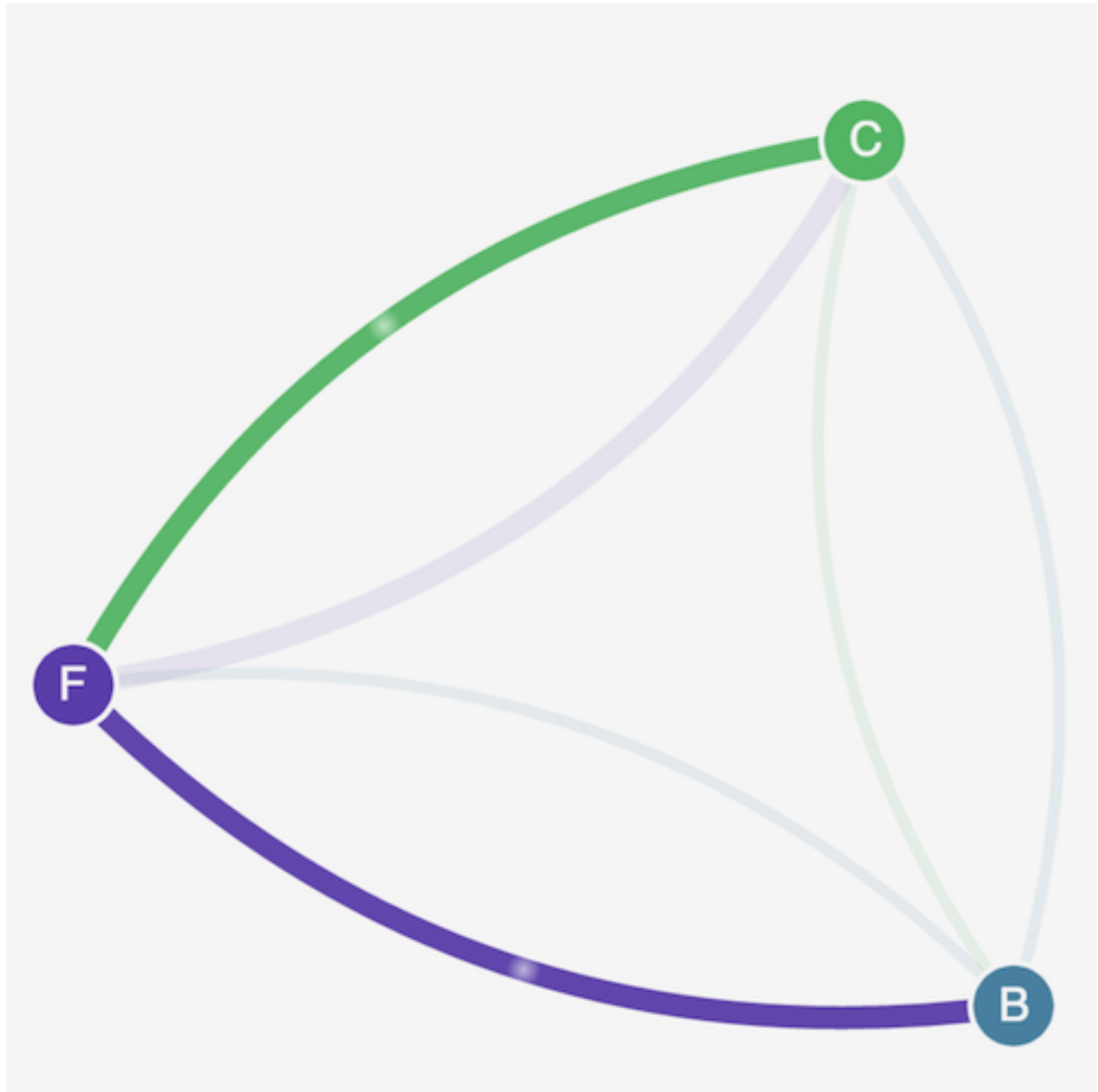


9. Apply the following network policy to allow traffic from the frontend service to the backend service:

```
kubectl apply -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/policies/backend-policy.yaml
```

10. Apply the following network policy to allow traffic from the `client` namespace to the frontend service:

```
kubectl apply -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/policies/frontend-policy.yaml
```



11. (Optional) When you are done with the demo, you can delete its resources with the following commands:

```
kubectl delete -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/manifests/04-client.yaml
kubectl delete -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/manifests/03-frontend.yaml
kubectl delete -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/manifests/02-backend.yaml
kubectl delete -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/manifests/01-management-ui.yaml
kubectl delete -f https://docs.projectcalico.org/v3.3/getting-started/kubernetes/tutorials/stars-policy/manifests/00-namespace.yaml
```

Even after deleting the resources, there can still be `iptables` rules on the nodes that might interfere in unexpected ways with networking in your cluster. The only sure way to remove Calico is to terminate all of the nodes and recycle them. To terminate all nodes, either set the Auto Scaling Group desired count to 0, then back up to the desired number, or just terminate the nodes. If you

are unable to recycle the nodes, then see [Disabling and removing Calico Policy](#) in the Calico GitHub repository for a last resort procedure.

# Applications

Your applications are deployed in containers, which are deployed in pods in Kubernetes. A pod includes one or more containers. Typically, one or more pods that provide the same service are deployed in a Kubernetes service. Once you've deployed multiple pods that provide the same service, you can:

- Vertically scale pods up or down with the Kubernetes [the section called “Vertical Pod Autoscaler” \(p. 204\)](#).
- Horizontally scale the number of pods needed to meet demand up or down with the Kubernetes [the section called “Horizontal Pod Autoscaler” \(p. 208\)](#).
- Create an external (for internet-accessible pods) or an internal (for private pods) [load balancer \(p. 211\)](#) to balance the traffic load across pods. The load balancer routes traffic at Layer 4 of the OSI model.
- Create an [the section called “ALB Ingress Controller on Amazon EKS” \(p. 212\)](#) to balance the traffic load across pods. The application load balancer routes traffic at Layer 7 of the OSI model.
- If you're new to Kubernetes, this topic helps you [the section called “Sample deployment” \(p. 200\)](#).

## Deploy a sample Linux application

In this topic, you create a Kubernetes manifest and deploy it to your cluster.

### Prerequisites

- You must have an existing Kubernetes cluster to deploy a sample application. If you don't have an existing cluster, you can deploy an Amazon EKS cluster using one of the [??? \(p. 3\)](#) guides.
- You must have `kubectl` installed on your computer. For more information, see [??? \(p. 229\)](#).
- `kubectl` must be configured to communicate with your cluster. For more information, see [??? \(p. 221\)](#).

### To deploy a sample application

1. Create a Kubernetes namespace for the sample app.

```
kubectl create namespace my-namespace
```

2. Create a Kubernetes service and deployment.
  - a. Save the following contents to a file named `sample-service.yaml` on your computer. If you're deploying to [??? \(p. 118\)](#) pods, then make sure that the value for `namespace` matches the namespace that you defined in your [??? \(p. 123\)](#). This sample deployment will pull a container image from a public repository, deploy three replicas of it to your cluster, and create a Kubernetes service with its own IP address that can be accessed from within the cluster only. To access the service from outside the cluster, you need to deploy a [load balancer \(p. 211\)](#) or [ALB Ingress Controller \(p. 212\)](#).

The image is a multi-architecture image, so if your cluster includes both x86 and Arm nodes, then the pod can be scheduled on either type of hardware architecture. Kubernetes will deploy the appropriate hardware image based on the hardware type of the node it schedules the pod on. Alternatively, if you only want the deployment to run on nodes with a specific hardware



architecture, or your cluster only contains one hardware architecture, then remove either amd64 or arm64 from the example that follows.

```
apiVersion: v1
kind: Service
metadata:
  name: my-service
  namespace: my-namespace
  labels:
    app: my-app
spec:
  selector:
    app: my-app
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: my-deployment
  namespace: my-namespace
  labels:
    app: my-app
spec:
  replicas: 3
  selector:
    matchLabels:
      app: my-app
  template:
    metadata:
      labels:
        app: my-app
    spec:
      affinity:
        nodeAffinity:
          requiredDuringSchedulingIgnoredDuringExecution:
            nodeSelectorTerms:
              - matchExpressions:
                  - key: beta.kubernetes.io/arch
                    operator: In
                    values:
                      - amd64
                      - arm64
      containers:
        - name: nginx
          image: nginx:1.19.2
          ports:
            - containerPort: 80
```

To learn more about Kubernetes [services](#) and [deployments](#), see the Kubernetes documentation. The containers in the sample manifest do not use network storage, but they may be able to. For more information, see [??? \(p. 150\)](#). Though not implemented in this example, we recommend that you create Kubernetes service accounts for your pods, and associate them to AWS IAM accounts. Specifying service accounts enables your pods to have the minimum permissions that they require to interact with other services. For more information, see [??? \(p. 268\)](#)

- b. Deploy the application.

```
kubectl apply -f sample-service.yaml
```

3. View all resources that exist in the my-namespace namespace.

```
kubectl get all -n my-namespace
```

#### Output

```
NAME                                READY   STATUS    RESTARTS   AGE
pod/my-deployment-776d8f8fd8-78w66 1/1     Running   0           27m
pod/my-deployment-776d8f8fd8-dkjfr 1/1     Running   0           27m
pod/my-deployment-776d8f8fd8-wmqj6 1/1     Running   0           27m

NAME          TYPE        CLUSTER-IP    EXTERNAL-IP  PORT(S)    AGE
service/my-service ClusterIP   10.100.190.12 <none>       80/TCP     32m

NAME                                READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/my-deployment        3/3     3             3           27m

NAME                                DESIRED   CURRENT   READY   AGE
replicaset.apps/my-deployment-776d8f8fd8 3         3         3       27m
```

In the output, you see the service and deployment that are specified in the sample manifest deployed in the previous step. You also see three pods, which are due to specifying 3 for replicas in the sample manifest. For more information about pods, see [Pods](#) in the Kubernetes documentation. Kubernetes automatically created the `replicaset` resource, even though it wasn't specified in the sample manifest. For more information about ReplicaSets, see [ReplicaSet](#) in the Kubernetes documentation.

#### Note

Kubernetes will maintain the number of replicas specified in the manifest. If this were a production deployment and you wanted Kubernetes to horizontally scale the number of replicas or vertically scale the compute resources for the pods, you'd need to use the [Horizontal Pod Autoscaler \(p. 208\)](#) and the [Vertical Pod Autoscaler \(p. 204\)](#).

4. View the details of the deployed service.

```
kubectl -n my-namespace describe service my-service
```

#### Abbreviated output

```
Name:          my-service
Namespace:     my-namespace
Labels:        app=my-app
Annotations:    kubectl.kubernetes.io/last-applied-configuration:
                 {"apiVersion":"v1","kind":"Service","metadata":{"annotations":
                 {}, "labels": {"app": "my-app"}, "name": "my-service", "namespace": "my-namespace"}}...
Selector:      app=my-app
Type:          ClusterIP
IP:            10.100.190.12
Port:          <unset> 80/TCP
TargetPort:    80/TCP
...
```

In the output, the value for `IP:` is a unique IP address that can be reached from any pod within the cluster.

5. View the details of one of the pods that was deployed.

```
kubectl -n my-namespace describe pod my-deployment-776d8f8fd8-78w66
```

#### Abbreviated output

```

Name:          my-deployment-776d8f8fd8-78w66
Namespace:     my-namespace
Priority:       0
Node:          ip-192-168-9-36.us-west-2.compute.internal/192.168.9.36
...
IP:            192.168.16.57
IPs:
  IP:          192.168.16.57
Controlled By: ReplicaSet/my-deployment-776d8f8fd8
...
Conditions:
  Type              Status
  Initialized        True
  Ready              True
  ContainersReady    True
  PodScheduled       True
...
Events:
  Type    Reason      Age    From
  Message
  ----
  Normal  Scheduled    3m20s  default-scheduler
        Successfully assigned my-namespace/my-deployment-776d8f8fd8-78w66 to
        ip-192-168-9-36.us-west-2.compute.internal
...

```

In the output, the value for `IP:` is a unique IP that is assigned to the pod from the CIDR block assigned to the subnet that the node is in, by default. If you'd prefer that pods be assigned IP addresses from different CIDR blocks than the subnet that the node is in, you can change the default behavior. For more information, see [??? \(p. 184\)](#). You can also see that the Kubernetes scheduler scheduled the pod on the node with the IP address `192.168.9.36`.

6. Execute a shell on one of the pods by replacing the `value` below with a value returned for one of your pods in step 3.

```
kubectl exec -it my-deployment-776d8f8fd8-78w66 -n my-namespace -- /bin/bash
```

7. View the DNS resolver configuration file.

```
cat /etc/resolv.conf
```

#### Output

```

nameserver 10.100.0.10
search my-namespace.svc.cluster.local svc.cluster.local cluster.local us-
west-2.compute.internal
options ndots:5

```

In the previous output, the value for `nameserver` is the cluster's nameserver and is automatically assigned as the name server for any pod deployed to the cluster.

8. Disconnect from the pod by typing `exit`.
9. Remove the sample service, deployment, pods, and namespace.

```
kubectl delete namespace my-namespace
```

## Vertical Pod Autoscaler

The Kubernetes [Vertical Pod Autoscaler](#) automatically adjusts the CPU and memory reservations for your pods to help "right size" your applications. This adjustment can improve cluster resource utilization and free up CPU and memory for other pods. This topic helps you to deploy the Vertical Pod Autoscaler to your cluster and verify that it is working.

### Install the metrics server

The Kubernetes metrics server is an aggregator of resource usage data in your cluster. It is not deployed by default in Amazon EKS clusters, but it provides metrics that are required by the Vertical Pod Autoscaler. This topic explains how to deploy the Kubernetes metrics server on your Amazon EKS cluster.

#### Note

You can also use Prometheus to provide metrics for the Vertical Pod Autoscaler. For more information, see [Control plane metrics with Prometheus \(p. 240\)](#).

If you have already deployed the metrics server to your cluster, you can move on to the next section. You can check for the metrics server with the following command.

```
kubectl -n kube-system get deployment/metrics-server
```

If this command returns a `NotFound` error, then you must deploy the metrics server to your Amazon EKS cluster.

#### To deploy the Metrics Server

1. Deploy the Metrics Server with the following command:

```
kubectl apply -f https://github.com/kubernetes-sigs/metrics-server/releases/download/v0.3.6/components.yaml
```

2. Verify that the `metrics-server` deployment is running the desired number of pods with the following command.

```
kubectl get deployment metrics-server -n kube-system
```

Output

NAME	READY	UP-TO-DATE	AVAILABLE	AGE
metrics-server	1/1	1	1	6m

## Deploy the Vertical Pod Autoscaler

In this section, you deploy the Vertical Pod Autoscaler to your cluster.

#### To deploy the Vertical Pod Autoscaler

1. Open a terminal window and navigate to a directory where you would like to download the Vertical Pod Autoscaler source code.
2. Clone the [kubernetes/autoscaler](#) GitHub repository.

```
git clone https://github.com/kubernetes/autoscaler.git
```

3. Change to the `vertical-pod-autoscaler` directory.

```
cd autoscaler/vertical-pod-autoscaler/
```

4. (Optional) If you have already deployed another version of the Vertical Pod Autoscaler, remove it with the following command.

```
./hack/vpa-down.sh
```

5. Deploy the Vertical Pod Autoscaler to your cluster with the following command.

```
./hack/vpa-up.sh
```

6. Verify that the Vertical Pod Autoscaler pods have been created successfully.

```
kubectl get pods -n kube-system
```

Output:

NAME	READY	STATUS	RESTARTS	AGE
aws-node-949vx	1/1	Running	0	122m
aws-node-b4nj8	1/1	Running	0	122m
coredns-6c75b69b98-r9x68	1/1	Running	0	133m
coredns-6c75b69b98-rt9bp	1/1	Running	0	133m
kube-proxy-bkm6b	1/1	Running	0	122m
kube-proxy-hpqm2	1/1	Running	0	122m
metrics-server-8459fc497-kfj8w	1/1	Running	0	83m
vpa-admission-controller-68c748777d-ppspd	1/1	Running	0	7s
vpa-recommender-6fc8c67d85-gljpl	1/1	Running	0	8s
vpa-updater-786b96955c-bgp9d	1/1	Running	0	8s

## Test your Vertical Pod Autoscaler installation

In this section, you deploy a sample application to verify that the Vertical Pod Autoscaler is working.

### To test your Vertical Pod Autoscaler installation

1. Deploy the `hamster.yaml` Vertical Pod Autoscaler example with the following command.

```
kubectl apply -f examples/hamster.yaml
```

2. Get the pods from the `hamster` example application.

```
kubectl get pods -l app=hamster
```

Output:

hamster-c7d89d6db-rglf5	1/1	Running	0	48s
hamster-c7d89d6db-znvz5	1/1	Running	0	48s

3. Describe one of the pods to view its CPU and memory reservation.

```
kubectl describe pod hamster-c7d89d6db-rglf5
```

Output:

```
Name:          hamster-c7d89d6db-rglf5
Namespace:     default
Priority:       0
Node:          ip-192-168-9-44.region-code.compute.internal/192.168.9.44
Start Time:    Fri, 27 Sep 2019 10:35:15 -0700
Labels:        app=hamster
               pod-template-hash=c7d89d6db
Annotations:   kubernetes.io/psp: eks.privileged
               vpaUpdates: Pod resources updated by hamster-vpa: container 0:
Status:        Running
IP:            192.168.23.42
IPs:           <none>
Controlled By: ReplicaSet/hamster-c7d89d6db
Containers:
  hamster:
    Container ID:  docker://
e76c2413fc720ac395c33b64588c82094fc8e5d590e373d5f818f3978f577e24
    Image:         k8s.gcr.io/ubuntu-slim:0.1
    Image ID:      docker-pullable://k8s.gcr.io/ubuntu-
slim@sha256:b6f8c3885f5880a4f1a7cf717c07242eb4858fdd5a84b5ffe35b1cf680ea17b1
    Port:          <none>
    Host Port:     <none>
    Command:
    /bin/sh
    Args:
    -c
    while true; do timeout 0.5s yes >/dev/null; sleep 0.5s; done
    State:         Running
    Started:        Fri, 27 Sep 2019 10:35:16 -0700
    Ready:          True
    Restart Count:  0
    Requests:
      cpu:          100m
      memory:       50Mi
    ...
```

You can see that the original pod reserves 100 millicpu of CPU and 50 mebibytes of memory. For this example application, 100 millicpu is less than the pod needs to run, so it is CPU-constrained. It also reserves much less memory than it needs. The Vertical Pod Autoscaler `vpa-recommender` deployment analyzes the `hamster` pods to see if the CPU and memory requirements are appropriate. If adjustments are needed, the `vpa-updater` relaunches the pods with updated values.

4. Wait for the `vpa-updater` to launch a new `hamster` pod. This should take a minute or two. You can monitor the pods with the following command.

#### Note

If you are not sure that a new pod has launched, compare the pod names with your previous list. When the new pod launches, you will see a new pod name.

```
kubectl get --watch pods -l app=hamster
```

5. When a new `hamster` pod is started, describe it and view the updated CPU and memory reservations.

```
kubectl describe pod hamster-c7d89d6db-jxgfv
```

Output:

```
Name:          hamster-c7d89d6db-jxgfv
Namespace:     default
```

```

Priority:      0
Node:         ip-192-168-9-44.region-code.compute.internal/192.168.9.44
Start Time:   Fri, 27 Sep 2019 10:37:08 -0700
Labels:       app=hamster
              pod-template-hash=c7d89d6db
Annotations:  kubernetes.io/psp: eks.privileged
              vpaUpdates: Pod resources updated by hamster-vpa: container 0: cpu
               request, memory request
Status:       Running
IP:           192.168.3.140
IPs:          <none>
Controlled By: ReplicaSet/hamster-c7d89d6db
Containers:
  hamster:
    Container ID:
      docker://2c3e7b6fb7ce0d8c86444334df654af6fb3fc88aad4c5d710eac3b1e7c58f7db
    Image:      k8s.gcr.io/ubuntu-slim:0.1
    Image ID:   docker-pullable://k8s.gcr.io/ubuntu-
slim@sha256:b6f8c3885f5880a4f1a7cf717c07242eb4858fdd5a84b5ffe35b1cf680ea17b1
    Port:       <none>
    Host Port:  <none>
    Command:
      /bin/sh
    Args:
      -c
      while true; do timeout 0.5s yes >/dev/null; sleep 0.5s; done
    State:      Running
      Started:   Fri, 27 Sep 2019 10:37:08 -0700
    Ready:      True
    Restart Count: 0
    Requests:
      cpu:       587m
      memory:    262144k
    ...

```

Here you can see that the CPU reservation has increased to 587 millicpu, which is over five times the original value. The memory has increased to 262,144 Kilobytes, which is around 250 mebibytes, or five times the original value. This pod was under-resourced, and the Vertical Pod Autoscaler corrected our estimate with a much more appropriate value.

6. Describe the hamster-vpa resource to view the new recommendation.

```
kubectl describe vpa/hamster-vpa
```

Output:

```

Name:         hamster-vpa
Namespace:    default
Labels:       <none>
Annotations:  kubectl.kubernetes.io/last-applied-configuration:
               {"apiVersion":"autoscaling.k8s.io/v1beta2", "kind":"VerticalPodAutoscaler", "metadata":{"annotations":{}}, "name":"hamster-
vpa", "namespace":"d...
API Version:  autoscaling.k8s.io/v1beta2
Kind:         VerticalPodAutoscaler
Metadata:
  Creation Timestamp:  2019-09-27T18:22:51Z
  Generation:          23
  Resource Version:    14411
  Self Link:           /apis/autoscaling.k8s.io/v1beta2/namespaces/default/
verticalpodautoscalers/hamster-vpa
  UID:                 d0d85fb9-e153-11e9-ae53-0205785d75b0
Spec:

```

```
Target Ref:
  API Version:  apps/v1
  Kind:         Deployment
  Name:         hamster
Status:
  Conditions:
    Last Transition Time:  2019-09-27T18:23:28Z
    Status:               True
    Type:                 RecommendationProvided
  Recommendation:
    Container Recommendations:
      Container Name:  hamster
    Lower Bound:
      Cpu:             550m
      Memory:          262144k
    Target:
      Cpu:             587m
      Memory:          262144k
    Uncapped Target:
      Cpu:             587m
      Memory:          262144k
    Upper Bound:
      Cpu:             21147m
      Memory:          387863636
  Events:              <none>
```

7. When you finish experimenting with the example application, you can delete it with the following command.

```
kubectl delete -f examples/hamster.yaml
```

## Horizontal Pod Autoscaler

The Kubernetes [Horizontal Pod Autoscaler](#) automatically scales the number of pods in a deployment, replication controller, or replica set based on that resource's CPU utilization. This can help your applications scale out to meet increased demand or scale in when resources are not needed, thus freeing up your nodes for other applications. When you set a target CPU utilization percentage, the Horizontal Pod Autoscaler scales your application in or out to try to meet that target.

The Horizontal Pod Autoscaler is a standard API resource in Kubernetes that simply requires that a metrics source (such as the Kubernetes metrics server) is installed on your Amazon EKS cluster to work. You do not need to deploy or install the Horizontal Pod Autoscaler on your cluster to begin scaling your applications. For more information, see [Horizontal Pod Autoscaler](#) in the Kubernetes documentation.

Use this topic to prepare the Horizontal Pod Autoscaler for your Amazon EKS cluster and to verify that it is working with a sample application.

### Note

This topic is based on the [Horizontal pod autoscaler walkthrough](#) in the Kubernetes documentation.

## Install the metrics server

The Kubernetes metrics server is an aggregator of resource usage data in your cluster. The metrics server is not deployed by default in Amazon EKS clusters, but it provides metrics that are required by the Horizontal Pod Autoscaler. This topic explains how to deploy the Kubernetes metrics server on your Amazon EKS cluster.



If you have already deployed the metrics server to your cluster, you can move on to the next section. You can check for the metrics server with the following command.

```
kubectl -n kube-system get deployment/metrics-server
```

If this command returns a `NotFound` error, then you must deploy the metrics server to your Amazon EKS cluster.

### To deploy the Metrics Server

1. Deploy the Metrics Server with the following command:

```
kubectl apply -f https://github.com/kubernetes-sigs/metrics-server/releases/download/v0.3.6/components.yaml
```

2. Verify that the `metrics-server` deployment is running the desired number of pods with the following command.

```
kubectl get deployment metrics-server -n kube-system
```

Output

NAME	READY	UP-TO-DATE	AVAILABLE	AGE
metrics-server	1/1	1	1	6m

## Run a Horizontal Pod Autoscaler test application

In this section, you deploy a sample application to verify that the Horizontal Pod Autoscaler is working.

### Note

This example is based on the [Horizontal pod autoscaler walkthrough](#) in the Kubernetes documentation.

### To test your Horizontal Pod Autoscaler installation

1. Deploy a simple Apache web server application with the following command.

```
kubectl apply -f https://k8s.io/examples/application/php-apache.yaml
```

This Apache web server pod is given a 500 millicpu CPU limit and it is serving on port 80.

2. Create a Horizontal Pod Autoscaler resource for the `php-apache` deployment.

```
kubectl autoscale deployment php-apache --cpu-percent=50 --min=1 --max=10
```

This command creates an autoscaler that targets 50 percent CPU utilization for the deployment, with a minimum of one pod and a maximum of ten pods. When the average CPU load is below 50 percent, the autoscaler tries to reduce the number of pods in the deployment, to a minimum of one. When the load is greater than 50 percent, the autoscaler tries to increase the number of pods in the deployment, up to a maximum of ten. For more information, see [How does the Horizontal Pod Autoscaler work?](#) in the Kubernetes documentation.

3. Describe the autoscaler with the following command to view its details.

```
kubectl describe hpa
```

Output:

```
Name: php-apache
Namespace: default
Labels: <none>
Annotations: <none>
CreationTimestamp: Thu, 11 Jun 2020 16:05:41 -0500
Reference: Deployment/php-apache
Metrics: ( current / target )
  resource cpu on pods (as a percentage of request): <unknown> / 50%
Min replicas: 1
Max replicas: 10
Deployment pods: 1 current / 0 desired
Conditions:
  Type           Status Reason
  ----           -
  AbleToScale    True  SucceededGetScale the HPA controller was able to get
the target's current scale
  ScalingActive  False FailedGetResourceMetric the HPA was unable to compute the
replica count: did not receive metrics for any ready pods
Events:
  Type Reason Age From
  ----
  Warning FailedGetResourceMetric 42s (x2 over 57s) horizontal-pod-autoscaler
unable to get metrics for resource cpu: no metrics returned from resource metrics API
  Warning FailedComputeMetricsReplicas 42s (x2 over 57s) horizontal-pod-autoscaler
invalid metrics (1 invalid out of 1), first error is: failed to get cpu utilization:
unable to get metrics for resource cpu: no metrics returned from resource metrics API
  Warning FailedGetResourceMetric 12s (x2 over 27s) horizontal-pod-autoscaler
did not receive metrics for any ready pods
  Warning FailedComputeMetricsReplicas 12s (x2 over 27s) horizontal-pod-autoscaler
invalid metrics (1 invalid out of 1), first error is: failed to get cpu utilization:
did not receive metrics for any ready pods
```

As you can see, the current CPU load is <unknown>, because there's no load on the server yet. The pod count is already at its lowest boundary (one), so it cannot scale in.

4. Create a load for the web server by running a container.

```
kubectl run -it --rm load-generator --image=busybox /bin/sh --generator=run-pod/v1
```

If you don't receive a command prompt after several seconds, you may need to press **Enter**. From the command prompt, enter the following command to generate load and cause the autoscaler to scale out the deployment.

```
while true; do wget -q -O- http://php-apache; done
```

5. To watch the deployment scale out, periodically run the following command in a separate terminal from the terminal that you ran the previous step in.

```
kubectl get hpa
```

Output:

NAME	REFERENCE	TARGETS	MINPODS	MAXPODS	REPLICAS	AGE
php-apache	Deployment/php-apache	250%/50%	1	10	5	4m44s

As long as actual CPU percentage is higher than the target percentage, then the replica count increases, up to 10. In this case, it's 250%, so the number of `REPLICAS` continues to increase.

**Note**

It may take a few minutes before you see the replica count reach its maximum. If only 6 replicas, for example, are necessary for the CPU load to remain at or under 50%, then the load won't scale beyond 6 replicas.

6. Stop the load. In the terminal window you're generating the load in (from step 4), stop the load by holding down the `Ctrl+C` keys. You can watch the replicas scale back to 1 by running the following command again.

```
kubectl get hpa
```

Output

NAME	REFERENCE	TARGETS	MINPODS	MAXPODS	REPLICAS	AGE
php-apache	Deployment/php-apache	0%/50%	1	10	1	25m

**Note**

The default timeframe for scaling back down is five minutes, so it will take some time before you see the replica count reach 1 again, even when the current CPU percentage is 0 percent. The timeframe is modifiable. For more information, see [Horizontal Pod Autoscaler](#) in the Kubernetes documentation.

7. When you are done experimenting with your sample application, delete the `php-apache` resources.

```
kubectl delete deployment.apps/php-apache service/php-apache
horizontalpodautoscaler.autoscaling/php-apache
```

## Load balancing

Amazon EKS supports the Network Load Balancer and the Classic Load Balancer for pods running on Amazon EC2 instance nodes through the Kubernetes service of type `LoadBalancer`. Classic Load Balancers and Network Load Balancers are not supported for pods running on AWS Fargate (Fargate). For Fargate ingress, we recommend that you use the [ALB Ingress Controller \(p. 212\)](#) on Amazon EKS (minimum version v1.1.8).

The configuration of your load balancer is controlled by annotations that are added to the manifest for your service. By default, Classic Load Balancers are used for `LoadBalancer` type services. To use the Network Load Balancer instead, apply the following annotation to your service:

```
service.beta.kubernetes.io/aws-load-balancer-type: nlb
```

For an example service manifest that specifies a load balancer, see [Type LoadBalancer](#) in the Kubernetes documentation. For more information about using Network Load Balancer with Kubernetes, see [Network Load Balancer support on AWS](#) in the Kubernetes documentation.

By default, services of type `LoadBalancer` create public-facing load balancers. To use an internal load balancer, apply the following annotation to your service:

```
service.beta.kubernetes.io/aws-load-balancer-internal: "true"
```

For internal load balancers, your Amazon EKS cluster must be configured to use at least one private subnet in your VPC. Kubernetes examines the route table for your subnets to identify whether they are

public or private. Public subnets have a route directly to the internet using an internet gateway, but private subnets do not.

## Subnet tagging for load balancers

You must tag the public subnets in your VPC so that Kubernetes knows to use only those subnets for external load balancers instead of choosing a public subnet in each Availability Zone (in lexicographical order by subnet ID). If you use an Amazon EKS AWS CloudFormation template to create your VPC after 03/26/2020, then the subnets created by the template are tagged when they're created. For more information about the Amazon EKS AWS CloudFormation VPC templates, see [??? \(p. 166\)](#).

Key	Value
<code>kubernetes.io/role/elb</code>	1

Private subnets must be tagged in the following way so that Kubernetes knows it can use the subnets for internal load balancers. If you use an Amazon EKS AWS CloudFormation template to create your VPC after 03/26/2020, then the subnets created by the template are tagged when they're created. For more information about the Amazon EKS AWS CloudFormation VPC templates, see [??? \(p. 166\)](#).

Key	Value
<code>kubernetes.io/role/internal-elb</code>	1

## ALB Ingress Controller on Amazon EKS

The [AWS ALB Ingress Controller for Kubernetes](#) is a controller that triggers the creation of an Application Load Balancer (ALB) and the necessary supporting AWS resources whenever an Ingress resource is created on the cluster with the `kubernetes.io/ingress.class: alb` annotation. The Ingress resource configures the ALB to route HTTP or HTTPS traffic to different pods within the cluster. The ALB Ingress Controller is supported for production workloads running on Amazon EKS clusters.

To ensure that your ingress objects use the ALB Ingress Controller, add the following annotation to your Ingress specification. For more information, see [Ingress specification](#) in the documentation.

```
annotations:
  kubernetes.io/ingress.class: alb
```

The ALB Ingress controller supports the following traffic modes:

- **Instance** – Registers nodes within your cluster as targets for the ALB. Traffic reaching the ALB is routed to `NodePort` for your service and then proxied to your pods. This is the default traffic mode. You can also explicitly specify it with the `alb.ingress.kubernetes.io/target-type: instance` annotation.

### Note

Your Kubernetes service must specify the `NodePort` type to use this traffic mode.

- **IP** – Registers pods as targets for the ALB. Traffic reaching the ALB is directly routed to pods for your service. You must specify the `alb.ingress.kubernetes.io/target-type: ip` annotation to use this traffic mode.

For other available annotations supported by the ALB Ingress Controller, see [Ingress annotations](#).

This topic shows you how to configure the ALB Ingress Controller to work with your Amazon EKS cluster.

### Important

You cannot use the ALB Ingress Controller with ??? (p. 82).

## To deploy the ALB Ingress Controller to an Amazon EKS cluster

1. Tag the subnets in your VPC that you want to use for your load balancers so that the ALB Ingress Controller knows that it can use them. For more information, see [Subnet tagging requirement](#) (p. 172). If you deployed your cluster with `eksctl`, then the tags are already applied.
  - All subnets in your VPC should be tagged accordingly so that Kubernetes can discover them.

Key	Value
kubernetes.io/cluster/<cluster-name>	shared

- Public subnets in your VPC should be tagged accordingly so that Kubernetes knows to use only those subnets for external load balancers.

Key	Value
kubernetes.io/role/elb	1

- Private subnets must be tagged in the following way so that Kubernetes knows it can use the subnets for internal load balancers. If you use an Amazon EKS AWS CloudFormation template to create your VPC after 03/26/2020, then the subnets created by the template are tagged when they're created. For more information about the Amazon EKS AWS CloudFormation VPC templates, see ??? (p. 166).

Key	Value
kubernetes.io/role/internal-elb	1

2. Create an IAM OIDC provider and associate it with your cluster. If you don't have `eksctl` version 0.26.0-rc.1 or later installed, complete the instructions in [Installing or upgrading eksctl](#) (p. 234) to install or upgrade it. You can check your installed version with `eksctl version`.

```
eksctl utils associate-iam-oidc-provider \
  --region region-code \
  --cluster prod \
  --approve
```

3. Download an IAM policy for the ALB Ingress Controller pod that allows it to make calls to AWS APIs on your behalf. You can view the [policy document](#) on GitHub.

```
curl -o iam-policy.json https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/iam-policy.json
```

4. Create an IAM policy called `ALBIngressControllerIAMPolicy` using the policy downloaded in the previous step.

```
aws iam create-policy \
  --policy-name ALBIngressControllerIAMPolicy \
  --policy-document file://iam-policy.json
```

Take note of the policy ARN that is returned.

5. Create a Kubernetes service account named `alb-ingress-controller` in the `kube-system` namespace, a cluster role, and a cluster role binding for the ALB Ingress Controller to use with the following command. If you don't have `kubectl` installed, complete the instructions in [Installing kubectl](#) (p. 229) to install it.

```
kubectl apply -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/rbac-role.yaml
```

6. Create an IAM role for the ALB Ingress Controller and attach the role to the service account created in the previous step. If you didn't create your cluster with `eksctl`, then use the instructions on the AWS Management Console or AWS CLI tabs.

`eksctl`

The command that follows only works for clusters that were created with `eksctl`.

```
eksctl create iamserviceaccount \
  --region region-code \
  --name alb-ingress-controller \
  --namespace kube-system \
  --cluster prod \
  --attach-policy-arn
arn:aws:iam::111122223333:policy/ALBIngressControllerIAMPolicy \
  --override-existing-serviceaccounts \
  --approve
```

AWS Management Console

1. Using the instructions on the AWS Management Console tab in [Create an IAM role](#) (p. 276), create an IAM role named `eks-alb-ingress-controller` and attach the `ALBIngressControllerIAMPolicy` IAM policy that you created in a previous step to it. Note the Amazon Resource Name (ARN) of the role, once you've created it.
2. Annotate the Kubernetes service account with the ARN of the role that you created with the following command.

```
kubectl annotate serviceaccount -n kube-system alb-ingress-controller \
eks.amazonaws.com/role-arn=arn:aws:iam::111122223333:role/eks-alb-ingress-
controller
```

AWS CLI

1. Using the instructions on the AWS CLI tab in [Create an IAM role](#) (p. 276), create an IAM role named `eks-alb-ingress-controller` and attach the `ALBIngressControllerIAMPolicy` IAM policy that you created in a previous step to it. Note the Amazon Resource Name (ARN) of the role, once you've created it.
2. Annotate the Kubernetes service account with the ARN of the role that you created with the following command.

```
kubectl annotate serviceaccount -n kube-system alb-ingress-controller \
eks.amazonaws.com/role-arn=arn:aws:iam::111122223333:role/eks-alb-ingress-
controller
```

7. Deploy the ALB Ingress Controller with the following command.

```
kubectl apply -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/alb-ingress-controller.yaml
```

8. Open the ALB Ingress Controller deployment manifest for editing with the following command.

```
kubectl edit deployment.apps/alb-ingress-controller -n kube-system
```

9. Add a line for the cluster name after the `--ingress-class=alb` line. If you're running the ALB Ingress Controller on Fargate, then you must also add the lines for the VPC ID, and AWS Region name of your cluster. Once you've added the appropriate lines, save and close the file.

```
spec:
  containers:
  - args:
    - --ingress-class=alb
    - --cluster-name=prod
    - --aws-vpc-id=vpc-03468a8157edca5bd
    - --aws-region=region-code
```

10. Confirm that the ALB Ingress Controller is running with the following command.

```
kubectl get pods -n kube-system
```

Expected output:

NAME	READY	STATUS	RESTARTS	AGE
alb-ingress-controller- <i>55b5bbcb5b-bc8q9</i>	1/1	Running	0	56s

## To deploy a sample application

1. Deploy the game [2048](#) as a sample application to verify that the ALB Ingress Controller creates an Application Load Balancer as a result of the Ingress object. You can run the sample application on a cluster that has Amazon EC2 nodes only, one or more Fargate pods, or a combination of the two. If your cluster has Amazon EC2 nodes and no Fargate pods, then select the **Amazon EC2 nodes only** tab. If your cluster has any existing Fargate pods, or you want to deploy the application to new Fargate pods, then select the **Fargate** tab. For more information about Fargate pods, see [Getting started with AWS Fargate using Amazon EKS \(p. 119\)](#).

Amazon EC2 nodes only

Deploy the application with the following commands.

```
kubectl apply -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-namespace.yaml
kubectl apply -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-deployment.yaml
kubectl apply -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-service.yaml
kubectl apply -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-ingress.yaml
```

Fargate

Ensure that the cluster that you want to use Fargate in is in the list of [supported Regions \(p. 118\)](#).

- a. Create a Fargate profile that includes the sample application's namespace with the following command. Replace the *example-values* with your own values.

**Note**

The command that follows only works for clusters that were created with `eksctl`. If you didn't create your cluster with `eksctl`, then you can create the profile with the [AWS Management Console \(p. 125\)](#), using the same values for name and namespace that are in the command below.

```
eksctl create fargateprofile --cluster prod --region region-code --name alb-sample-app --namespace 2048-game
```

- b. Download and apply the manifest files to create the Kubernetes namespace, deployment, and service with the following commands.

```
kubectl apply -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-namespace.yaml
kubectl apply -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-deployment.yaml
kubectl apply -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-service.yaml
```

- c. Download the ingress manifest file with the following command.

```
curl -o 2048-ingress.yaml https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-ingress.yaml
```

- d. Edit the `2048-ingress.yaml` file. Under the existing `alb.ingress.kubernetes.io/scheme: internet-facing` line, add the line `alb.ingress.kubernetes.io/target-type: ip`.
- e. Apply the ingress manifest file with the following command.

```
kubectl apply -f 2048-ingress.yaml
```

2. After a few minutes, verify that the Ingress resource was created with the following command.

```
kubectl get ingress/2048-ingress -n 2048-game
```

Output:

NAME	HOSTS	ADDRESS
PORTS	AGE	
2048-ingress	*	<i>example-2048game-2048ingr-6fa0-352729433.region-code.elb.amazonaws.com</i>
	80	24h

**Note**

If your Ingress has not been created after several minutes, run the following command to view the Ingress controller logs. These logs may contain error messages that can help you diagnose any issues with your deployment.

```
kubectl logs -n kube-system deployment.apps/alb-ingress-controller
```

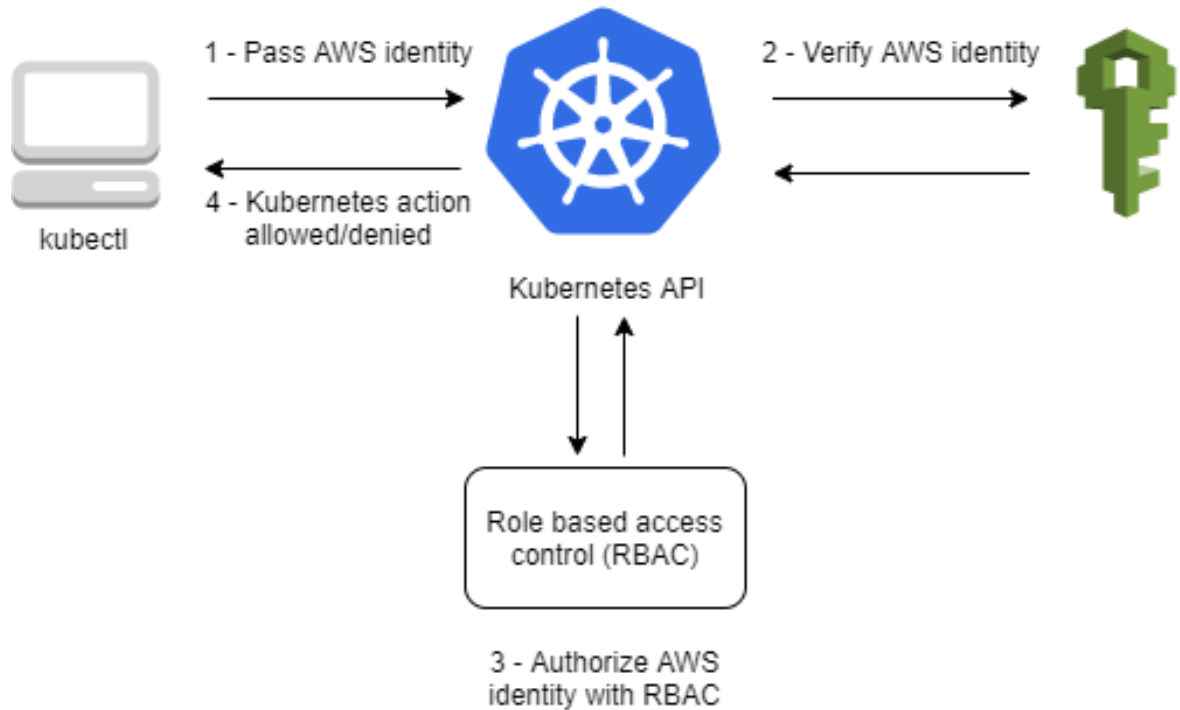
3. Open a browser and navigate to the ADDRESS URL from the previous command output to see the sample application.
4. When you finish experimenting with your sample application, delete it with the following commands.



```
kubectl delete -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-ingress.yaml
kubectl delete -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-service.yaml
kubectl delete -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-deployment.yaml
kubectl delete -f https://raw.githubusercontent.com/kubernetes-sigs/aws-alb-ingress-controller/v1.1.8/docs/examples/2048/2048-namespace.yaml
```

# Cluster authentication

Amazon EKS uses IAM to provide authentication to your Kubernetes cluster (through the `aws eks get-token` command, available in version 1.16.156 or later of the AWS CLI, or the [AWS IAM Authenticator for Kubernetes](#)), but it still relies on native Kubernetes [Role Based Access Control](#) (RBAC) for authorization. This means that IAM is only used for authentication of valid IAM entities. All permissions for interacting with your Amazon EKS cluster's Kubernetes API is managed through the native Kubernetes RBAC system.



## Topics

- [Installing aws-iam-authenticator](#) (p. 218)
- [Create a kubeconfig for Amazon EKS](#) (p. 221)
- [Managing users or IAM roles for your cluster](#) (p. 225)

## Installing aws-iam-authenticator

Amazon EKS uses IAM to provide authentication to your Kubernetes cluster through the [AWS IAM authenticator for Kubernetes](#). You can configure the stock `kubectl` client to work with Amazon EKS by installing the AWS IAM authenticator for Kubernetes and modifying your `kubectl` configuration file to use it for authentication.

### Note

If you're running the AWS CLI version 1.16.156 or later, then you don't need to install the authenticator. Instead, you can use the `aws eks get-token` command. For more information, see the section called ["Create kubeconfig manually"](#) (p. 223).

If you're unable to use the AWS CLI version 1.16.156 or later to create the `kubeconfig` file, then select the operating system that you want to install the `aws-iam-authenticator` on.

## macOS

### To install aws-iam-authenticator with Homebrew

The easiest way to install the aws-iam-authenticator is with [Homebrew](#).

1. If you do not already have [Homebrew](#) installed on your Mac, install it with the following command.

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

2. Install the aws-iam-authenticator with the following command.

```
brew install aws-iam-authenticator
```

3. Test that the aws-iam-authenticator binary works.

```
aws-iam-authenticator help
```

### To install aws-iam-authenticator on macOS

You can also install the AWS-vended version of the aws-iam-authenticator by following these steps.

1. Download the Amazon EKS vended aws-iam-authenticator binary from Amazon S3:

```
curl -o aws-iam-authenticator https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/darwin/amd64/aws-iam-authenticator
```

2. (Optional) Verify the downloaded binary with the SHA-256 sum provided in the same bucket prefix.
  - a. Download the SHA-256 sum for your system.

```
curl -o aws-iam-authenticator.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/darwin/amd64/aws-iam-authenticator.sha256
```

- b. Check the SHA-256 sum for your downloaded binary.

```
openssl sha1 -sha256 aws-iam-authenticator
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded aws-iam-authenticator.sha256 file. The two should match.
3. Apply execute permissions to the binary.

```
chmod +x ./aws-iam-authenticator
```

4. Copy the binary to a folder in your \$PATH. We recommend creating a \$HOME/bin/aws-iam-authenticator and ensuring that \$HOME/bin comes first in your \$PATH.

```
mkdir -p $HOME/bin && cp ./aws-iam-authenticator $HOME/bin/aws-iam-authenticator && export PATH=$PATH:$HOME/bin
```

5. Add \$HOME/bin to your PATH environment variable.

```
echo 'export PATH=$PATH:$HOME/bin' >> ~/.bash_profile
```

6. Test that the `aws-iam-authenticator` binary works.

```
aws-iam-authenticator help
```

## Linux

### To install `aws-iam-authenticator` on Linux

1. Download the Amazon EKS vended `aws-iam-authenticator` binary from Amazon S3. To download the Arm version, change `amd64` to `arm64` before running the command.

```
curl -o aws-iam-authenticator https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/linux/amd64/aws-iam-authenticator
```

2. (Optional) Verify the downloaded binary with the SHA-256 sum provided in the same bucket prefix.
  - a. Download the SHA-256 sum for your system. To download the Arm version, change `amd64` to `arm64` before running the command.

```
curl -o aws-iam-authenticator.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/linux/amd64/aws-iam-authenticator.sha256
```

- b. Check the SHA-256 sum for your downloaded binary.

```
openssl sha1 -sha256 aws-iam-authenticator
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded `aws-iam-authenticator.sha256` file. The two should match.
3. Apply execute permissions to the binary.

```
chmod +x ./aws-iam-authenticator
```

4. Copy the binary to a folder in your `$PATH`. We recommend creating a `$HOME/bin/aws-iam-authenticator` and ensuring that `$HOME/bin` comes first in your `$PATH`.

```
mkdir -p $HOME/bin && cp ./aws-iam-authenticator $HOME/bin/aws-iam-authenticator &&  
export PATH=$PATH:$HOME/bin
```

5. Add `$HOME/bin` to your `PATH` environment variable.

```
echo 'export PATH=$PATH:$HOME/bin' >> ~/.bashrc
```

6. Test that the `aws-iam-authenticator` binary works.

```
aws-iam-authenticator help
```

## Windows

### To install `aws-iam-authenticator` on Windows with Chocolatey

1. If you do not already have Chocolatey installed on your Windows system, see [Installing chocolatey](#).
2. Open a PowerShell terminal window and install the `aws-iam-authenticator` package with the following command:

```
choco install -y aws-iam-authenticator
```

3. Test that the aws-iam-authenticator binary works.

```
aws-iam-authenticator help
```

### To install aws-iam-authenticator on Windows

1. Open a PowerShell terminal window and download the Amazon EKS vended aws-iam-authenticator binary from Amazon S3:

```
curl -o aws-iam-authenticator.exe https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/windows/amd64/aws-iam-authenticator.exe
```

2. (Optional) Verify the downloaded binary with the SHA-256 sum provided in the same bucket prefix.
  - a. Download the SHA-256 sum for your system.

```
curl -o aws-iam-authenticator.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/windows/amd64/aws-iam-authenticator.exe.sha256
```

- b. Check the SHA-256 sum for your downloaded binary.

```
Get-FileHash aws-iam-authenticator.exe
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded SHA-256 file. The two should match, although the PowerShell output will be uppercase.
3. Copy the binary to a folder in your PATH. If you have an existing directory in your PATH that you use for command line utilities, copy the binary to that directory. Otherwise, complete the following steps.
    - a. Create a new directory for your command line binaries, such as C:\bin.
    - b. Copy the aws-iam-authenticator.exe binary to your new directory.
    - c. Edit your user or system PATH environment variable to add the new directory to your PATH.
    - d. Close your PowerShell terminal and open a new one to pick up the new PATH variable.
  4. Test that the aws-iam-authenticator binary works.

```
aws-iam-authenticator help
```

If you have an existing Amazon EKS cluster, create a kubeconfig file for that cluster. For more information, see [Create a kubeconfig for Amazon EKS \(p. 221\)](#). Otherwise, see [Creating an Amazon EKS cluster \(p. 30\)](#) to create a new Amazon EKS cluster.

## Create a kubeconfig for Amazon EKS

In this section, you create a kubeconfig file for your cluster (or update an existing one).

This section offers two procedures to create or update your kubeconfig. You can quickly create or update a kubeconfig with the AWS CLI `update-kubeconfig` command automatically by using the AWS CLI, or you can create a kubeconfig manually using the AWS CLI or the `aws-iam-authenticator`.

Amazon EKS uses the `aws eks get-token` command, available in version 1.16.156 or later of the AWS CLI or the [AWS IAM Authenticator for Kubernetes](#) with `kubectl` for cluster authentication. If you have installed the AWS CLI on your system, then by default the AWS IAM Authenticator for Kubernetes will use the same credentials that are returned with the following command:

```
aws sts get-caller-identity
```

For more information, see [Configuring the AWS CLI](#) in the *AWS Command Line Interface User Guide*.

## Create kubeconfig automatically

### To create your kubeconfig file with the AWS CLI

1. Ensure that you have version 1.16.156 or later of the AWS CLI installed. To install or upgrade the AWS CLI, see [Installing the AWS Command Line Interface](#) in the *AWS Command Line Interface User Guide*.

#### Note

Your system's Python version must be 2.7.9 or later. Otherwise, you receive `hostname doesn't match` errors with AWS CLI calls to Amazon EKS.

You can check your AWS CLI version with the following command:

```
aws --version
```

#### Important

Package managers such `yum`, `apt-get`, or Homebrew for macOS are often behind several versions of the AWS CLI. To ensure that you have the latest version, see [Installing the AWS Command Line Interface](#) in the *AWS Command Line Interface User Guide*.

2. Use the AWS CLI `update-kubeconfig` command to create or update your kubeconfig for your cluster.
  - By default, the resulting configuration file is created at the default kubeconfig path (`.kube/config`) in your home directory or merged with an existing kubeconfig at that location. You can specify another path with the `--kubeconfig` option.
  - You can specify an IAM role ARN with the `--role-arn` option to use for authentication when you issue `kubectl` commands. Otherwise, the IAM entity in your default AWS CLI or SDK credential chain is used. You can view your default AWS CLI or SDK identity by running the `aws sts get-caller-identity` command.
  - For more information, see the help page with the `aws eks update-kubeconfig help` command or see [update-kubeconfig](#) in the *AWS CLI Command Reference*.

#### Note

To run the following command, you must have permission to use the `eks:DescribeCluster` API action with the cluster that you specify. For more information, see [Amazon EKS identity-based policy examples \(p. 257\)](#).

```
aws eks --region region-code update-kubeconfig --name cluster_name
```

3. Test your configuration.

```
kubectl get svc
```

### Note

If you receive any authorization or resource type errors, see [Unauthorized or access denied \(kubect1\)](#) (p. 314) in the troubleshooting section.

Output:

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
svc/kubernetes	ClusterIP	10.100.0.1	<none>	443/TCP	1m

## Create kubeconfig manually

### To create your kubeconfig file manually

1. Create the default `~/.kube` directory if it does not already exist.

```
mkdir -p ~/.kube
```

2. Open your favorite text editor and copy one of the kubeconfig code blocks below into it, depending on your preferred client token method.
  - To use the AWS CLI `aws eks get-token` command (requires version 1.16.156 or later of the AWS CLI):

```
apiVersion: v1
clusters:
- cluster:
  server: <endpoint-url>
  certificate-authority-data: <base64-encoded-ca-cert>
  name: kubernetes
contexts:
- context:
  cluster: kubernetes
  user: aws
  name: aws
current-context: aws
kind: Config
preferences: {}
users:
- name: aws
  user:
    exec:
      apiVersion: client.authentication.k8s.io/v1alpha1
      command: aws
      args:
      - "eks"
      - "get-token"
      - "--cluster-name"
      - "<cluster-name>"
      # - "--role"
      # - "<role-arn>"
      # env:
      # - name: AWS_PROFILE
      #   value: "<aws-profile>"
```

- To use the [AWS IAM authenticator for Kubernetes](#):

```
apiVersion: v1
clusters:
```

```
- cluster:
  server: <endpoint-url>
  certificate-authority-data: <base64-encoded-ca-cert>
  name: kubernetes
contexts:
- context:
  cluster: kubernetes
  user: aws
  name: aws
current-context: aws
kind: Config
preferences: {}
users:
- name: aws
  user:
    exec:
      apiVersion: client.authentication.k8s.io/v1alpha1
      command: aws-iam-authenticator
      args:
        - "token"
        - "-i"
        - "<cluster-name>"
        # - "-r"
        # - "<role-arn>"
      # env:
      # - name: AWS_PROFILE
      #   value: "<aws-profile>"
```

3. Replace the `<endpoint-url>` with the endpoint URL that was created for your cluster.
4. Replace the `<base64-encoded-ca-cert>` with the `certificateAuthority.data` that was created for your cluster.
5. Replace the `<cluster-name>` with your cluster name.
6. (Optional) To assume an IAM role to perform cluster operations instead of the default AWS credential provider chain, uncomment the `-r` or `--role` and `<role-arn>` lines and substitute an IAM role ARN to use with your user.
7. (Optional) To always use a specific named AWS credential profile (instead of the default AWS credential provider chain), uncomment the `env` lines and substitute `<aws-profile>` with the profile name to use.
8. Save the file to the default `kubectl` folder, with your cluster name in the file name. For example, if your cluster name is `devel`, save the file to `~/.kube/config-devel`.
9. Add that file path to your `KUBECONFIG` environment variable so that `kubectl` knows where to look for your cluster configuration.

- For Bash shells on macOS or Linux:

```
export KUBECONFIG=$KUBECONFIG:~/.kube/config-devel
```

- For PowerShell on Windows:

```
$ENV:KUBECONFIG="{0};{1}" -f $ENV:KUBECONFIG, "$ENV:userprofile\.kube\config-devel"
```

10. (Optional) Add the configuration to your shell initialization file so that it is configured when you open a shell.

- For Bash shells on macOS:

```
echo 'export KUBECONFIG=$KUBECONFIG:~/.kube/config-devel' >> ~/.bash_profile
```

- For Bash shells on Linux:



```
echo 'export KUBECONFIG=$KUBECONFIG:~/.kube/config-devel' >> ~/.bashrc
```

- For PowerShell on Windows:

```
[System.Environment]::SetEnvironmentVariable('KUBECONFIG', $ENV:KUBECONFIG,  
'Machine')
```

#### 11. Test your configuration.

```
kubectl get svc
```

##### Note

If you receive any authorization or resource type errors, see [Unauthorized or access denied \(kubectl\)](#) (p. 314) in the troubleshooting section.

Output:

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
svc/kubernetes	ClusterIP	10.100.0.1	<none>	443/TCP	1m

## Managing users or IAM roles for your cluster

When you create an Amazon EKS cluster, the IAM entity user or role, such as a [federated user](#) that creates the cluster, is automatically granted `system:masters` permissions in the cluster's RBAC configuration. To grant additional AWS users or roles the ability to interact with your cluster, you must edit the `aws-auth` ConfigMap within Kubernetes.

##### Note

For more information about different IAM identities, see [Identities \(Users, Groups, and Roles\)](#) in the *IAM User Guide*. For more information on Kubernetes RBAC configuration, see [Using RBAC Authorization](#). For all ConfigMap settings, see [Full Configuration Format](#) on GitHub.

The `aws-auth` ConfigMap is applied as part of the [Getting started with Amazon EKS \(p. 3\)](#) guide which provides a complete end-to-end walkthrough from creating an Amazon EKS cluster to deploying a sample Kubernetes application. It is initially created to allow your nodes to join your cluster, but you also use this ConfigMap to add RBAC access to IAM users and roles. If you have not launched nodes and applied the `aws-auth` ConfigMap, you can do so with the following procedure.

#### To apply the `aws-auth` ConfigMap to your cluster

1. Check to see if you have already applied the `aws-auth` ConfigMap.

```
kubectl describe configmap -n kube-system aws-auth
```

If you receive an error stating "Error from server (NotFound): configmaps "aws-auth" not found", then proceed with the following steps to apply the stock ConfigMap.

2. Download, edit, and apply the AWS authenticator configuration map.
  - a. Download the configuration map:

```
curl -o aws-auth-cm.yaml https://amazon-eks.s3.us-west-2.amazonaws.com/  
cloudformation/2020-08-12/aws-auth-cm.yaml
```

- b. Open the file with your favorite text editor. Replace *<ARN of instance role (not instance profile)>* with the Amazon Resource Name (ARN) of the IAM role associated with your nodes, and save the file. Do not modify any other lines in this file.

### Important

The role ARN cannot include a path. The format of the role ARN must be `arn:aws:iam::123456789012:role/role-name`. For more information, see [aws-auth ConfigMap does not grant access to the cluster \(p. 320\)](#).

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: aws-auth
  namespace: kube-system
data:
  mapRoles: |
    - rolearn: <ARN of instance role (not instance profile)>
      username: system:node:{{EC2PrivateDNSName}}
      groups:
        - system:bootstrappers
        - system:nodes
```

You can inspect the AWS CloudFormation stack outputs for your worker node groups and look for the following values:

- **InstanceRoleARN** (for node groups that were created with `eksctl`)
  - **NodeInstanceRole** (for node groups that were created with Amazon EKS vended AWS CloudFormation templates in the AWS Management Console)
- c. Apply the configuration. This command may take a few minutes to finish.

```
kubectl apply -f aws-auth-cm.yaml
```

### Note

If you receive any authorization or resource type errors, see [Unauthorized or access denied \(kubectl\) \(p. 314\)](#) in the troubleshooting section.

3. Watch the status of your nodes and wait for them to reach the Ready status.

```
kubectl get nodes --watch
```

## To add an IAM user or role to an Amazon EKS cluster

1. Ensure that the AWS credentials that `kubectl` is using are already authorized for your cluster. The IAM user that created the cluster has these permissions by default.
2. Open the `aws-auth` ConfigMap.

```
kubectl edit -n kube-system configmap/aws-auth
```

### Note

If you receive an error stating "Error from server (NotFound): configmaps "aws-auth" not found", then use the previous procedure to apply the stock ConfigMap.

Example ConfigMap:

```
# Please edit the object below. Lines beginning with a '#' will be ignored,
```

```
# and an empty file will abort the edit. If an error occurs while saving this file will
be
# reopened with the relevant failures.
#
apiVersion: v1
data:
  mapRoles: |
    - rolearn: arn:aws:iam::111122223333:role/doc-test-nodes-NodeInstanceRole-
      WDO5P42N3ETB
      username: system:node:{{EC2PrivateDNSName}}
      groups:
        - system:bootstrappers
        - system:nodes
kind: ConfigMap
metadata:
  annotations:
    kubectl.kubernetes.io/last-applied-configuration: |
      {"apiVersion":"v1","data":{"mapRoles":"- rolearn: arn:aws:iam::111122223333:role/
doc-test-nodes-NodeInstanceRole-WDO5P42N3ETB\n username: system:node:
{{EC2PrivateDNSName}}\n groups:\n - system:bootstrappers\n -
system:nodes\n"},"kind":"ConfigMap","metadata":{"annotations":{},"name":"aws-
auth","namespace":"kube-system"}}
    creationTimestamp: 2018-04-04T18:49:10Z
    name: aws-auth
    namespace: kube-system
    resourceVersion: "780"
    selfLink: /api/v1/namespaces/kube-system/configmaps/aws-auth
    uid: dcc31de5-3838-11e8-af26-02e00430057c
```

3. Add your IAM users, roles, or AWS accounts to the configMap. You cannot add IAM groups to the configMap.
  - **To add an IAM user:** add the user details to the mapUsers section of the ConfigMap, under data. Add this section if it does not already exist in the file. Each entry supports the following parameters:
    - **userarn:** The ARN of the IAM user to add.
    - **username:** The user name within Kubernetes to map to the IAM user.
    - **groups:** A list of groups within Kubernetes to which the user is mapped to. For more information, see [Default Roles and Role Bindings](#) in the Kubernetes documentation.
  - **To add an IAM role (for example, for federated users):** add the role details to the mapRoles section of the ConfigMap, under data. Add this section if it does not already exist in the file. Each entry supports the following parameters:
    - **rolearn:** The ARN of the IAM role to add.
    - **username:** The user name within Kubernetes to map to the IAM role.
    - **groups:** A list of groups within Kubernetes to which the role is mapped. For more information, see [Default Roles and Role Bindings](#) in the Kubernetes documentation.

For example, the block below contains:

- A mapRoles section that adds the node instance role so that nodes can register themselves with the cluster.
- A mapUsers section with the AWS users admin from the default AWS account, and ops-user from another AWS account. Both users are added to the system:masters group.

```
# Please edit the object below. Lines beginning with a '#' will be ignored,
# and an empty file will abort the edit. If an error occurs while saving this file will
be
# reopened with the relevant failures.
```

```
#
apiVersion: v1
data:
  mapRoles: |
    - rolearn: arn:aws:iam::555555555555:role/devel-nodes-NodeInstanceRole-74RF4UBDUKL6
      username: system:node:{{EC2PrivateDNSName}}
      groups:
        - system:bootstrappers
        - system:nodes
  mapUsers: |
    - userarn: arn:aws:iam::555555555555:user/admin
      username: admin
      groups:
        - system:masters
    - userarn: arn:aws:iam::111122223333:user/ops-user
      username: ops-user
      groups:
        - system:masters
```

4. Save the file and exit your text editor.

# Cluster management

This chapter includes the following topics to help you manage your cluster.

- [the section called “Installing `kubectl`” \(p. 229\)](#) – Learn how to install `kubectl`; a command line tool for managing Kubernetes.
- [the section called “`eksctl`” \(p. 234\)](#) – Learn how to install a simple command line utility for creating and managing Kubernetes clusters on Amazon EKS.
- [the section called “Tutorial: Deploy Kubernetes Dashboard” \(p. 236\)](#) – Learn how to install the dashboard, a web-based user interface for your Kubernetes cluster and applications.
- [the section called “Metrics server” \(p. 239\)](#) – The Kubernetes Metrics Server is an aggregator of resource usage data in your cluster. It is not deployed by default in your cluster, but is used by Kubernetes add-ons, such as the Kubernetes Dashboard and [the section called “Horizontal Pod Autoscaler” \(p. 208\)](#). In this topic you learn how to install the Metrics Server.
- [the section called “Prometheus metrics” \(p. 240\)](#) – The Kubernetes API server exposes a number of metrics that are useful for monitoring and analysis. This topic explains how to deploy Prometheus and some of the ways that you can use it to view and analyze what your cluster is doing.
- [the section called “Using Helm” \(p. 243\)](#) – The Helm package manager for Kubernetes helps you install and manage applications on your Kubernetes cluster. This topic helps you install and run the Helm binaries so that you can install and manage charts using the Helm CLI on your local computer.
- [the section called “Tagging your resources” \(p. 243\)](#) – To help you manage your Amazon EKS resources, you can assign your own metadata to each resource in the form of *tags*. This topic describes tags and shows you how to create them.
- [the section called “Service quotas” \(p. 247\)](#) – Your AWS account has default quotas, formerly referred to as limits, for each AWS service. Learn about the quotas for Amazon EKS and how to increase them.

## Installing `kubectl`

Kubernetes uses a command line utility called `kubectl` for communicating with the cluster API server. The `kubectl` binary is available in many operating system package managers, and this option is often much easier than a manual download and install process. You can follow the instructions for your specific operating system or package manager in the [Kubernetes documentation](#) to install.

This topic helps you to download and install the Amazon EKS vended `kubectl` binaries for macOS, Linux, and Windows operating systems. These binaries are identical to the upstream community versions, and are not unique to Amazon EKS or AWS.

### Note

You must use a `kubectl` version that is within one minor version difference of your Amazon EKS cluster control plane. For example, a 1.16 `kubectl` client should work with Kubernetes 1.15, 1.16 and 1.17 clusters.

macOS

### To install `kubectl` on macOS

1. Download the Amazon EKS vended `kubectl` binary for your cluster's Kubernetes version from Amazon S3:

- **Kubernetes 1.17:**

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/darwin/amd64/kubectl
```

- **Kubernetes 1.16:**

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.16.13/2020-08-04/bin/darwin/amd64/kubectl
```

- **Kubernetes 1.15:**

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.15.11/2020-08-04/bin/darwin/amd64/kubectl
```

- **Kubernetes 1.14:**

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.14.9/2020-08-04/bin/darwin/amd64/kubectl
```

2. (Optional) Verify the downloaded binary with the SHA-256 sum for your binary.

- a. Download the SHA-256 sum for your cluster's Kubernetes version for macOS:

- **Kubernetes 1.17:**

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/darwin/amd64/kubectl.sha256
```

- **Kubernetes 1.16:**

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.16.13/2020-08-04/bin/darwin/amd64/kubectl.sha256
```

- **Kubernetes 1.15:**

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.15.11/2020-08-04/bin/darwin/amd64/kubectl.sha256
```

- **Kubernetes 1.14:**

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.14.9/2020-08-04/bin/darwin/amd64/kubectl.sha256
```

- b. Check the SHA-256 sum for your downloaded binary.

```
openssl sha1 -sha256 kubectl
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded SHA-256 file. The two should match.

3. Apply execute permissions to the binary.

```
chmod +x ./kubectl
```

4. Copy the binary to a folder in your `PATH`. If you have already installed a version of `kubectl`, then we recommend creating a `$HOME/bin/kubectl` and ensuring that `$HOME/bin` comes first in your `$PATH`.

```
mkdir -p $HOME/bin && cp ./kubectl $HOME/bin/kubectl && export PATH=$PATH:$HOME/bin
```

5. (Optional) Add the \$HOME/bin path to your shell initialization file so that it is configured when you open a shell.

```
echo 'export PATH=$PATH:$HOME/bin' >> ~/.bash_profile
```

6. After you install kubectl, you can verify its version with the following command:

```
kubectl version --short --client
```

## Linux

### To install kubectl on Linux

1. Download the Amazon EKS vended kubectl binary for your cluster's Kubernetes version from Amazon S3. To download the Arm version, change `amd64` to `arm64` before running the command.

- **Kubernetes 1.17:**

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/linux/amd64/kubectl
```

- **Kubernetes 1.16:**

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.16.13/2020-08-04/bin/linux/amd64/kubectl
```

- **Kubernetes 1.15:**

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.15.11/2020-08-04/bin/linux/amd64/kubectl
```

- **Kubernetes 1.14:**

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.14.9/2020-08-04/bin/linux/amd64/kubectl
```

2. (Optional) Verify the downloaded binary with the SHA-256 sum for your binary.
  - a. Download the SHA-256 sum for your cluster's Kubernetes version for Linux. To download the Arm version, change `amd64` to `arm64` before running the command.

- **Kubernetes 1.17:**

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/linux/amd64/kubectl.sha256
```

- **Kubernetes 1.16:**

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.16.13/2020-08-04/bin/linux/amd64/kubectl.sha256
```

- **Kubernetes 1.15:**

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.15.11/2020-08-04/bin/linux/amd64/kubectl.sha256
```

- **Kubernetes 1.14:**

```
curl -o kubectl.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.14.9/2020-08-04/bin/linux/amd64/kubectl.sha256
```

- b. Check the SHA-256 sum for your downloaded binary.

```
openssl sha1 -sha256 kubectl
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded SHA-256 file. The two should match.

3. Apply execute permissions to the binary.

```
chmod +x ./kubectl
```

4. Copy the binary to a folder in your `PATH`. If you have already installed a version of `kubectl`, then we recommend creating a `$HOME/bin/kubectl` and ensuring that `$HOME/bin` comes first in your `$PATH`.

```
mkdir -p $HOME/bin && cp ./kubectl $HOME/bin/kubectl && export PATH=$PATH:$HOME/bin
```

5. (Optional) Add the `$HOME/bin` path to your shell initialization file so that it is configured when you open a shell.

**Note**

This step assumes you are using the Bash shell; if you are using another shell, change the command to use your specific shell initialization file.

```
echo 'export PATH=$PATH:$HOME/bin' >> ~/.bashrc
```

6. After you install `kubectl`, you can verify its version with the following command:

```
kubectl version --short --client
```

## Windows

### To install kubectl on Windows

1. Open a PowerShell terminal.
2. Download the Amazon EKS vended `kubectl` binary for your cluster's Kubernetes version from Amazon S3:

- **Kubernetes 1.17:**

```
curl -o kubectl.exe https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/windows/amd64/kubectl.exe
```

- **Kubernetes 1.16:**

```
curl -o kubectl.exe https://amazon-eks.s3.us-west-2.amazonaws.com/1.16.13/2020-08-04/bin/windows/amd64/kubectl.exe
```



- **Kubernetes 1.15:**

```
curl -o kubectl.exe https://amazon-eks.s3.us-west-2.amazonaws.com/1.15.11/2020-08-04/bin/windows/amd64/kubectl.exe
```

- **Kubernetes 1.14:**

```
curl -o kubectl.exe https://amazon-eks.s3.us-west-2.amazonaws.com/1.14.9/2020-08-04/bin/windows/amd64/kubectl.exe
```

3. (Optional) Verify the downloaded binary with the SHA-256 sum for your binary.
  - a. Download the SHA-256 sum for your cluster's Kubernetes version for Windows:

- **Kubernetes 1.17:**

```
curl -o kubectl.exe.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.17.9/2020-08-04/bin/windows/amd64/kubectl.exe.sha256
```

- **Kubernetes 1.16:**

```
curl -o kubectl.exe.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.16.13/2020-08-04/bin/windows/amd64/kubectl.exe.sha256
```

- **Kubernetes 1.15:**

```
curl -o kubectl.exe.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.15.11/2020-08-04/bin/windows/amd64/kubectl.exe.sha256
```

- **Kubernetes 1.14:**

```
curl -o kubectl.exe.sha256 https://amazon-eks.s3.us-west-2.amazonaws.com/1.14.9/2020-08-04/bin/windows/amd64/kubectl.exe.sha256
```

- b. Check the SHA-256 sum for your downloaded binary.

```
Get-FileHash kubectl.exe
```

- c. Compare the generated SHA-256 sum in the command output against your downloaded SHA-256 file. The two should match, although the PowerShell output will be uppercase.
4. Copy the binary to a folder in your PATH. If you have an existing directory in your PATH that you use for command line utilities, copy the binary to that directory. Otherwise, complete the following steps.
    - a. Create a new directory for your command line binaries, such as C:\bin.
    - b. Copy the kubectl.exe binary to your new directory.
    - c. Edit your user or system PATH environment variable to add the new directory to your PATH.
    - d. Close your PowerShell terminal and open a new one to pick up the new PATH variable.
  5. After you install kubectl, you can verify its version with the following command:

```
kubectl version --short --client
```

## The eksctl command line utility

This topic covers eksctl, a simple command line utility for creating and managing Kubernetes clusters on Amazon EKS. The eksctl command line utility provides the fastest and easiest way to create a new cluster with nodes for Amazon EKS.

For more information and to see the official documentation, visit <https://eksctl.io/>.

### Installing or upgrading eksctl

This section helps you to install or upgrade the latest version of the eksctl command line utility.

Choose the tab below that best represents your client setup.

macOS

#### To install or upgrade eksctl on macOS using Homebrew

The easiest way to get started with Amazon EKS and macOS is by installing eksctl with [Homebrew](#). The eksctl Homebrew recipe installs eksctl and any other dependencies that are required for Amazon EKS, such as kubectl. The recipe also installs the [aws-iam-authenticator](#) (p. 218), which is required if you don't have the AWS CLI version 1.16.156 or higher installed.

1. If you do not already have Homebrew installed on macOS, install it with the following command.

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

2. Install the Weaveworks Homebrew tap.

```
brew tap weaveworks/tap
```

3. Install or upgrade eksctl.

- Install eksctl with the following command:

```
brew install weaveworks/tap/eksctl
```

- If eksctl is already installed, run the following command to upgrade:

```
brew upgrade eksctl && brew link --overwrite eksctl
```

4. Test that your installation was successful with the following command.

```
eksctl version
```

#### Note

The GitTag version should be at least 0.26.0-rc.1. If not, check your terminal output for any installation or upgrade errors, or manually download an archive of the release from [https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl\\_Darwin\\_amd64.tar.gz](https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl_Darwin_amd64.tar.gz), extract eksctl, and then execute it.

## Linux

### To install or upgrade eksctl on Linux using curl

1. Download and extract the latest release of eksctl with the following command.

```
curl --silent --location "https://github.com/weaveworks/eksctl/releases/latest/download/eksctl_$(uname -s)_amd64.tar.gz" | tar xz -C /tmp
```

2. Move the extracted binary to /usr/local/bin.

```
sudo mv /tmp/eksctl /usr/local/bin
```

3. Test that your installation was successful with the following command.

```
eksctl version
```

#### Note

The GitTag version should be at least 0.26.0-rc.1. If not, check your terminal output for any installation or upgrade errors, or replace the address in step 1 with [https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl\\_Linux\\_amd64.tar.gz](https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl_Linux_amd64.tar.gz) and complete steps 1-3 again.

## Windows

### To install or upgrade eksctl on Windows using Chocolatey

1. If you do not already have Chocolatey installed on your Windows system, see [Installing Chocolatey](#).
2. Install or upgrade eksctl.
  - Install the binaries with the following command:

```
chocolatey install -y eksctl
```

- If they are already installed, run the following command to upgrade:

```
chocolatey upgrade -y eksctl
```

3. Test that your installation was successful with the following command.

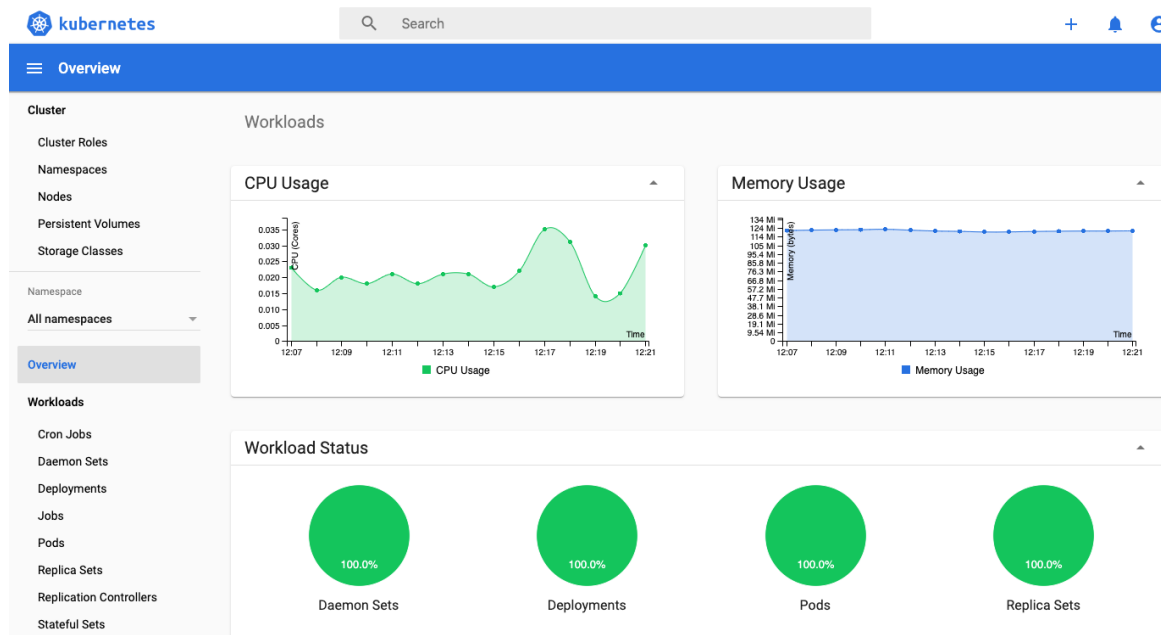
```
eksctl version
```

#### Note

The GitTag version should be at least 0.26.0-rc.1. If not, check your terminal output for any installation or upgrade errors, or manually download an archive of the release from [https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl\\_Windows\\_amd64.zip](https://github.com/weaveworks/eksctl/releases/download/0.26.0-rc.1/eksctl_Windows_amd64.zip), extract eksctl, and then execute it.

# Tutorial: Deploy the Kubernetes Dashboard (web UI)

This tutorial guides you through deploying the [Kubernetes Dashboard](#) to your Amazon EKS cluster, complete with CPU and memory metrics. It also helps you to create an Amazon EKS administrator service account that you can use to securely connect to the dashboard to view and control your cluster.



## Prerequisites

This tutorial assumes the following:

- You have created an Amazon EKS cluster by following the steps in [Getting started with Amazon EKS \(p. 3\)](#).
- The security groups for your control plane elastic network interfaces and nodes follow the recommended settings in [Amazon EKS security group considerations \(p. 173\)](#).
- You are using a `kubectl` client that is [configured to communicate with your Amazon EKS cluster \(p. 24\)](#).

## Step 1: Deploy the Kubernetes Metrics Server

The Kubernetes Metrics Server is an aggregator of resource usage data in your cluster, and it is not deployed by default in Amazon EKS clusters. The Kubernetes Dashboard uses the metrics server to gather metrics for your cluster, such as CPU and memory usage over time.

### To deploy the Metrics Server

1. Deploy the Metrics Server with the following command:

```
kubectl apply -f https://github.com/kubernetes-sigs/metrics-server/releases/download/v0.3.6/components.yaml
```

2. Verify that the `metrics-server` deployment is running the desired number of pods with the following command.

```
kubectl get deployment metrics-server -n kube-system
```

Output

NAME	READY	UP-TO-DATE	AVAILABLE	AGE
metrics-server	1/1	1	1	6m

## Step 2: Deploy the dashboard

Use the following command to deploy the Kubernetes Dashboard.

```
kubectl apply -f https://raw.githubusercontent.com/kubernetes/dashboard/v2.0.0-beta8/aio/deploy/recommended.yaml
```

Output:

```
namespace/kubernetes-dashboard created
serviceaccount/kubernetes-dashboard created
service/kubernetes-dashboard created
secret/kubernetes-dashboard-certs created
secret/kubernetes-dashboard-csrf created
secret/kubernetes-dashboard-key-holder created
configmap/kubernetes-dashboard-settings created
role.rbac.authorization.k8s.io/kubernetes-dashboard created
clusterrole.rbac.authorization.k8s.io/kubernetes-dashboard created
rolebinding.rbac.authorization.k8s.io/kubernetes-dashboard created
clusterrolebinding.rbac.authorization.k8s.io/kubernetes-dashboard created
deployment.apps/kubernetes-dashboard created
service/dashboard-metrics-scraper created
deployment.apps/dashboard-metrics-scraper created
```

## Step 3: Create an `eks-admin` service account and cluster role binding

By default, the Kubernetes Dashboard user has limited permissions. In this section, you create an `eks-admin` service account and cluster role binding that you can use to securely connect to the dashboard with admin-level permissions. For more information, see [Managing Service Accounts](#) in the Kubernetes documentation.

### To create the `eks-admin` service account and cluster role binding

#### Important

The example service account created with this procedure has full `cluster-admin` (superuser) privileges on the cluster. For more information, see [Using RBAC authorization](#) in the Kubernetes documentation.

1. Create a file called `eks-admin-service-account.yaml` with the text below. This manifest defines a service account and cluster role binding called `eks-admin`.

```
apiVersion: v1
```

```
kind: ServiceAccount
metadata:
  name: eks-admin
  namespace: kube-system
---
apiVersion: rbac.authorization.k8s.io/v1beta1
kind: ClusterRoleBinding
metadata:
  name: eks-admin
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: cluster-admin
subjects:
- kind: ServiceAccount
  name: eks-admin
  namespace: kube-system
```

2. Apply the service account and cluster role binding to your cluster.

```
kubectl apply -f eks-admin-service-account.yaml
```

Output:

```
serviceaccount "eks-admin" created
clusterrolebinding.rbac.authorization.k8s.io "eks-admin" created
```

## Step 4: Connect to the dashboard

Now that the Kubernetes Dashboard is deployed to your cluster, and you have an administrator service account that you can use to view and control your cluster, you can connect to the dashboard with that service account.

### To connect to the Kubernetes dashboard

1. Retrieve an authentication token for the eks-admin service account. Copy the `<authentication_token>` value from the output. You use this token to connect to the dashboard.

```
kubectl -n kube-system describe secret $(kubectl -n kube-system get secret | grep eks-admin | awk '{print $1}')
```

Output:

```
Name:          eks-admin-token-b5zv4
Namespace:     kube-system
Labels:        <none>
Annotations:   kubernetes.io/service-account.name=eks-admin
               kubernetes.io/service-account.uid=bcfe66ac-39be-11e8-97e8-026dce96b6e8

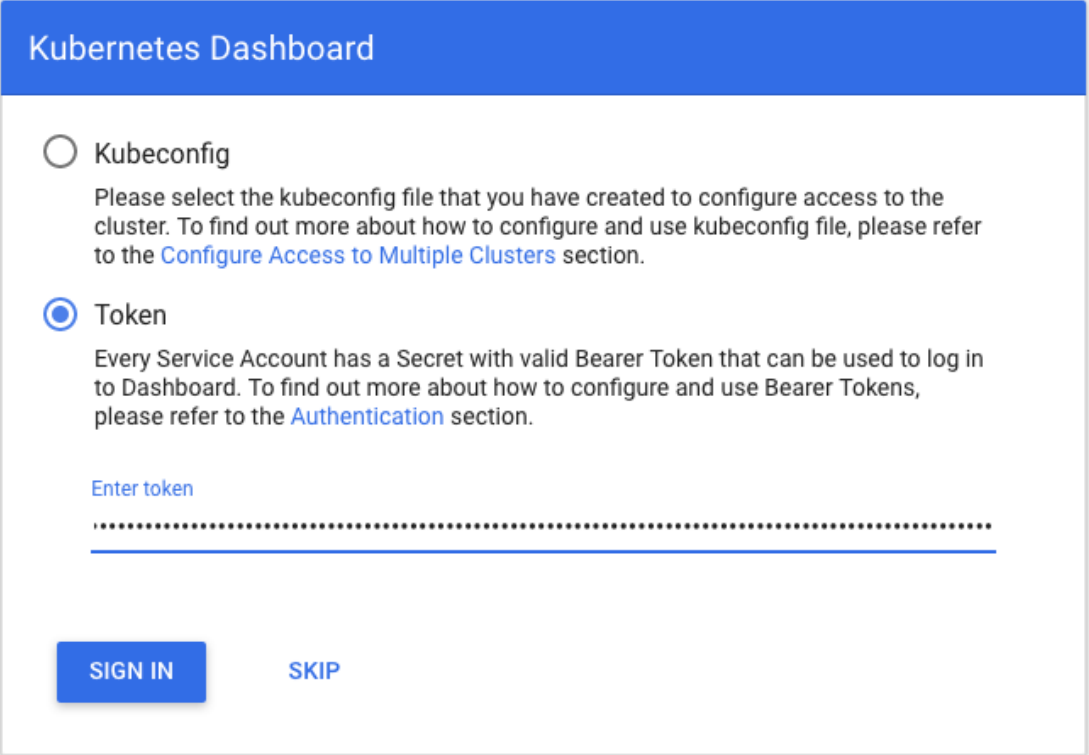
Type:          kubernetes.io/service-account-token

Data
====
ca.crt:      1025 bytes
namespace:   11 bytes
token:       <authentication_token>
```

2. Start the kubectl proxy.

```
kubectl proxy
```

3. To access the dashboard endpoint, open the following link with a web browser: <http://localhost:8001/api/v1/namespaces/kubernetes-dashboard/services/https:kubernetes-dashboard:/proxy/#!/login>.
4. Choose **Token**, paste the `<authentication_token>` output from the previous command into the **Token** field, and choose **SIGN IN**.



Kubernetes Dashboard

☐ Kubeconfig

Please select the kubeconfig file that you have created to configure access to the cluster. To find out more about how to configure and use kubeconfig file, please refer to the [Configure Access to Multiple Clusters](#) section.

☒ Token

Every Service Account has a Secret with valid Bearer Token that can be used to log in to Dashboard. To find out more about how to configure and use Bearer Tokens, please refer to the [Authentication](#) section.

Enter token

.....

**SIGN IN** **SKIP**

**Note**

It may take a few minutes before CPU and memory metrics appear in the dashboard.

## Step 5: Next steps

After you have connected to your Kubernetes Dashboard, you can view and control your cluster using your `eks-admin` service account. For more information about using the dashboard, see the [project documentation on GitHub](#).

## Installing the Kubernetes Metrics Server

The Kubernetes Metrics Server is an aggregator of resource usage data in your cluster, and it is not deployed by default in Amazon EKS clusters. The Metrics Server is commonly used by other Kubernetes add ons, such as the [Horizontal Pod Autoscaler \(p. 208\)](#) or the [Kubernetes Dashboard \(p. 236\)](#). For more information, see [Resource metrics pipeline](#) in the Kubernetes documentation. This topic explains how to deploy the Kubernetes Metrics Server on your Amazon EKS cluster.

## To deploy the Metrics Server

1. Deploy the Metrics Server with the following command:

```
kubectl apply -f https://github.com/kubernetes-sigs/metrics-server/releases/download/v0.3.6/components.yaml
```

2. Verify that the metrics-server deployment is running the desired number of pods with the following command.

```
kubectl get deployment metrics-server -n kube-system
```

### Output

NAME	READY	UP-TO-DATE	AVAILABLE	AGE
metrics-server	1/1	1	1	6m

# Control plane metrics with Prometheus

The Kubernetes API server exposes a number of metrics that are useful for monitoring and analysis. These metrics are exposed internally through a metrics endpoint that refers to the `/metrics` HTTP API. Like other endpoints, this endpoint is exposed on the Amazon EKS control plane. This topic explains some of the ways you can use this endpoint to view and analyze what your cluster is doing.

## Viewing the raw metrics

To view the raw metrics output, use `kubectl` with the `--raw` flag. This command allows you to pass any HTTP path and returns the raw response.

```
kubectl get --raw /metrics
```

Example output:

```
...
# HELP rest_client_requests_total Number of HTTP requests, partitioned by status code,
# method, and host.
# TYPE rest_client_requests_total counter
rest_client_requests_total{code="200",host="127.0.0.1:21362",method="POST"} 4994
rest_client_requests_total{code="200",host="127.0.0.1:443",method="DELETE"} 1
rest_client_requests_total{code="200",host="127.0.0.1:443",method="GET"} 1.326086e+06
rest_client_requests_total{code="200",host="127.0.0.1:443",method="PUT"} 862173
rest_client_requests_total{code="404",host="127.0.0.1:443",method="GET"} 2
rest_client_requests_total{code="409",host="127.0.0.1:443",method="POST"} 3
rest_client_requests_total{code="409",host="127.0.0.1:443",method="PUT"} 8
# HELP ssh_tunnel_open_count Counter of ssh tunnel total open attempts
# TYPE ssh_tunnel_open_count counter
ssh_tunnel_open_count 0
# HELP ssh_tunnel_open_fail_count Counter of ssh tunnel failed open attempts
# TYPE ssh_tunnel_open_fail_count counter
ssh_tunnel_open_fail_count 0
```

This raw output returns verbatim what the API server exposes. These metrics are represented in a [Prometheus format](#). This format allows the API server to expose different metrics broken down by line. Each line includes a metric name, tags, and a value.



```
metric_name{"tag"="value"[,...]} value
```

While this endpoint is useful if you are looking for a specific metric, you typically want to analyze these metrics over time. To do this, you can deploy [Prometheus](#) into your cluster. Prometheus is a monitoring and time series database that scrapes exposed endpoints and aggregates data, allowing you to filter, graph, and query the results.

## Deploying Prometheus

This topic helps you deploy Prometheus into your cluster with Helm V3. If you already have Helm installed, you can check your version with the `helm version` command. Helm is a package manager for Kubernetes clusters. For more information about Helm and how to install it, see [Using Helm with Amazon EKS \(p. 243\)](#).

After you configure Helm for your Amazon EKS cluster, you can use it to deploy Prometheus with the following steps.

### To deploy Prometheus using Helm

1. Create a Prometheus namespace.

```
kubectl create namespace prometheus
```

2. Deploy Prometheus.

```
helm install prometheus stable/prometheus \
  --namespace prometheus \
  --set
  alertmanager.persistentVolume.storageClass="gp2",server.persistentVolume.storageClass="gp2"
```

3. Verify that all of the pods in the prometheus namespace are in the READY state.

```
kubectl get pods -n prometheus
```

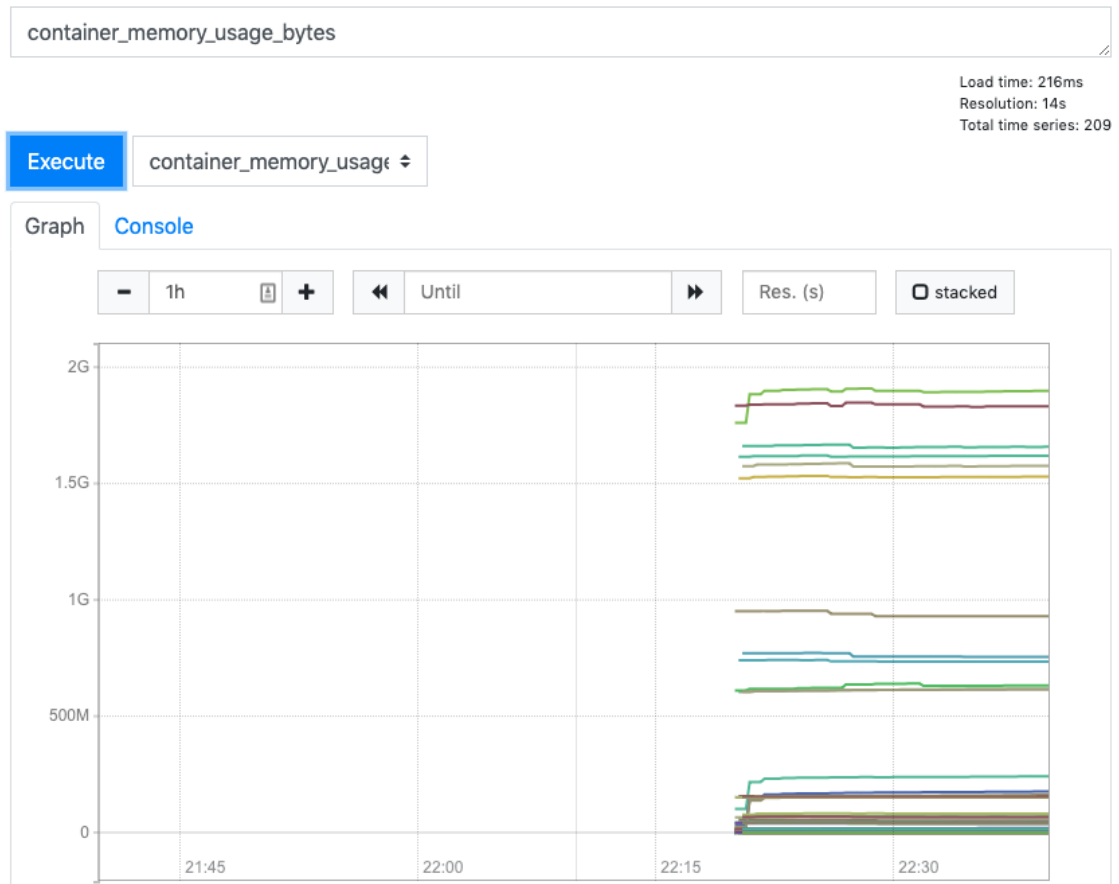
Output:

NAME	READY	STATUS	RESTARTS	AGE
prometheus-alertmanager-59b4c8c744-r7bgp	1/2	Running	0	48s
prometheus-kube-state-metrics-7cfd87cf99-jkz2f	1/1	Running	0	48s
prometheus-node-exporter-jcjqz	1/1	Running	0	48s
prometheus-node-exporter-jxv2h	1/1	Running	0	48s
prometheus-node-exporter-vbdks	1/1	Running	0	48s
prometheus-pushgateway-76c444b68c-82tnw	1/1	Running	0	48s
prometheus-server-775957f748-mmht9	1/2	Running	0	48s

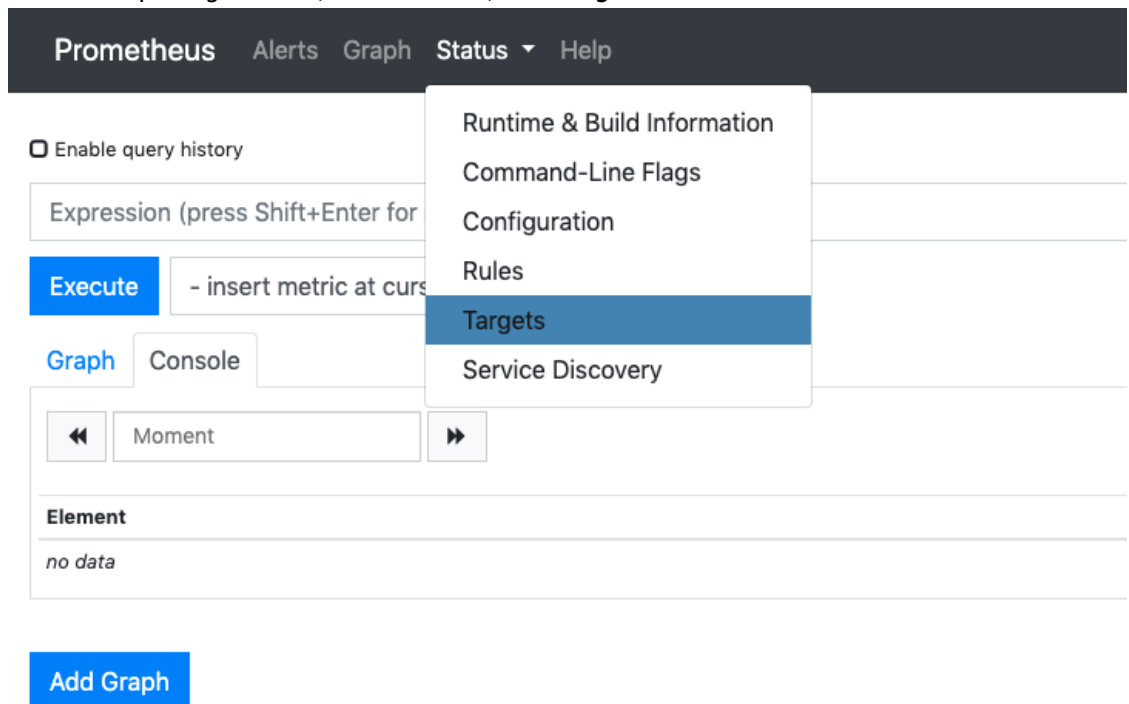
4. Use `kubectl` to port forward the Prometheus console to your local machine.

```
kubectl --namespace=prometheus port-forward deploy/prometheus-server 9090
```

5. Point a web browser to [localhost:9090](http://localhost:9090) to view the Prometheus console.
6. Choose a metric from the - **insert metric at cursor** menu, then choose **Execute**. Choose the **Graph** tab to show the metric over time. The following image shows `container_memory_usage_bytes` over time.



7. From the top navigation bar, choose **Status**, then **Targets**.



All of the Kubernetes endpoints that are connected to Prometheus using service discovery are displayed.

## Using Helm with Amazon EKS

The Helm package manager for Kubernetes helps you install and manage applications on your Kubernetes cluster. For more information, see the [Helm documentation](#). This topic helps you install and run the Helm binaries so that you can install and manage charts using the Helm CLI on your local system.

### Important

Before you can install Helm charts on your Amazon EKS cluster, you must configure `kubectl` to work for Amazon EKS. If you have not already done this, see [Create a kubeconfig for Amazon EKS \(p. 221\)](#) before proceeding. If the following command succeeds for your cluster, you're properly configured.

```
kubectl get svc
```

### To install the Helm binaries on your local system

1. Run the appropriate command for your client operating system.

- If you're using macOS with [Homebrew](#), install the binaries with the following command.

```
brew install helm
```

- If you're using Windows with [Chocolatey](#), install the binaries with the following command.

```
choco install kubernetes-helm
```

- If you're using Linux, install the binaries with the following commands.

```
curl https://raw.githubusercontent.com/helm/helm/master/scripts/get-helm-3 >  
get_helm.sh  
chmod 700 get_helm.sh  
./get_helm.sh
```

2. To pick up the new binary in your `PATH`, Close your current terminal window and open a new one.
3. Confirm that Helm is running with the following command.

```
helm help
```

4. At this point, you can run any Helm commands (such as `helm install chart_name`) to install, modify, delete, or query Helm charts in your cluster. If you're new to Helm and don't have a specific chart to install, you can:
  - Experiment by installing an example chart. See [Install an example chart](#) in the Helm [Quickstart guide](#).
  - Install an Amazon EKS chart from the [eks-charts](#) GitHub repo or from [Helm Hub](#).

## Tagging your Amazon EKS resources

To help you manage your Amazon EKS resources, you can assign your own metadata to each resource using *tags*. This topic provides an overview of the tags function and shows how you can create tags.

## Contents

- [Tag basics \(p. 244\)](#)
- [Tagging your resources \(p. 244\)](#)
- [Tag restrictions \(p. 245\)](#)
- [Working with tags using the console \(p. 245\)](#)
- [Working with tags using the CLI, API, or eksctl \(p. 246\)](#)

## Tag basics

A tag is a label that you assign to an AWS resource. Each tag consists of a *key* and an optional *value*, both of which you define.

Tags enable you to categorize your AWS resources by, for example, purpose, owner, or environment. When you have many resources of the same type, you can quickly identify a specific resource based on the tags you've assigned to it. For example, you can define a set of tags for your Amazon EKS clusters to help you track each cluster's owner and stack level. We recommend that you devise a consistent set of tag keys for each resource type. You can then search and filter the resources based on the tags that you add.

Tags are not automatically assigned to your resources. After you add a tag, you can edit tag keys and values or remove tags from a resource at any time. If you delete a resource, any tags for the resource are also deleted.

Tags don't have any semantic meaning to Amazon EKS and are interpreted strictly as a string of characters. You can set the value of a tag to an empty string, but you can't set the value of a tag to null. If you add a tag that has the same key as an existing tag on that resource, the new value overwrites the earlier value.

You can tag new or existing cluster resources using the AWS Management Console, the AWS CLI, or the Amazon EKS API. You can tag only new cluster resources using `eksctl`.

If you use AWS Identity and Access Management (IAM), you can control which users in your AWS account have permission to manage tags.

## Tagging your resources

You can tag new or existing Amazon EKS clusters and managed node groups.

If you're using the Amazon EKS console, then you can apply tags to new or existing resources at any time. You can do this by using the **Tags** tab on the relevant resource page. If you're using `eksctl`, then you can apply tags to resources when they are created using the `--tags` option.

If you're using the Amazon EKS API, the AWS CLI, or an AWS SDK, you can apply tags to new resources using the `tags` parameter on the relevant API action. You can apply tags to existing resources using the `TagResource` API action. For more information, see [TagResource](#).

Some resource-creating actions enable you to specify tags for a resource when the resource is created. If tags cannot be applied while a resource is being created, the resource fails to be created. This mechanism ensures that resources you intended to tag on creation are either created with specified tags or not created at all. If you tag resources at the time of creation, you don't need to run custom tagging scripts after creating a resource.

The following table describes the Amazon EKS resources that can be tagged and the resources that can be tagged on creation.

### Tagging support for Amazon EKS resources

Resource	Supports tags	Supports tag propagation	Supports tagging on creation (Amazon EKS API, AWS CLI, AWS SDK, and <code>eksctl</code> )
Amazon EKS clusters	Yes	No. Cluster tags do not propagate to any other resources associated with the cluster.	Yes
Amazon EKS managed node groups	Yes	No. Managed node group tags do not propagate to any other resources associated with the node group.	Yes
Amazon EKS Fargate profiles	Yes	No. Fargate profile tags do not propagate to any other resources associated with the Fargate profile, such as the pods that are scheduled with it.	Yes

## Tag restrictions

The following basic restrictions apply to tags:

- Maximum number of tags per resource – 50
- For each resource, each tag key must be unique, and each tag key can have only one value.
- Maximum key length – 128 Unicode characters in UTF-8
- Maximum value length – 256 Unicode characters in UTF-8
- If your tagging schema is used across multiple AWS services and resources, remember that other services may have restrictions on allowed characters. Generally allowed characters are letters, numbers, spaces representable in UTF-8, and the following characters: + - = . \_ : / @.
- Tag keys and values are case sensitive.
- Don't use `aws:`, `AWS:`, or any upper or lowercase combination of such as a prefix for either keys or values. These are reserved only for AWS use. You can't edit or delete tag keys or values with this prefix. Tags with this prefix do not count against your tags-per-resource limit.

## Working with tags using the console

Using the Amazon EKS console, you can manage the tags associated with new or existing clusters and managed node groups.

When you select a resource-specific page in the Amazon EKS console, it displays a list of those resources. For example, if you select **Clusters** from the navigation pane, the console displays a list of Amazon EKS clusters. When you select a resource from one of these lists (for example, a specific cluster) that supports tags, you can view and manage its tags on the **Tags** tab.

## Adding tags on an individual resource on creation

You can add tags to Amazon EKS clusters, managed node groups, and Fargate profiles when you create them. For more information, see [Creating an Amazon EKS cluster](#) (p. 30).

## Adding and deleting tags on an individual resource

Amazon EKS allows you to add or delete tags associated with your clusters directly from the resource's page.

### To add or delete a tag on an individual resource

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. From the navigation bar, select the Region to use.
3. In the navigation pane, choose **Clusters**.
4. Choose a specific cluster, then scroll down and choose **Manage tags**.
5. On the **Update tags** page, add or delete your tags as necessary.
  - To add a tag — choose **Add tag** and then specify the key and value for each tag.
  - To delete a tag — choose **Remove tag**.
6. Repeat this process for each tag you want to add or delete, and then choose **Update** to finish.

## Working with tags using the CLI, API, or eksctl

Use the following AWS CLI commands or Amazon EKS API operations to add, update, list, and delete the tags for your resources. You can only use `eksctl` to add tags to new resources.

### Tagging support for Amazon EKS resources

Task	AWS CLI	AWS Tools for Windows PowerShell	API action
Add or overwrite one or more tags.	<code>tag-resource</code>	<code>Add-EKSResourceTag</code>	<code>TagResource</code>
Delete one or more tags.	<code>untag-resource</code>	<code>Remove-EKSResourceTag</code>	<code>UntagResource</code>

The following examples show how to tag or untag resources using the AWS CLI.

#### Example 1: Tag an existing cluster

The following command tags an existing cluster.

```
aws eks tag-resource --resource-arn resource_ARN --tags team=devs
```

#### Example 2: Untag an existing cluster

The following command deletes a tag from an existing cluster.

```
aws eks untag-resource --resource-arn resource_ARN --tag-keys tag_key
```

#### Example 3: List tags for a resource

The following command lists the tags associated with an existing resource.

```
aws eks list-tags-for-resource --resource-arn resource_ARN
```

Some resource-creating actions enable you to specify tags when you create the resource. The following actions support tagging when creating a resource.

Task	AWS CLI	AWS Tools for Windows PowerShell	API action	eksctl
Create a cluster	<a href="#">create-cluster</a>	<a href="#">New-EKSCluster</a>	<a href="#">CreateCluster</a>	<a href="#">create cluster</a>
Create a managed node group	<a href="#">create-nodegroup</a>	<a href="#">New-EKSNodegroup</a>	<a href="#">CreateNodegroup</a>	<a href="#">create nodegroup</a>
Create a Fargate profile	<a href="#">create-fargate-profile</a>	<a href="#">New-EKSFargateProfile</a>	<a href="#">CreateFargateProfile</a>	<a href="#">create fargateprofile</a>

## Amazon EKS service quotas

Amazon EKS has integrated with Service Quotas, an AWS service that enables you to view and manage your quotas from a central location. For more information, see [What Is Service Quotas?](#) in the *Service Quotas User Guide*. Service Quotas makes it easy to look up the value of your Amazon EKS and AWS Fargate service quotas using the AWS Management Console and AWS CLI.

### AWS Management Console

#### To view Amazon EKS and Fargate service quotas using the AWS Management Console

1. Open the Service Quotas console at <https://console.aws.amazon.com/servicequotas/>.
2. In the navigation pane, choose **AWS services**.
3. From the **AWS services** list, search for and select **Amazon Elastic Kubernetes Service (Amazon EKS)** or **AWS Fargate**.

In the **Service quotas** list, you can see the service quota name, applied value (if it is available), AWS default quota, and whether the quota value is adjustable.

4. To view additional information about a service quota, such as the description, choose the quota name.
5. (Optional) To request a quota increase, select the quota that you want to increase, select **Request quota increase**, enter or select the required information, and select **Request**.

To work more with service quotas using the AWS Management Console see the [Service Quotas User Guide](#). To request a quota increase, see [Requesting a Quota Increase](#) in the *Service Quotas User Guide*.

### AWS CLI

#### To view Amazon EKS and Fargate service quotas using the AWS CLI

Run the following command to view your Amazon EKS quotas.

```
aws service-quotas list-aws-default-service-quotas \
  --query 'Quotas[*]'.
{Adjustable:Adjustable,Name:QuotaName,Value:Value,Code:QuotaCode}' \
  --service-code eks \
```

```
--output table
```

Run the following command to view your Fargate quotas.

```
aws service-quotas list-aws-default-service-quotas \
  --query 'Quotas[*]'.
{Adjustable:Adjustable,Name:QuotaName,Value:Value,Code:QuotaCode}' \
  --service-code fargate \
  --output table
```

#### Note

The quota returned is the maximum number of Amazon ECS tasks or Amazon EKS pods running concurrently on Fargate in this account in the current Region.

To work more with service quotas using the AWS CLI, see the [Service Quotas AWS CLI Command Reference](#). To request a quota increase, see the [request-service-quota-increase](#) command in the [AWS CLI Command Reference](#).

The following tables provide the default quotas (also referred to as limits) for Amazon EKS and AWS Fargate for an AWS account.

#### Amazon EKS service quotas

The following quotas are Amazon EKS service quotas. Most of these service quotas are listed under the Amazon Elastic Kubernetes Service (Amazon EKS) namespace in the Service Quotas console. To request a quota increase, see [Requesting a quota increase](#) in the *Service Quotas User Guide*.

Service quota	Description	Default quota value	Adjustable
Clusters	The maximum number of EKS clusters in this account in the current Region.	100	Yes
Control plane security groups per cluster	The maximum number of control plane security groups per cluster (these are specified when you create the cluster).	4	No
Managed node groups per cluster	The maximum number of managed node groups per cluster.	30	Yes
Nodes per managed node group	The maximum number of nodes per managed node group.	100	Yes
Public endpoint access CIDR ranges per cluster	The maximum number of public endpoint access CIDR ranges per cluster (these are specified when you create or update the cluster).	40	No



Service quota	Description	Default quota value	Adjustable
Fargate profiles per cluster	The maximum number Fargate profiles per cluster.	10	Yes
Selectors per Fargate profile	The maximum number selectors per Fargate profile	5	Yes
Label pairs per Fargate profile selector	The maximum number of label pairs per Fargate profile selector	5	Yes

### AWS Fargate service quotas

The following quota is an Amazon EKS on AWS Fargate service quota. The service quota is listed under the AWS Fargate namespace in the Service Quotas console. To request a quota increase, see [Requesting a quota increase](#) in the *Service Quotas User Guide*.

Service quota	Description	Default quota value	Adjustable
Fargate On-Demand resource count	The maximum number of Amazon ECS tasks or Amazon EKS pods running concurrently on Fargate in this account in the current Region.	100	Yes

# Security in Amazon EKS

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 [shared responsibility model](#) describes this as security *of* the cloud and security *in* the cloud:

- **Security of the cloud** – AWS is responsible for protecting the infrastructure that runs AWS services in the AWS Cloud. For Amazon EKS, AWS is responsible for the Kubernetes control plane, which includes the control plane nodes and etcd database. Third-party auditors regularly test and verify the effectiveness of our security as part of the [AWS compliance programs](#). To learn about the compliance programs that apply to Amazon EKS, see [AWS Services in Scope by Compliance Program](#).
- **Security in the cloud** – Your responsibility includes the following areas.
  - The security configuration of the data plane, including the configuration of the security groups that allow traffic to pass from the Amazon EKS control plane into the customer VPC
  - The configuration of the nodes and the containers themselves
  - The node's guest operating system (including updates and security patches)
  - Other associated application software:
    - Setting up and managing network controls, such as firewall rules
    - Managing platform-level identity and access management, either with or in addition to IAM
  - 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 EKS. The following topics show you how to configure Amazon EKS 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 EKS resources.

## Topics

- [Identity and access management for Amazon EKS \(p. 250\)](#)
- [Logging and monitoring in Amazon EKS \(p. 282\)](#)
- [Compliance validation for Amazon EKS \(p. 282\)](#)
- [Resilience in Amazon EKS \(p. 283\)](#)
- [Infrastructure security in Amazon EKS \(p. 283\)](#)
- [Configuration and vulnerability analysis in Amazon EKS \(p. 284\)](#)
- [Pod security policy \(p. 284\)](#)

## Identity and access management for Amazon EKS

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 EKS resources. IAM is an AWS service that you can use with no additional charge.

## Audience

How you use AWS Identity and Access Management (IAM) differs, depending on the work you do in Amazon EKS.

**Service user** – If you use the Amazon EKS service to do your job, then your administrator provides you with the credentials and permissions that you need. As you use more Amazon EKS 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 EKS, see [Troubleshooting Amazon EKS identity and access \(p. 281\)](#).

**Service administrator** – If you're in charge of Amazon EKS resources at your company, you probably have full access to Amazon EKS. It's your job to determine which Amazon EKS features and resources your employees 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 EKS, see [How Amazon EKS works with IAM \(p. 254\)](#).

**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 EKS. To view example Amazon EKS identity-based policies that you can use in IAM, see [Amazon EKS identity-based policy examples \(p. 257\)](#).

## Authenticating with identities

Authentication is how you sign in to AWS using your identity credentials. For more information about signing in using the AWS Management Console, see [The IAM Console and Sign-in Page](#) in the *IAM User Guide*.

You must be *authenticated* (signed in to AWS) as the AWS account root user, an IAM user, or by assuming an IAM role. You can also use your company's single sign-on authentication, or even sign in using Google or Facebook. In these cases, your administrator previously set up identity federation using IAM roles. When you access AWS using credentials from another company, you are assuming a role indirectly.

To sign in directly to the [AWS Management Console](#), use your password with your root user email or your IAM user name. You can access AWS programmatically using your root user or IAM user access keys. AWS provides SDK and command line tools to cryptographically sign your request using your credentials. If you don't use AWS tools, you must sign the request yourself. Do this using *Signature Version 4*, a protocol for authenticating inbound API requests. For more information about authenticating requests, see [Signature Version 4 Signing Process](#) in the *AWS General Reference*.

Regardless of the authentication method that you use, you might also 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 [Using Multi-Factor Authentication \(MFA\) in AWS](#) in the *IAM User Guide*.

## AWS Account Root User

When you first create an AWS account, you begin with a single sign-in identity that has complete access to all AWS services and resources in the account. This identity is called the AWS account *root user* and is accessed by signing in with the email address and password that you used to create the account. We strongly recommend that you do not use the root user for your everyday tasks, even the administrative ones. Instead, adhere to the [best practice of using the root user only to create your first IAM user](#). Then securely lock away the root user credentials and use them to perform only a few account and service management tasks.

## IAM users and groups

An *IAM user* is an identity within your AWS account that has specific permissions for a single person or application. An IAM user can have long-term credentials such as a user name and password or a set of access keys. To learn how to generate access keys, see [Managing Access Keys for IAM Users](#) in the *IAM User Guide*. When you generate access keys for an IAM user, make sure you view and securely save the key

pair. You cannot recover the secret access key in the future. Instead, you must generate a new access key pair.

An *IAM group* is an identity that specifies a collection of IAM users. You can't sign in as a group. You can use groups to specify permissions for multiple users at a time. Groups make permissions easier to manage for large sets of users. For example, you could have a group named *IAMAdmins* and give that group permissions to administer IAM resources.

Users are different from roles. A user is uniquely associated with one person or application, but a role is intended to be assumable by anyone who needs it. Users have permanent long-term credentials, but roles provide temporary credentials. To learn more, see [When to Create an IAM User \(Instead of a Role\)](#) in the *IAM User Guide*.

## IAM roles

An *IAM role* is an identity within your AWS account that has specific permissions. It is similar to an IAM user, but is not associated with a specific person. You can temporarily assume an IAM role in the AWS Management Console by [switching roles](#). You can assume a role by calling an AWS CLI or AWS API operation or by using a custom URL. For more information about methods for using roles, see [Using IAM Roles](#) in the *IAM User Guide*.

IAM roles with temporary credentials are useful in the following situations:

- **Temporary IAM user permissions** – An IAM user can assume an IAM role to temporarily take on different permissions for a specific task.
- **Federated user access** – Instead of creating an IAM user, you can use existing identities from AWS Directory Service, your enterprise user directory, or a web identity provider. These are known as *federated users*. AWS assigns a role to a federated user when access is requested through an [identity provider](#). For more information about federated users, see [Federated Users and Roles](#) in the *IAM User Guide*.
- **Cross-account access** – You can use an IAM role to allow someone (a trusted principal) in a different account to access resources in your account. Roles are the primary way to grant cross-account access. However, with some AWS services, you can attach a policy directly to a resource (instead of using a role as a proxy). To learn the difference between roles and resource-based policies for cross-account access, see [How IAM Roles Differ from Resource-based Policies](#) in the *IAM User Guide*.
- **AWS service access** – A service role is an IAM role that a service assumes to perform actions in your account on your behalf. When you set up some AWS service environments, you must define a role for the service to assume. This service role must include all the permissions that are required for the service to access the AWS resources that it needs. Service roles vary from service to service, but many allow you to choose your permissions as long as you meet the documented requirements for that service. Service roles provide access only within your account and cannot be used to grant access to services in other accounts. You can create, modify, and delete a service role from within IAM. For example, you can create a role that allows Amazon Redshift to access an Amazon S3 bucket on your behalf and then load data from that bucket into an Amazon Redshift cluster. For more information, see [Creating a Role to Delegate Permissions to an AWS Service](#) in the *IAM User Guide*.
- **Applications running on Amazon EC2** – You can use an IAM role to manage temporary credentials for applications that are running on an EC2 instance and making AWS CLI or AWS API requests. This is preferable to storing access keys within the EC2 instance. To assign an AWS role to an EC2 instance and make it available to all of its applications, you create an instance profile that is attached to the instance. An instance profile contains the role and enables programs that are running on the EC2 instance to get temporary credentials. For more information, see [Using an IAM Role to Grant Permissions to Applications Running on Amazon EC2 Instances](#) in the *IAM User Guide*.

To learn whether to use IAM roles, see [When to Create an IAM Role \(Instead of a User\)](#) in the *IAM User Guide*.

## Managing access using policies

You control access in AWS by creating policies and attaching them to IAM identities or AWS resources. A policy is an object in AWS that, when associated with an identity or resource, defines their permissions. AWS evaluates these policies when an entity (root user, IAM user, or IAM role) makes a request. Permissions in the policies determine whether the request is allowed or denied. Most policies are stored in AWS as JSON documents. For more information about the structure and contents of JSON policy documents, see [Overview of JSON Policies](#) in the *IAM User Guide*.

An IAM administrator can use policies to specify who has access to AWS resources, and what actions they can perform on those resources. Every IAM entity (user or role) starts with no permissions. In other words, by default, users can do nothing, not even change their own password. To give a user permission to do something, an administrator must attach a permissions policy to a user. Or the administrator can add the user to a group that has the intended permissions. When an administrator gives permissions to a group, all users in that group are granted those permissions.

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, role, or group. These policies control what actions that identity can perform, on which resources, and under what conditions. To learn how to create an identity-based policy, see [Creating IAM Policies](#) in the *IAM User Guide*.

Identity-based policies can be further categorized as *inline policies* or *managed policies*. Inline policies are embedded directly into a single user, group, or role. Managed policies are standalone policies that you can attach to multiple users, groups, and roles in your AWS account. Managed policies include AWS managed policies and customer managed policies. To learn how to choose between a managed policy or an inline policy, see [Choosing Between Managed Policies and Inline Policies](#) in the *IAM User Guide*.

### Resource-based policies

Resource-based policies are JSON policy documents that you attach to a resource such as an Amazon S3 bucket. Service administrators can use these policies to define what actions a specified principal (account member, user, or role) can perform on that resource and under what conditions. Resource-based policies are inline policies. There are no managed resource-based policies.

### Access control lists (ACLs)

Access control lists (ACLs) are a type of policy that controls which principals (account members, users, or roles) have permissions to access a resource. ACLs are similar to resource-based policies, although they do not use the JSON policy document format. Amazon S3, AWS WAF, and Amazon VPC are examples of services that support ACLs. To learn more about ACLs, see [Access Control List \(ACL\) Overview](#) in the *Amazon Simple Storage Service Developer Guide*.

### Other policy types

AWS supports additional, less-common policy types. These policy types can set the maximum permissions granted to you by the more common policy types.

- **Permissions boundaries** – A permissions boundary is an advanced feature in which you set the maximum permissions that an identity-based policy can grant to an IAM entity (IAM user or role). You can set a permissions boundary for an entity. The resulting permissions are the intersection of

entity's identity-based policies and its permissions boundaries. Resource-based policies that specify the user or role in the `Principal` field are not limited by the permissions boundary. An explicit deny in any of these policies overrides the allow. For more information about permissions boundaries, see [Permissions Boundaries for IAM Entities](#) in the *IAM User Guide*.

- **Service control policies (SCPs)** – SCPs are JSON policies that specify the maximum permissions for an organization or organizational unit (OU) in AWS Organizations. AWS Organizations is a service for grouping and centrally managing multiple AWS accounts that your business owns. If you enable all features in an organization, then you can apply service control policies (SCPs) to any or all of your accounts. The SCP limits permissions for entities in member accounts, including each AWS account root user. For more information about Organizations and SCPs, see [How SCPs Work](#) in the *AWS Organizations User Guide*.
- **Session policies** – Session policies are advanced policies that you pass as a parameter when you programmatically create a temporary session for a role or federated user. The resulting session's permissions are the intersection of the user or role's identity-based policies and the session policies. Permissions can also come from a resource-based policy. An explicit deny in any of these policies overrides the allow. For more information, see [Session Policies](#) in the *IAM User Guide*.

## Multiple policy types

When multiple types of policies apply to a request, the resulting permissions are more complicated to understand. To learn how AWS determines whether to allow a request when multiple policy types are involved, see [Policy Evaluation Logic](#) in the *IAM User Guide*.

## How Amazon EKS works with IAM

Before you use IAM to manage access to Amazon EKS, you should understand what IAM features are available to use with Amazon EKS. To get a high-level view of how Amazon EKS and other AWS services work with IAM, see [AWS services that work with IAM](#) in the *IAM User Guide*.

### Topics

- [Amazon EKS identity-based policies](#) (p. 254)
- [Amazon EKS resource-based policies](#) (p. 256)
- [Authorization based on Amazon EKS tags](#) (p. 256)
- [Amazon EKS IAM roles](#) (p. 256)

## Amazon EKS 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 EKS supports specific actions, resources, and condition keys. To learn about all of the elements that you use in a JSON policy, see [IAM JSON policy elements reference](#) in the *IAM User Guide*.

### Actions

The `Action` element of an IAM identity-based policy describes the specific action or actions that will be allowed or denied by the policy. Policy actions usually have the same name as the associated AWS API operation. The action is used in a policy to grant permissions to perform the associated operation.

Policy actions in Amazon EKS use the following prefix before the action: `eks:`. For example, to grant someone permission to get descriptive information about an Amazon EKS cluster, you include the `DescribeCluster` action in their policy. Policy statements must include either an `Action` or `NotAction` element.

To specify multiple actions in a single statement, separate them with commas as follows:

```
"Action": ["eks:action1", "eks:action2"]
```

You can specify multiple actions using wildcards (\*). For example, to specify all actions that begin with the word `Describe`, include the following action:

```
"Action": "eks:Describe*"
```

To see a list of Amazon EKS actions, see [Actions Defined by Amazon Elastic Kubernetes Service](#) in the *IAM User Guide*.

## Resources

The `Resource` element specifies the object or objects to which the action applies. Statements must include either a `Resource` or a `NotResource` element. You specify a resource using an ARN or using the wildcard (\*) to indicate that the statement applies to all resources.

The Amazon EKS cluster resource has the following ARN:

```
arn:${Partition}:eks:${Region}:${Account}:cluster/${ClusterName}
```

For more information about the format of ARNs, see [Amazon resource names \(ARNs\) and AWS service namespaces](#).

For example, to specify the dev cluster in your statement, use the following ARN:

```
"Resource": "arn:aws:eks:region-code:123456789012:cluster/dev"
```

To specify all clusters that belong to a specific account and Region, use the wildcard (\*):

```
"Resource": "arn:aws:eks:region-code:123456789012:cluster/*"
```

Some Amazon EKS actions, such as those for creating resources, cannot be performed on a specific resource. In those cases, you must use the wildcard (\*).

```
"Resource": "*" 
```

To see a list of Amazon EKS resource types and their ARNs, see [Resources Defined by Amazon Elastic Kubernetes Service](#) in the *IAM User Guide*. To learn with which actions you can specify the ARN of each resource, see [Actions Defined by Amazon Elastic Kubernetes Service](#).

## Condition keys

Amazon EKS does not provide any service-specific condition keys, but it does support using some global condition keys. To see all AWS global condition keys, see [AWS global condition context keys](#) in the *IAM User Guide*.

## Examples

To view examples of Amazon EKS identity-based policies, see [Amazon EKS identity-based policy examples \(p. 257\)](#).

When you create an Amazon EKS cluster, the IAM entity user or role, such as a [federated user](#) that creates the cluster, is automatically granted `system:masters` permissions in the cluster's RBAC



configuration. To grant additional AWS users or roles the ability to interact with your cluster, you must edit the `aws-auth` ConfigMap within Kubernetes.

For additional information about working with the ConfigMap, see [Managing users or IAM roles for your cluster](#) (p. 225).

## Amazon EKS resource-based policies

Amazon EKS does not support resource-based policies.

## Authorization based on Amazon EKS tags

You can attach tags to Amazon EKS resources or pass tags in a request to Amazon EKS. To control access based on tags, you provide tag information in the [condition element](#) of a policy using the `eks:ResourceTag/key-name`, `aws:RequestTag/key-name`, or `aws:TagKeys` condition keys. For more information about tagging Amazon EKS resources, see [Tagging your Amazon EKS resources](#) (p. 243).

## Amazon EKS IAM roles

An [IAM role](#) is an entity within your AWS account that has specific permissions.

### Using temporary credentials with Amazon EKS

You can use temporary credentials to sign in with federation, assume an IAM role, or to assume a cross-account role. You obtain temporary security credentials by calling AWS STS API operations such as [AssumeRole](#) or [GetFederationToken](#).

Amazon EKS supports using temporary credentials.

### Service-linked roles

[Service-linked roles](#) allow AWS services to access resources in other services to complete an action on your behalf. Service-linked roles appear in your IAM account and are owned by the service. An IAM administrator can view but not edit the permissions for service-linked roles.

Amazon EKS supports service-linked roles. For details about creating or managing Amazon EKS service-linked roles, see [Using Service-Linked Roles for Amazon EKS](#) (p. 259).

### Service roles

This feature allows a service to assume a [service role](#) on your behalf. This role allows the service to access resources in other services to complete an action on your behalf. Service roles appear in your IAM account and are owned by the account. This means that an IAM administrator can change the permissions for this role. However, doing so might break the functionality of the service.

Amazon EKS supports service roles. For more information, see [the section called "Cluster IAM role"](#) (p. 263) and [the section called "Node IAM role"](#) (p. 265).

## Choosing an IAM role in Amazon EKS

When you create a cluster resource in Amazon EKS, you must choose a role to allow Amazon EKS to access several other AWS resources on your behalf. If you have previously created a service role, then Amazon EKS provides you with a list of roles to choose from. It's important to choose a role that has the Amazon EKS managed policies attached to it. For more information, see [the section called "Check for an existing cluster role"](#) (p. 263) and [the section called "Check for an existing node role"](#) (p. 265).



## Amazon EKS identity-based policy examples

By default, IAM users and roles don't have permission to create or modify Amazon EKS 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 must then attach those policies to the IAM users or groups that require those permissions.

To learn how to create an IAM identity-based policy using these example JSON policy documents, see [Creating policies on the JSON tab](#) in the *IAM User Guide*.

When you create an Amazon EKS cluster, the IAM entity user or role, such as a [federated user](#) that creates the cluster, is automatically granted `system:masters` permissions in the cluster's RBAC configuration. To grant additional AWS users or roles the ability to interact with your cluster, you must edit the `aws-auth` ConfigMap within Kubernetes.

For additional information about working with the ConfigMap, see [Managing users or IAM roles for your cluster](#) (p. 225).

### Topics

- [Policy best practices](#) (p. 257)
- [Using the Amazon EKS console](#) (p. 257)
- [Allow users to view their own permissions](#) (p. 258)
- [Update a Kubernetes cluster](#) (p. 259)
- [List or describe all clusters](#) (p. 259)

## Policy best practices

Identity-based policies are very powerful. They determine whether someone can create, access, or delete Amazon EKS 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 Using AWS Managed Policies** – To start using Amazon EKS quickly, use AWS managed policies to give your employees the permissions they need. These policies are already available in your account and are maintained and updated by AWS. For more information, see [Get Started Using Permissions With AWS Managed Policies](#) in the *IAM User Guide*.
- **Grant Least Privilege** – When you create custom policies, grant only the permissions required to perform a task. Start with a minimum set of permissions and grant additional permissions as necessary. Doing so is more secure than starting with permissions that are too lenient and then trying to tighten them later. For more information, see [Grant Least Privilege](#) in the *IAM User Guide*.
- **Enable MFA for Sensitive Operations** – For extra security, require IAM users to use multi-factor authentication (MFA) to access sensitive resources or API operations. For more information, see [Using Multi-Factor Authentication \(MFA\) in AWS](#) in the *IAM User Guide*.
- **Use Policy Conditions for Extra Security** – To the extent that it's practical, define the conditions under which your identity-based policies allow access to a resource. For example, you can write conditions to specify a range of allowable IP addresses that a request must come from. You can also write conditions to allow requests only within a specified date or time range, or to require the use of SSL or MFA. For more information, see [IAM JSON Policy Elements: Condition](#) in the *IAM User Guide*.

## Using the Amazon EKS console

To access the Amazon EKS console, you must have a minimum set of permissions. These permissions must allow you to list and view details about the Amazon EKS resources in your AWS account. If you

create an identity-based policy that is more restrictive than the minimum required permissions, the console won't function as intended for entities (IAM users or roles) with that policy.

To ensure that those entities can still use the Amazon EKS console, create a policy with your own unique name, such as `AmazonEKSAAdminPolicy`. Attach the policy to the entities. For more information, see [Adding permissions to a user](#) in the *IAM User Guide*:

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

You don't need to allow minimum console permissions for users that are making calls only to the AWS CLI or the AWS API. Instead, allow access to only the actions that match the API operation that you're trying to perform.

## Allow 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": "*"
}
]
```

## Update a Kubernetes cluster

This example shows how you can create a policy that allows a user to update the Kubernetes version of any *dev* cluster for an account, in any region.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": "eks:UpdateClusterVersion",
      "Resource": "arn:aws:eks:*:111122223333:cluster/dev"
    }
  ]
}
```

## List or describe all clusters

This example shows how you can create a policy that allows a user read-only access to list or describe all clusters. An account must be able to list and describe clusters to use the `update-kubeconfig` AWS CLI command.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "eks:DescribeCluster",
        "eks:ListClusters"
      ],
      "Resource": "*"
    }
  ]
}
```

## Using Service-Linked Roles for Amazon EKS

Amazon Elastic Kubernetes Service uses AWS Identity and Access Management (IAM) [service-linked roles](#). A service-linked role is a unique type of IAM role that is linked directly to Amazon EKS. Service-linked roles are predefined by Amazon EKS and include all the permissions that the service requires to call other AWS services on your behalf.

### Topics

- [Using Roles for Amazon EKS \(p. 260\)](#)
- [Using Roles for Amazon EKS node groups \(p. 261\)](#)

## Using Roles for Amazon EKS

Amazon Elastic Kubernetes Service uses AWS Identity and Access Management (IAM) [service-linked roles](#). A service-linked role is a unique type of IAM role that is linked directly to Amazon EKS. Service-linked roles are predefined by Amazon EKS 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 EKS easier because you don't have to manually add the necessary permissions. Amazon EKS defines the permissions of its service-linked roles, and unless defined otherwise, only Amazon EKS 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 EKS resources because you can't inadvertently remove permission to access the resources.

For information about other services that support service-linked roles, see [AWS Services That Work with IAM](#) and look for the services that have **Yes** in the **Service-Linked Role** column. Choose a **Yes** with a link to view the service-linked role documentation for that service.

## Service-Linked Role Permissions for Amazon EKS

Amazon EKS uses the service-linked role named **AWSServiceRoleForAmazonEKS** – These permissions are required for Amazon EKS to manage clusters in your account. These policies are related to management of the following resources: network interfaces, security groups, logs, and VPCs.

### Note

The **AWSServiceRoleForAmazonEKS** service-linked role is distinct from the role required for cluster creation. For more information, see [the section called "Cluster IAM role" \(p. 263\)](#).

The **AWSServiceRoleForAmazonEKS** service-linked role trusts the following services to assume the role:

- `eks.amazonaws.com`

The role permissions policy allows Amazon EKS to complete the following actions on the specified resources:

- [AWSServiceRoleForAmazonEKS](#)

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, see [Service-Linked Role Permissions](#) in the *IAM User Guide*.

## Creating a Service-Linked Role for Amazon EKS

You don't need to manually create a service-linked role. When you create a cluster in the AWS Management Console, the AWS CLI, or the AWS API, Amazon EKS 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 a cluster, Amazon EKS creates the service-linked role for you again.

## Editing a Service-Linked Role for Amazon EKS

Amazon EKS does not allow you to edit the **AWSServiceRoleForAmazonEKS** 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, see [Editing a Service-Linked Role](#) in the *IAM User Guide*.

## Deleting a Service-Linked Role for Amazon EKS

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. However, you must clean up your service-linked role before you can manually delete it.

### Cleaning Up a Service-Linked Role

Before you can use IAM to delete a service-linked role, you must first delete any resources used by the role.

#### Note

If the Amazon EKS service is using the role when you try to delete the resources, then the deletion might fail. If that happens, wait for a few minutes and try the operation again.

#### To delete Amazon EKS resources used by the `AWSServiceRoleForAmazonEKS`

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose a cluster.
3. On the cluster page, if there are any managed node groups in the **Node Groups** section, select each one individually, and then choose **Delete**.
4. Type the name of the node group in the deletion confirmation window, and then choose **Confirm** to delete.
5. Repeat this procedure for any other node groups in the cluster. Wait for all of the delete operations to finish.
6. On the cluster page choose **Delete**.
7. Repeat this procedure for any other clusters in your account.

### Manually Delete the Service-Linked Role

Use the IAM console, the AWS CLI, or the AWS API to delete the `AWSServiceRoleForAmazonEKS` service-linked role. For more information, see [Deleting a Service-Linked Role](#) in the *IAM User Guide*.

## Supported Regions for Amazon EKS Service-Linked Roles

Amazon EKS supports using service-linked roles in all of the regions where the service is available. For more information, see [Amazon EKS Service Endpoints and Quotas](#).

## Using Roles for Amazon EKS node groups

Amazon EKS uses AWS Identity and Access Management (IAM) [service-linked roles](#). A service-linked role is a unique type of IAM role that is linked directly to Amazon EKS. Service-linked roles are predefined by Amazon EKS 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 EKS easier because you don't have to manually add the necessary permissions. Amazon EKS defines the permissions of its service-linked roles, and unless defined otherwise, only Amazon EKS 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 EKS resources because you can't inadvertently remove permission to access the resources.

For information about other services that support service-linked roles, see [AWS Services That Work with IAM](#) and look for the services that have **Yes** in the **Service-Linked Role** column. Choose a **Yes** with a link to view the service-linked role documentation for that service.

## Service-Linked Role Permissions for Amazon EKS

Amazon EKS uses the service-linked role named **AWSServiceRoleForAmazonEKSNodegroup** – These permissions are required for managing nodegroups in your account. These policies are related to management of the following resources: Auto Scaling groups, security groups, launch templates and IAM instance profiles..

The AWSServiceRoleForAmazonEKSNodegroup service-linked role trusts the following services to assume the role:

- `eks-nodegroup.amazonaws.com`

The role permissions policy allows Amazon EKS to complete the following actions on the specified resources:

- [AWSServiceRoleForAmazonEKS](#)

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, see [Service-Linked Role Permissions](#) in the *IAM User Guide*.

## Creating a Service-Linked Role for Amazon EKS

You don't need to manually create a service-linked role. When you `CreateNodegroup` in the AWS Management Console, the AWS CLI, or the AWS API, Amazon EKS creates the service-linked role for you.

### Important

This service-linked role can appear in your account if you completed an action in another service that uses the features supported by this role. If you were using the Amazon EKS service before January 1, 2017, when it began supporting service-linked roles, then Amazon EKS created the AWSServiceRoleForAmazonEKSNodegroup role in your account. To learn more, see [A New Role Appeared in My IAM Account](#).

### Creating a Service-Linked Role in Amazon EKS (AWS API)

You don't need to manually create a service-linked role. When you create a managed node group in the AWS Management Console, the AWS CLI, or the AWS API, Amazon EKS 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 managed node group, Amazon EKS creates the service-linked role for you again.

## Editing a Service-Linked Role for Amazon EKS

Amazon EKS does not allow you to edit the AWSServiceRoleForAmazonEKSNodegroup 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, see [Editing a Service-Linked Role](#) in the *IAM User Guide*.

## Deleting a Service-Linked Role for Amazon EKS

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. However, you must clean up your service-linked role before you can manually delete it.

## Cleaning Up a Service-Linked Role

Before you can use IAM to delete a service-linked role, you must first delete any resources used by the role.

### Note

If the Amazon EKS service is using the role when you try to delete the resources, then the deletion might fail. If that happens, wait for a few minutes and try the operation again.

### To delete Amazon EKS resources used by the `AWSServiceRoleForAmazonEKSNodegroup`

1. Open the Amazon EKS console at <https://console.aws.amazon.com/eks/home#/clusters>.
2. Choose a cluster.
3. On the cluster page, if there are any managed node groups in the **Node Groups** section, select each one individually, and then choose **Delete**.
4. Type the name of the cluster in the deletion confirmation window, and then choose **Confirm** to delete.
5. Repeat this procedure for any other node groups in the cluster and for any other clusters in your account.

## Manually Delete the Service-Linked Role

Use the IAM console, the AWS CLI, or the AWS API to delete the `AWSServiceRoleForAmazonEKSNodegroup` service-linked role. For more information, see [Deleting a Service-Linked Role](#) in the *IAM User Guide*.

## Supported Regions for Amazon EKS Service-Linked Roles

Amazon EKS supports using service-linked roles in all of the regions where the service is available. For more information, see [Amazon EKS Service Endpoints and Quotas](#).

## Amazon EKS cluster IAM role

Kubernetes clusters managed by Amazon EKS make calls to other AWS services on your behalf to manage the resources that you use with the service. Before you can create Amazon EKS clusters, you must create an IAM role with the following IAM policies:

- [AmazonEKSClusterPolicy](#)

### Note

Prior to April 16, 2020, [AmazonEKSServicePolicy](#) was also required and the suggested name was `eksServiceRole`. With the `AWSServiceRoleForAmazonEKS` service-linked role, that policy is no longer required.

## Check for an existing cluster role

You can use the following procedure to check and see if your account already has the Amazon EKS cluster role.

### To check for the `eksClusterRole` in the IAM console

1. Open the IAM console at <https://console.aws.amazon.com/iam/>.
2. In the navigation pane, choose **Roles**.
3. Search the list of roles for `eksClusterRole`. If a role that includes `eksClusterRole` does not exist, then see [Creating the Amazon EKS cluster role \(p. 264\)](#) to create the role. If a role that includes `eksClusterRole` does exist, then select the role to view the attached policies.

4. Choose **Permissions**.
5. Ensure that the **AmazonEKSClusterPolicy** managed policy is attached to the role. If the policy is attached, your Amazon EKS cluster role is properly configured.
6. Choose **Trust Relationships, Edit Trust Relationship**.
7. Verify that the trust relationship contains the following policy. If the trust relationship matches the policy below, choose **Cancel**. If the trust relationship does not match, copy the policy into the **Policy Document** window and choose **Update Trust Policy**.

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

## Creating the Amazon EKS cluster role

You can use the AWS Management Console or AWS CloudFormation to create the cluster role if you do not already have one for your account. Select the name of the tool that you'd like to use to create the role.

### AWS Management Console

#### To create your Amazon EKS cluster role in the IAM console

1. Open the IAM console at <https://console.aws.amazon.com/iam/>.
2. Choose **Roles**, then **Create role**.
3. Choose **EKS** from the list of services, then **EKS - Cluster** for your use case, and then **Next: Permissions**.
4. Choose **Next: Tags**.
5. (Optional) Add metadata to the role by attaching tags as key-value pairs. For more information about using tags in IAM, see [Tagging IAM Entities](#) in the *IAM User Guide*.
6. Choose **Next: Review**.
7. For **Role name**, enter a unique name for your role, such as `eksClusterRole`, then choose **Create role**.

### AWS CloudFormation

#### To create your Amazon EKS cluster role with AWS CloudFormation

1. Save the following AWS CloudFormation template to a text file on your local system.

```
---
AWSTemplateFormatVersion: '2010-09-09'
Description: 'Amazon EKS Cluster Role'

Resources:
```



```
eksClusterRole:
  Type: AWS::IAM::Role
  Properties:
    AssumeRolePolicyDocument:
      Version: '2012-10-17'
      Statement:
        - Effect: Allow
          Principal:
            Service:
              - eks.amazonaws.com
          Action:
            - sts:AssumeRole
    ManagedPolicyArns:
      - arn:aws:iam::aws:policy/AmazonEKSClusterPolicy

Outputs:

  RoleArn:
    Description: The role that Amazon EKS will use to create AWS resources for
    Kubernetes clusters
    Value: !GetAtt eksClusterRole.Arn
    Export:
      Name: !Sub "${AWS::StackName}-RoleArn"
```

#### Note

Prior to April 16, 2020, ManagedPolicyArns had an entry for `arn:aws:iam::aws:policy/AmazonEKSServicePolicy`. With the `AWSServiceRoleForAmazonEKS` service-linked role, that policy is no longer required.

2. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
3. Choose **Create stack**.
4. For **Specify template**, select **Upload a template file**, and then choose **Choose file**.
5. Choose the file you created earlier, and then choose **Next**.
6. For **Stack name**, enter a name for your role, such as `eksClusterRole`, and then choose **Next**.
7. On the **Configure stack options** page, choose **Next**.
8. On the **Review** page, review your information, acknowledge that the stack might create IAM resources, and then choose **Create stack**.

## Amazon EKS node IAM role

The Amazon EKS node `kubelet` daemon makes calls to AWS APIs on your behalf. Nodes receive permissions for these API calls through an IAM instance profile and associated policies. Before you can launch nodes and register them into a cluster, you must create an IAM role for those nodes to use when they are launched. This requirement applies to nodes launched with the Amazon EKS optimized AMI provided by Amazon, or with any other node AMIs that you intend to use. Before you create nodes, you must create an IAM role with the following IAM policies:

- [AmazonEKSEKSWorkerNodePolicy](#)
- [AmazonEKS\\_CNI\\_Policy](#)
- [AmazonEC2ContainerRegistryReadOnly](#)

## Check for an existing node role

You can use the following procedure to check and see if your account already has the Amazon EKS node role.

### To check for the `NodeInstanceRole` in the IAM console

1. Open the IAM console at <https://console.aws.amazon.com/iam/>.
2. In the navigation pane, choose **Roles**.
3. Search the list of roles for `NodeInstanceRole`. If a role that contains `NodeInstanceRole` does not exist, then see [Creating the Amazon EKS node IAM role \(p. 266\)](#) to create the role. If a role that contains `NodeInstanceRole` does exist, then select the role to view the attached policies.
4. Choose **Permissions**.
5. Ensure that the **AmazonEKSWorkerNodePolicy**, **AmazonEKS\_CNI\_Policy**, and **AmazonEC2ContainerRegistryReadOnly** managed policies are attached to the role. If the policies are attached, your Amazon EKS node role is properly configured.
6. Choose **Trust Relationships**, **Edit Trust Relationship**.
7. Verify that the trust relationship contains the following policy. If the trust relationship matches the policy below, choose **Cancel**. If the trust relationship does not match, copy the policy into the **Policy Document** window and choose **Update Trust Policy**.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "ec2.amazonaws.com"
      },
      "Action": "sts:AssumeRole"
    }
  ]
}
```

## Creating the Amazon EKS node IAM role

If you created your nodes by following the steps in the [Getting started with the AWS Management Console \(p. 14\)](#) or [Getting started with `eksctl` \(p. 3\)](#) topics, then the node role already exists and you don't need to manually create it. You can use the AWS Management Console or AWS CloudFormation to create the Amazon EKS node role if you do not already have one for your account. Select the name of the tool that you'd like to use to create the role.

### AWS Management Console

#### To create your Amazon EKS node role in the IAM console

1. Open the IAM console at <https://console.aws.amazon.com/iam/>.
2. Choose **Roles**, then **Create role**.
3. Choose **EC2** from the list of **Common use cases** under **Choose a use case**, then choose **Next: Permissions**.
4. In the **Filter policies** box, enter **AmazonEKSWorkerNodePolicy**. Check the box to the left of **AmazonEKSWorkerNodePolicy**.
5. In the **Filter policies** box, enter **AmazonEKS\_CNI\_Policy**. Check the box to the left of **AmazonEKS\_CNI\_Policy**.
6. In the **Filter policies** box, enter **AmazonEC2ContainerRegistryReadOnly**. Check the box to the left of **AmazonEC2ContainerRegistryReadOnly**.
7. Choose **Next: Tags**.
8. (Optional) Add metadata to the role by attaching tags as key-value pairs. For more information about using tags in IAM, see [Tagging IAM Entities](#) in the *IAM User Guide*.

9. Choose **Next: Review**.
10. For **Role name**, enter a unique name for your role, such as **NodeInstanceRole**. For **Role description**, replace the current text with descriptive text such as **Amazon EKS - Node Group Role**, then choose **Create role**.

## AWS CloudFormation

### To create your Amazon EKS node role using AWS CloudFormation

1. Open the AWS CloudFormation console at <https://console.aws.amazon.com/cloudformation>.
2. Choose **Create stack** and then choose **With new resources (standard)**.
3. For **Specify template**, select **Amazon S3 URL**.
4. Paste the following URL into the **Amazon S3 URL** text area and choose **Next** twice:

```
https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-08-12/amazon-eks-nodegroup-role.yaml
```

5. On the **Specify stack details** page, for **Stack name** enter a name such as **eks-node-group-instance-role** and choose **Next**.
6. (Optional) On the **Configure stack options** page, you can choose to tag your stack resources. Choose **Next**.
7. On the **Review** page, check the box in the **Capabilities** section and choose **Create stack**.
8. When your stack is created, select it in the console and choose **Outputs**.
9. Record the **NodeInstanceRole** value for the IAM role that was created. You need this when you create your node group.

## Pod execution role

The Amazon EKS pod execution role is required to run pods on AWS Fargate infrastructure.

When your cluster creates pods on AWS Fargate infrastructure, the pod needs to make calls to AWS APIs on your behalf, for example, to pull container images from Amazon ECR. The Amazon EKS pod execution role provides the IAM permissions to do this.

When you create a Fargate profile, you must specify a pod execution role to use with your pods. This role is added to the cluster's Kubernetes [Role based access control](#) (RBAC) for authorization, so that the `kubelet` that is running on the Fargate infrastructure can register with your Amazon EKS cluster. This is what allows Fargate infrastructure to appear in your cluster as nodes.

Before you create a Fargate profile, you must create an IAM role with the following IAM policy:

- [AmazonEKSFargatePodExecutionRolePolicy](#)

## Check for an existing pod execution role

You can use the following procedure to check and see if your account already has the Amazon EKS pod execution role.

### To check for the `AmazonEKSFargatePodExecutionRole` in the IAM console

1. Open the IAM console at <https://console.aws.amazon.com/iam/>.

2. In the navigation pane, choose **Roles**.
3. Search the list of roles for `AmazonEKSFargatePodExecutionRole`. If the role does not exist, see [Creating the Amazon EKS pod execution role \(p. 268\)](#) to create the role. If the role does exist, select the role to view the attached policies.
4. Choose **Permissions**.
5. Ensure that the **AmazonEKSFargatePodExecutionRolePolicy** Amazon managed policy is attached to the role. If the policy is attached, then your Amazon EKS pod execution role is properly configured.
6. Choose **Trust Relationships, Edit Trust Relationship**.
7. Verify that the trust relationship contains the following policy. If the trust relationship matches the policy below, choose **Cancel**. If the trust relationship does not match, copy the policy into the **Policy Document** window and choose **Update Trust Policy**.

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

## Creating the Amazon EKS pod execution role

You can use the following procedure to create the Amazon EKS pod execution role if you do not already have one for your account.

### To create an AWS Fargate pod execution role with the AWS Management Console

1. Open the IAM console at <https://console.aws.amazon.com/iam/>.
2. Choose **Roles**, then **Create role**.
3. Choose **EKS** from the list of services, **EKS - Fargate pod** for your use case, and then **Next: Permissions**.
4. Choose **Next: Tags**.
5. (Optional) Add metadata to the role by attaching tags as key-value pairs. For more information about using tags in IAM, see [Tagging IAM Entities](#) in the *IAM User Guide*.
6. Choose **Next: Review**.
7. For **Role name**, enter a unique name for your role, such as `AmazonEKSFargatePodExecutionRole`, then choose **Create role**.

## IAM roles for service accounts

With IAM roles for service accounts on Amazon EKS clusters, you can associate an IAM role with a Kubernetes service account. This service account can then provide AWS permissions to the containers in any pod that uses that service account. With this feature, you no longer need to provide extended permissions to the node IAM role so that pods on that node can call AWS APIs.

Applications must sign their AWS API requests with AWS credentials. This feature provides a strategy for managing credentials for your applications, similar to the way that Amazon EC2 instance profiles provide

credentials to Amazon EC2 instances. Instead of creating and distributing your AWS credentials to the containers or using the Amazon EC2 instance's role, you can associate an IAM role with a Kubernetes service account. The applications in the pod's containers can then use an AWS SDK or the AWS CLI to make API requests to authorized AWS services.

The IAM roles for service accounts feature provides the following benefits:

- **Least privilege** — By using the IAM roles for service accounts feature, you no longer need to provide extended permissions to the node IAM role so that pods on that node can call AWS APIs. You can scope IAM permissions to a service account, and only pods that use that service account have access to those permissions. This feature also eliminates the need for third-party solutions such as `kiam` or `kube2iam`.
- **Credential isolation** — A container can only retrieve credentials for the IAM role that is associated with the service account to which it belongs. A container never has access to credentials that are intended for another container that belongs to another pod.
- **Auditability** — Access and event logging is available through CloudTrail to help ensure retrospective auditing.

To get started, see [Enabling IAM roles for service accounts on your cluster \(p. 273\)](#).

For an end-to-end walkthrough using `eksctl`, see [Walkthrough: Updating a DaemonSet to use IAM for service accounts \(p. 279\)](#).

## IAM roles for service accounts technical overview

In 2014, AWS Identity and Access Management added support for federated identities using OpenID Connect (OIDC). This feature allows you to authenticate AWS API calls with supported identity providers and receive a valid OIDC JSON web token (JWT). You can pass this token to the AWS STS `AssumeRoleWithWebIdentity` API operation and receive IAM temporary role credentials. You can use these credentials to interact with any AWS service, like Amazon S3 and DynamoDB.

Kubernetes has long used service accounts as its own internal identity system. Pods can authenticate with the Kubernetes API server using an auto-mounted token (which was a non-OIDC JWT) that only the Kubernetes API server could validate. These legacy service account tokens do not expire, and rotating the signing key is a difficult process. In Kubernetes version 1.12, support was added for a new `ProjectedServiceAccountToken` feature, which is an OIDC JSON web token that also contains the service account identity, and supports a configurable audience.

Amazon EKS now hosts a public OIDC discovery endpoint per cluster containing the signing keys for the `ProjectedServiceAccountToken` JSON web tokens so external systems, like IAM, can validate and accept the OIDC tokens issued by Kubernetes.

### IAM role configuration

In IAM, you create an IAM role with a trust relationship that is scoped to your cluster's OIDC provider, the service account namespace, and (optionally) the service account name, and then attach the IAM policy that you want to associate with the service account. You can add multiple entries in the `StringEquals` and `StringLike` conditions below to use multiple service accounts or namespaces with the role.

- To scope a role to a specific service account:

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Federated": "arn:aws:iam::AWS_ACCOUNT_ID:oidc-provider/OIDC_PROVIDER"
```

```
    },
    "Action": "sts:AssumeRoleWithWebIdentity",
    "Condition": {
      "StringEquals": {
        "OIDC_PROVIDER:sub":
        "system:serviceaccount:SERVICE_ACCOUNT_NAMESPACE:SERVICE_ACCOUNT_NAME"
      }
    }
  ]
}
```

- To scope a role to an entire namespace (to use the namespace as a boundary):

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Federated": "arn:aws:iam::AWS_ACCOUNT_ID:oidc-provider/OIDC_PROVIDER"
      },
      "Action": "sts:AssumeRoleWithWebIdentity",
      "Condition": {
        "StringLike": {
          "OIDC_PROVIDER:sub": "system:serviceaccount:SERVICE_ACCOUNT_NAMESPACE:*"
        }
      }
    }
  ]
}
```

## Service account configuration

In Kubernetes, you define the IAM role to associate with a service account in your cluster by adding the `eks.amazonaws.com/role-arn` annotation to the service account.

```
apiVersion: v1
kind: ServiceAccount
metadata:
  annotations:
    eks.amazonaws.com/role-arn: arn:aws:iam::AWS_ACCOUNT_ID:role/IAM_ROLE_NAME
```

## Pod configuration

The [Amazon EKS Pod Identity Webhook](#) on the cluster watches for pods that are associated with service accounts with this annotation and applies the following environment variables to them.

```
AWS_ROLE_ARN=arn:aws:iam::AWS_ACCOUNT_ID:role/IAM_ROLE_NAME
AWS_WEB_IDENTITY_TOKEN_FILE=/var/run/secrets/eks.amazonaws.com/serviceaccount/token
```

### Note

Your cluster does not need to use the mutating web hook to configure the environment variables and token file mounts; you can choose to configure pods to add these environment variables manually.

[Supported versions of the AWS SDK \(p. 273\)](#) look for these environment variables first in the credential chain provider. The role credentials are used for pods that meet this criteria.

### Note

When a pod uses AWS credentials from an IAM role associated with a service account, the AWS CLI or other SDKs in the containers for that pod use the credentials provided by that role exclusively. They no longer inherit any IAM permissions from the node IAM role.

By default, only containers that run as `root` have the proper file system permissions to read the web identity token file. You can provide these permissions by having your containers run as `root`, or by providing the following security context for the containers in your manifest. The `fsGroup` ID is arbitrary, and you can choose any valid group ID. For more information about the implications of setting a security context for your pods, see [Configure a Security Context for a Pod or Container](#) in the Kubernetes documentation.

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: my-app
spec:
  template:
    metadata:
      labels:
        app: my-app
    spec:
      serviceAccountName: my-app
      containers:
        - name: my-app
          image: my-app:latest
          securityContext:
            fsGroup: 1337
...

```

The `kubelet` requests and stores the token on behalf of the pod. By default, the `kubelet` refreshes the token if it is older than 80 percent of its total TTL, or if the token is older than 24 hours. You can modify the expiration duration for any account, except the default service account, with settings in your pod spec. For more information, see [Service Account Token Volume Projection](#) in the Kubernetes documentation.

## Cross-account IAM permissions

You can configure cross-account IAM permissions either by creating an identity provider from another account's cluster or by using chained `AssumeRole` operations. In the following examples, Account A owns an Amazon EKS cluster that supports IAM roles for service accounts. Pods running on that cluster need to assume IAM permissions from Account B.

### Example : Create an identity provider from another account's cluster

#### Example

In this example, Account A would provide Account B with the OIDC issuer URL from their cluster. Account B follows the instructions in [Enabling IAM roles for service accounts on your cluster \(p. 273\)](#) and [Creating an IAM role and policy for your service account \(p. 274\)](#) using the OIDC issuer URL from Account A's cluster. Then a cluster administrator annotates the service account in Account A's cluster to use the role from Account B.

```
apiVersion: v1
kind: ServiceAccount
metadata:
  annotations:
    eks.amazonaws.com/role-arn: arn:aws:iam::ACCOUNT_B_AWS_ACCOUNT_ID:role/IAM_ROLE_NAME

```

## Example : Use chained AssumeRole operations

### Example

In this example, Account B creates an IAM policy with the permissions to give to pods in Account A's cluster. Account B attaches that policy to an IAM role with a trust relationship that allows AssumeRole permissions to Account A (111111111111), as shown below.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "AWS": "arn:aws:iam::111111111111:root"
      },
      "Action": "sts:AssumeRole",
      "Condition": {}
    }
  ]
}
```

Account A creates a role with a trust policy that gets credentials from the identity provider created with the cluster's OIDC issuer URL, as shown below.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Federated": "arn:aws:iam::111111111111:oidc-provider/oidc.eks.region-  
code.amazonaws.com/id/EXAMPLEC061A78C479E31025A21AC4CDE191335D05820BE5CE"
      },
      "Action": "sts:AssumeRoleWithWebIdentity"
    }
  ]
}
```

Account A attaches a policy to that role with the following permissions to assume the role that Account B created.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": "sts:AssumeRole",
      "Resource": "arn:aws:iam::222222222222:role/account-b-role"
    }
  ]
}
```

The application code for pods to assume Account B's role uses two profiles: `account_b_role` and `account_a_role`. The `account_b_role` profile uses the `account_a_role` profile as its source. For the AWS CLI, the `~/.aws/config` file would look like the following example.

```
[profile account_b_role]
source_profile = account_a_role
role_arn=arn:aws:iam::222222222222:role/account-b-role
```



```
[profile account_a_role]
web_identity_token_file = /var/run/secrets/eks.amazonaws.com/serviceaccount/token
role_arn=arn:aws:iam::111111111111:role/account-a-role
```

To specify chained profiles for other AWS SDKs, consult their documentation.

## Using a supported AWS SDK

The containers in your pods must use an AWS SDK version that supports assuming an IAM role via an OIDC web identity token file. AWS SDKs that are included in Linux distribution package managers may not be new enough to support this feature. Be sure to use at least the minimum SDK versions listed below:

- Java (Version 2) — [2.10.11](#)
- Java — [1.11.704](#)
- Go — [1.23.13](#)
- Python (Boto3) — [1.9.220](#)
- Python (botocore) — [1.12.200](#)
- AWS CLI — [1.16.232](#)
- Node — [2.521.0](#)
- Ruby — [2.11.345](#)
- C++ — [1.7.174](#)
- .NET — [3.3.659.1](#)
- PHP — [3.110.7](#)

Many popular Kubernetes add-ons, such as the [Cluster Autoscaler](#) and the [ALB Ingress Controller](#) support IAM roles for service accounts. The [Amazon VPC CNI plugin for Kubernetes](#) has been updated with a supported version of the AWS SDK for Go, and you can use the IAM roles for service accounts feature to provide the required permissions for the CNI to work.

To ensure that you are using a supported SDK, follow the installation instructions for your preferred SDK at [Tools for Amazon Web Services](#) when you build your containers.

## Enabling IAM roles for service accounts on your cluster

The IAM roles for service accounts feature is available on new Amazon EKS Kubernetes version 1.14 and later clusters, and clusters that were updated to versions 1.13 or later on or after September 3rd, 2019. Existing clusters can update to version 1.13 or later to take advantage of this feature. For more information, see [Updating an Amazon EKS cluster Kubernetes version \(p. 36\)](#).

If your cluster supports IAM roles for service accounts, it will have an [OpenID Connect](#) issuer URL associated with it. You can view this URL in the Amazon EKS console, or you can use the following AWS CLI command to retrieve it.

### Important

You must use at least version 1.18.120 or 2.0.40 of the AWS CLI to receive the proper output from this command. For more information, see [Installing the AWS CLI](#) in the *AWS Command Line Interface User Guide*.

```
aws eks describe-cluster --name cluster_name --query "cluster.identity.oidc.issuer" --
output text
```

Output:

```
https://oidc.eks.region-code.amazonaws.com/id/EXAMPLED539D4633E53DE1B716D3041E
```

To use IAM roles for service accounts in your cluster, you must create an OIDC identity provider in the IAM console.

eksctl

### To create an IAM OIDC identity provider for your cluster with eksctl

1. Check your eksctl version with the following command. This procedure assumes that you have installed eksctl and that your eksctl version is at least 0.26.0-rc.1.

```
eksctl version
```

For more information about installing or upgrading eksctl, see [Installing or upgrading eksctl \(p. 234\)](#).

2. Create your OIDC identity provider for your cluster with the following command. Substitute *cluster\_name* with your own value.

```
eksctl utils associate-iam-oidc-provider --cluster cluster_name --approve
```

AWS Management Console

### To create an IAM OIDC identity provider for your cluster with the AWS Management Console

1. Retrieve the OIDC issuer URL from the Amazon EKS console description of your cluster or use the following AWS CLI command.

#### Important

You must use at least version 1.18.120 or 2.0.40 of the AWS CLI to receive the proper output from this command. For more information, see [Installing the AWS CLI](#) in the *AWS Command Line Interface User Guide*.

```
aws eks describe-cluster --name cluster_name --query "cluster.identity.oidc.issuer" --output text
```

2. Open the IAM console at <https://console.aws.amazon.com/iam/>.
3. In the navigation pane, choose **Identity Providers**, and then choose **Create Provider**.
4. For **Provider Type**, choose **Choose a provider type**, and then choose **OpenID Connect**.
5. For **Provider URL**, paste the OIDC issuer URL for your cluster.
6. For Audience, type `sts.amazonaws.com` and choose **Next Step**.
7. Verify that the provider information is correct, and then choose **Create** to create your identity provider.

After you have enabled the IAM OIDC identity provider for your cluster, you can create IAM roles to associate with a service account in your cluster. For more information, see [Creating an IAM role and policy for your service account \(p. 274\)](#)

## Creating an IAM role and policy for your service account

You must create an IAM policy that specifies the permissions that you would like the containers in your pods to have. You have several ways to create a new IAM permission policy. One way is to copy a

complete AWS managed policy that already does some of what you're looking for and then customize it to your specific requirements. For more information, see [Creating a New Policy](#) in the *IAM User Guide*.

You must also create an IAM role for your Kubernetes service accounts to use before you associate it with a service account. The trust relationship is scoped to your cluster and service account so that each cluster and service account combination requires its own role. You can then attach a specific IAM policy to the role that gives the containers in your pods the permissions you desire. The following procedures describe how to do this.

## Create an IAM policy

In this procedure, we offer two example policies that you can use for your application:

- A policy to allow read-only access to an Amazon S3 bucket. You could store configuration information or a bootstrap script in this bucket, and the containers in your pod can read the file from the bucket and load it into your application.
- A policy to allow paid container images from AWS Marketplace.

1. Open the IAM console at <https://console.aws.amazon.com/iam/>.
2. In the navigation pane, choose **Policies** and then choose **Create policy**.
3. Choose the **JSON** tab.
4. In the **Policy Document** field, paste one of the following policies to apply to your service accounts, or paste your own policy document into the field. You can also use the visual editor to construct your own policy.

The example below allows permission to the *my-pod-secrets-bucket* Amazon S3 bucket. You can modify the policy document to suit your specific needs.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:GetObject"
      ],
      "Resource": [
        "arn:aws:s3:::my-pod-secrets-bucket/*"
      ]
    }
  ]
}
```

The example below gives the required permissions to use a paid container image from AWS Marketplace.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Action": [
        "aws-marketplace:RegisterUsage"
      ],
      "Effect": "Allow",
      "Resource": "*"
    }
  ]
}
```

5. Choose **Review policy**.
6. Enter a name and description for your policy and then choose **Create policy**.
7. Record the Amazon Resource Name (ARN) of the policy to use later when you create your role.

## Create an IAM role

Create an IAM role for your service accounts. Select the tab with the name of the tool that you want to use to create the role.

eksctl

Create the service account and IAM role with the following command. Substitute the *example values* with your own values.

### Note

This command only works for clusters that were created with eksctl. If you didn't create your cluster with eksctl, then use the instructions on the AWS Management Console or AWS CLI tabs.

```
eksctl create iamserviceaccount \
  --name service_account_name \
  --namespace service_account_namespace \
  --cluster cluster_name \
  --attach-policy-arn IAM_policy_ARN \
  --approve \
  --override-existing-serviceaccounts
```

An AWS CloudFormation template was deployed that created an IAM role and attached the IAM policy to it. The role was associated with a Kubernetes service account.

AWS Management Console

1. Retrieve the OIDC issuer URL from the Amazon EKS console description of your cluster, or use the following AWS CLI command.

### Important

You must use at least version 1.18.120 or 2.0.40 of the AWS CLI to receive the proper output from this command. For more information, see [Installing the AWS CLI](#) in the *AWS Command Line Interface User Guide*.

```
aws eks describe-cluster --name cluster_name --query "cluster.identity.oidc.issuer"
--output text
```

2. Open the IAM console at <https://console.aws.amazon.com/iam/>.
3. In the navigation pane, choose **Roles**, **Create Role**.
4. In the **Select type of trusted entity** section, choose **Web identity**.
5. In the **Choose a web identity provider** section:
  1. For **Identity provider**, choose the URL for your cluster.
  2. For **Audience**, choose `sts.amazonaws.com`.
6. Choose **Next: Permissions**.
7. In the **Attach Policy** section, select the policy to use for your service account. Choose **Next: Tags**.
8. On the **Add tags (optional)** screen, you can add tags for the account. Choose **Next: Review**.
9. For **Role Name**, enter a name for your role and then choose **Create Role**.
10. After the role is created, choose the role in the console to open it for editing.

11. Choose the **Trust relationships** tab, and then choose **Edit trust relationship**.

1. Edit the OIDC provider suffix and change it from `:aud` to `:sub`.
2. Replace `sts.amazonaws.com` with your service account ID.
3. If necessary, change `region-code` to the Region code returned in the output from step 1.

The resulting line should look like this.

```
"oidc.eks.region-code.amazonaws.com/id/EXAMPLED539D4633E53DE1B716D3041E:sub":  
"system:serviceaccount:SERVICE_ACCOUNT_NAMESPACE:SERVICE_ACCOUNT_NAME"
```

12. Choose **Update Trust Policy** to finish.
13. Associate the IAM role with a Kubernetes service account. For more information, see [Specifying an IAM role for your service account \(p. 278\)](#).

## AWS CLI

1. Set your AWS account ID to an environment variable with the following command.

```
AWS_ACCOUNT_ID=$(aws sts get-caller-identity --query "Account" --output text)
```

2. Set your OIDC identity provider to an environment variable with the following command, replacing your cluster name.

### Important

You must use at least version 1.18.120 or 2.0.40 of the AWS CLI to receive the proper output from this command. For more information, see [Installing the AWS CLI](#) in the *AWS Command Line Interface User Guide*.

```
OIDC_PROVIDER=$(aws eks describe-cluster --name cluster-name --query  
"cluster.identity.oidc.issuer" --output text | sed -e "s/^https:\/\/\///")
```

3. Copy the following code block to your computer and replace `namespace` and `service-account-name` with your own values.

```
read -r -d '' TRUST_RELATIONSHIP <<EOF  
{  
  "Version": "2012-10-17",  
  "Statement": [  
    {  
      "Effect": "Allow",  
      "Principal": {  
        "Federated": "arn:aws:iam:${AWS_ACCOUNT_ID}:oidc-provider/  
${OIDC_PROVIDER}"  
      },  
      "Action": "sts:AssumeRoleWithWebIdentity",  
      "Condition": {  
        "StringEquals": {  
          "${OIDC_PROVIDER}:sub": "system:serviceaccount:namespace:service-account-  
name"  
        }  
      }  
    }  
  ]  
}  
EOF  
echo "${TRUST_RELATIONSHIP}" > trust.json
```

4. Run the modified code block from the previous step to create a file named `trust.json`.

5. Run the following AWS CLI command to create the role, replacing your IAM role name and description.

```
aws iam create-role --role-name IAM_ROLE_NAME --assume-role-policy-document file://trust.json --description "IAM_ROLE_DESCRIPTION"
```

6. Run the following command to attach your IAM policy to your role, replacing your IAM role name and policy ARN.

```
aws iam attach-role-policy --role-name IAM_ROLE_NAME --policy-arn=IAM_POLICY_ARN
```

7. Associate the IAM role with a Kubernetes service account. For more information, see [Specifying an IAM role for your service account](#) (p. 278).

## Specifying an IAM role for your service account

In Kubernetes, you define the IAM role to associate with a service account in your cluster by adding the following annotation to the service account.

### Note

If you created an IAM role to use with your service account using `eksctl`, this has already been done for you with the service account that you specified when creating the role.

```
apiVersion: v1
kind: ServiceAccount
metadata:
  annotations:
    eks.amazonaws.com/role-arn: arn:aws:iam::AWS_ACCOUNT_ID:role/IAM_ROLE_NAME
```

### To patch a service account to use with IAM roles

1. Use the following command to annotate your service account with the ARN of the IAM role that you want to use with your service account. Be sure to substitute your own values for the *alternate-colored* example values to use with your pods.

```
kubectl annotate serviceaccount -n SERVICE_ACCOUNT_NAMESPACE SERVICE_ACCOUNT_NAME \
eks.amazonaws.com/role-arn=arn:aws:iam::AWS_ACCOUNT_ID:role/IAM_ROLE_NAME
```

2. Delete and re-create any existing pods that are associated with the service account to apply the credential environment variables. The mutating web hook does not apply them to pods that are already running. The following command deletes the existing the `aws-node` DaemonSet pods and deploys them with the service account annotation. You can modify the namespace, deployment type, and label to update your specific pods.

```
kubectl delete pods -n kube-system -l k8s-app=aws-node
```

3. Confirm that the pods all restarted.

```
kubectl get pods -n kube-system -l k8s-app=aws-node
```

4. Describe one of the pods and verify that the `AWS_WEB_IDENTITY_TOKEN_FILE` and `AWS_ROLE_ARN` environment variables exist.

```
kubectl exec -n kube-system aws-node-9rgzw env | grep AWS
```

Output:

```
AWS_VPC_K8S_CNI_LOGLEVEL=DEBUG  
AWS_ROLE_ARN=arn:aws:iam::AWS_ACCOUNT_ID:role/IAM_ROLE_NAME  
AWS_WEB_IDENTITY_TOKEN_FILE=/var/run/secrets/eks.amazonaws.com/serviceaccount/token
```

The IAM role was created by `eksctl` when you created the Kubernetes service account in a previous step.

## Restricting access to Amazon EC2 instance profile credentials

By default, all containers that are running on a node have all permissions assigned to the ??? (p. 265) that is attached to the node. The Amazon EC2 [instance metadata service](#) provides the credentials to any process running on an instance. For more information, see [Retrieving Security Credentials from Instance Metadata](#).

When you implement IAM roles for service accounts for a pod, the containers in the pod have all permissions assigned to the service account and the node IAM role. If you implement IAM roles for service accounts for all pods in a cluster, you may want to prevent the containers in the pods from using the permissions assigned to the node IAM role. Keep in mind however, that there may be certain key permissions on the node IAM role that pods need to function. It's important to properly scope your service account IAM roles so that your pods have all of the necessary permissions. For example, the node IAM role is assigned permissions to pull container images from Amazon ECR. If a pod isn't assigned those permissions, then the pod can't pull container images from Amazon ECR.

To prevent all containers in all pods on a node from using the permissions assigned to the node IAM role (while still allowing the permissions that are assigned to the service account), run the following `iptables` commands on your nodes (as `root`) or include them in your instance bootstrap user data script.

### Important

- These commands completely block **all** containers running on a node from querying the instance metadata service for any metadata, not just the credentials for the node IAM role. Do not run these commands on nodes that run pods that you haven't implemented IAM roles for service accounts for or none of the containers on the node will have any of the permissions assigned to the node IAM role.
- If you implement network policy, using a tool such as [Calico \(p. 194\)](#), this rule may be overridden. When implementing network policy, ensure that it doesn't override this rule, or that your policy includes this rule.

```
yum install -y iptables-services  
iptables --insert FORWARD 1 --in-interface eni+ --destination 169.254.169.254/32 --jump  
DROP  
iptables-save | tee /etc/sysconfig/iptables  
systemctl enable --now iptables
```

## Walkthrough: Updating a DaemonSet to use IAM for service accounts

The [Amazon VPC CNI plugin for Kubernetes](#) is the networking plugin for pod networking in Amazon EKS clusters. The CNI plugin is responsible for allocating VPC IP addresses to Kubernetes nodes and configuring the necessary networking for pods on each node. The plugin requires IAM permissions, provided by the AWS managed policy [AmazonEKS\\_CNI\\_Policy](#), to make calls to AWS APIs on your behalf. By default, this policy is attached to your node IAM role. However, using this method, all pods on

the nodes have the same permissions as the CNI plugin. You can use the IAM roles for service accounts feature to provide the [AmazonEKS\\_CNI\\_Policy](#) permissions, and then remove the policy from the node IAM role.

For ease of use, this topic uses `eksctl` to configure IAM roles for service accounts. However, if you would rather use the AWS Management Console, the AWS CLI, or one of the AWS SDKs, the same basic concepts apply, but you will have to modify the steps to use the procedures in [Enabling IAM roles for service accounts on your cluster \(p. 273\)](#).

### To configure the CNI plugin to use IAM roles for service accounts

1. Check your `eksctl` version with the following command. This procedure assumes that you have installed `eksctl` and that your `eksctl` version is at least `0.26.0-rc.1`.

```
eksctl version
```

For more information about installing or upgrading `eksctl`, see [Installing or upgrading eksctl \(p. 234\)](#).

2. Check the version of your cluster's Amazon VPC CNI Plugin for Kubernetes. Use the following command to print your cluster's CNI version.

```
kubectl describe daemonset aws-node --namespace kube-system | grep Image | cut -d "/" -f 2
```

Output:

```
amazon-k8s-cni:1.6.2
```

If your CNI version is earlier than 1.6.3, complete the following steps to create a service account and then upgrade your CNI version to the latest version:

- a. Create an OIDC identity provider for your cluster with the following command. Substitute the cluster name with your own value.

```
eksctl utils associate-iam-oidc-provider --cluster cluster_name --approve
```

- b. Create a Kubernetes service account with the following command. Substitute *cluster\_name* with your own value. This command deploys an AWS CloudFormation stack that creates an IAM role, attaches the `AmazonEKS_CNI_Policy` AWS managed policy to it, and binds the IAM role to the service account.

```
eksctl create iamserviceaccount \
  --name aws-node \
  --namespace kube-system \
  --cluster cluster_name \
  --attach-policy-arn arn:aws:iam::aws:policy/AmazonEKS_CNI_Policy \
  --approve \
  --override-existing-serviceaccounts
```

- c. Upgrade your CNI version to the latest version. The manifest specifies the `aws-node` service account that you created in the previous step.

```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/release-1.6/config/v1.6/aws-k8s-cni.yaml
```

3. Watch the roll out, and wait for the DESIRED count of the deployment to match the UP-TO-DATE count. Press **Ctrl + c** to exit.



```
kubectl get -n kube-system daemonset.apps/aws-node --watch
```

4. List the pods in the aws-node DaemonSet.

```
kubectl get pods -n kube-system -l k8s-app=aws-node
```

Output:

NAME	READY	STATUS	RESTARTS	AGE
aws-node-mp88b	1/1	Running	0	17m
aws-node-n4tcd	1/1	Running	0	20s
aws-node-qt9dl	1/1	Running	0	17m

5. Check the version of your cluster's Amazon VPC CNI Plugin for Kubernetes again, confirming that the version is 1.6.3.

```
kubectl describe daemonset aws-node --namespace kube-system | grep Image | cut -d "/" -f 2
```

Output:

```
amazon-k8s-cni:1.6.3
```

6. Describe one of the pods and verify that the AWS\_WEB\_IDENTITY\_TOKEN\_FILE and AWS\_ROLE\_ARN environment variables exist.

```
kubectl exec -n kube-system aws-node-9rgzw env | grep AWS
```

Output:

```
AWS_VPC_K8S_CNI_LOGLEVEL=DEBUG
AWS_ROLE_ARN=arn:aws:iam::111122223333:role/eksctl-prod-addon-iamserviceaccount-kube-
sys-Role1-V66K5I6JLDGK
AWS_WEB_IDENTITY_TOKEN_FILE=/var/run/secrets/eks.amazonaws.com/serviceaccount/token
```

The IAM role was created by eksctl when you created the Kubernetes service account in a previous step.

7. Remove the [AmazonEKS\\_CNI\\_Policy](#) policy from your node IAM role.
  - a. Open the IAM console at <https://console.aws.amazon.com/iam/>.
  - b. In the left navigation, choose **Roles**, and then search for your node instance role.
  - c. Choose the **Permissions** tab for your node instance role and then choose the **X** to the right of the [AmazonEKS\\_CNI\\_Policy](#).
  - d. Choose **Detach** to finish.

Now your CNI plugin pods are getting their IAM permissions from their own role, and the instance role no longer can provide those permissions to other pods.

## Troubleshooting Amazon EKS identity and access

To diagnose and fix common issues that you might encounter when working with Amazon EKS and IAM see [Troubleshooting IAM](#) (p. 319).

## Logging and monitoring in Amazon EKS

Amazon EKS control plane logging provides audit and diagnostic logs directly from the Amazon EKS control plane to CloudWatch Logs in your account. These logs make it easy for you to secure and run your clusters. You can select the exact log types you need, and logs are sent as log streams to a group for each Amazon EKS cluster in CloudWatch. For more information, see [Amazon EKS Control Plane Logging](#) (p. 58).

### Note

When you check the Amazon EKS authenticator logs in Amazon CloudWatch, you'll see entries that contain text similar to the following example text.

```
level=info msg="mapping IAM role" groups="[]"
role="arn:aws:iam::111122223333:role/XXXXXXXXXXXXXXXXXXXX-NodeManagerRole-XXXXXXX"
username="eks:node-manager"
```

Entries that contain this text are expected. The username is an Amazon EKS internal service role that performs specific operations for managed node groups and Fargate.

Amazon EKS is integrated with AWS CloudTrail, a service that provides a record of actions taken by a user, role, or an AWS service in Amazon EKS. CloudTrail captures all API calls for Amazon EKS as events. The calls captured include calls from the Amazon EKS console and code calls to the Amazon EKS API operations. For more information, see [Logging Amazon EKS API Calls with AWS CloudTrail](#) (p. 290).

The Kubernetes API server exposes a number of metrics that are useful for monitoring and analysis. For more information, see [??? \(p. 240\)](#).

## Compliance validation for Amazon EKS

Third-party auditors assess the security and compliance of Amazon EKS as part of multiple AWS compliance programs. These include SOC, PCI, ISO, HIPAA, and others.

For a list of AWS services in scope of specific compliance programs, see [AWS services in scope by compliance program](#). For general information, see [AWS compliance programs](#).

You can download third-party audit reports using AWS Artifact. For more information, see [Downloading reports in AWS Artifact](#).

Your compliance responsibility when using Amazon EKS is determined by the sensitivity of your data, your company's compliance objectives, and applicable laws and regulations. AWS provides the following resources to help with compliance:

- [Security and compliance quick start guides](#) – These deployment guides discuss architectural considerations and provide steps for deploying security- and compliance-focused baseline environments on AWS.
- [Architecting for HIPAA security and compliance paper](#) – This paper describes how companies can use AWS to create HIPAA-compliant applications.
- [AWS compliance resources](#) – This collection of workbooks and guides might apply to your industry and location.
- [AWS Config](#) – This AWS service assesses how well your resource configurations comply with internal practices, industry guidelines, and regulations.
- [AWS Security Hub](#) – This AWS service provides a comprehensive view of your security state within AWS that helps you check your compliance with security industry standards and best practices.

## Resilience in Amazon EKS

The AWS global infrastructure is built around AWS Regions and Availability Zones. AWS Regions provide multiple physically separated and isolated Availability Zones, which are connected with low-latency, high-throughput, and highly redundant networking. With Availability Zones, you can design and operate applications and databases that automatically fail over between Availability Zones without interruption. Availability Zones are more highly available, fault tolerant, and scalable than traditional single or multiple data center infrastructures.

Amazon EKS runs Kubernetes control plane instances across multiple Availability Zones to ensure high availability. Amazon EKS automatically detects and replaces unhealthy control plane instances, and it provides automated version upgrades and patching for them.

This control plane consists of at least two API server nodes and three `etcd` nodes that run across three Availability Zones within a Region. Amazon EKS automatically detects and replaces unhealthy control plane instances, restarting them across the Availability Zones within the Region as needed. Amazon EKS leverages the architecture of AWS Regions in order to maintain high availability. Because of this, Amazon EKS is able to offer an [SLA for API server endpoint availability](#).

For more information about AWS Regions and Availability Zones, see [AWS global infrastructure](#).

## Infrastructure security in Amazon EKS

As a managed service, Amazon EKS is protected by the AWS global network security procedures that are described in the [Amazon Web Services: Overview of security processes](#) paper.

You use AWS published API calls to access Amazon EKS through the network. Clients must support Transport Layer Security (TLS) 1.0 or later. We recommend TLS 1.2 or later. Clients must also support cipher suites with perfect forward secrecy (PFS) such as Ephemeral Diffie-Hellman (DHE) or Elliptic Curve Ephemeral Diffie-Hellman (ECDHE). Most modern systems such as Java 7 and later support these modes.

Additionally, requests must be signed by using an access key ID and a secret access key that is associated with an IAM principal. Or you can use the [AWS Security Token Service](#) (AWS STS) to generate temporary security credentials to sign requests.

When you create an Amazon EKS cluster, you specify the VPC subnets for your cluster to use. Amazon EKS requires subnets in at least two Availability Zones. We recommend a VPC with public and private subnets so that Kubernetes can create public load balancers in the public subnets that load balance traffic to pods running on nodes that are in private subnets.

For more information about VPC considerations, see [Cluster VPC considerations \(p. 170\)](#).

If you create your VPC and node groups with the AWS CloudFormation templates provided in the [Getting started with Amazon EKS \(p. 3\)](#) walkthrough, then your control plane and node security groups are configured with our recommended settings.

For more information about security group considerations, see [Amazon EKS security group considerations \(p. 173\)](#).

When you create a new cluster, Amazon EKS creates an endpoint for the managed Kubernetes API server that you use to communicate with your cluster (using Kubernetes management tools such as `kubectl`). By default, this API server endpoint is public to the internet, and access to the API server is secured using a combination of AWS Identity and Access Management (IAM) and native Kubernetes [Role Based Access Control](#) (RBAC).

You can enable private access to the Kubernetes API server so that all communication between your nodes and the API server stays within your VPC. You can limit the IP addresses that can access your API server from the internet, or completely disable internet access to the API server.

For more information about modifying cluster endpoint access, see [Modifying cluster endpoint access \(p. 49\)](#).

You can implement network policies with tools such as [Project Calico \(p. 194\)](#). Project Calico is a third party open source project. For more information, see the [Project Calico documentation](#).

## Configuration and vulnerability analysis in Amazon EKS

Security is a critical consideration for configuring and maintaining Kubernetes clusters and applications. The [Center for Internet Security \(CIS\) Kubernetes Benchmark](#) provides guidance for Amazon EKS node security configurations. The benchmark:

- Is applicable to Amazon EC2 nodes (both managed and self-managed) where you are responsible for security configurations of Kubernetes components.
- Provides a standard, community-approved way to ensure that you have configured your Kubernetes cluster and nodes securely when using Amazon EKS.
- Consists of four sections; control plane logging configuration, node security configurations, policies, and managed services.
- Supports all of the Kubernetes versions currently available in Amazon EKS and can be run using [kube-bench](#), a standard open source tool for checking configuration using the CIS benchmark on Kubernetes clusters.

To learn more, see [Introducing The CIS Amazon EKS Benchmark](#).

Amazon EKS platform versions represent the capabilities of the cluster control plane, including which Kubernetes API server flags are enabled and the current Kubernetes patch version. New clusters are deployed with the latest platform version. For details, see [Platform versions \(p. 64\)](#).

You can [update an Amazon EKS cluster \(p. 36\)](#) to newer Kubernetes versions. As new Kubernetes versions become available in Amazon EKS, we recommend that you proactively update your clusters to use the latest available version. For more information about Kubernetes versions in EKS, see [Amazon EKS Kubernetes Versions \(p. 61\)](#).

Track security or privacy events for Amazon Linux 2 at the [Amazon Linux Security Center](#) or subscribe to the associated [RSS feed](#). Security and privacy events include an overview of the issue affected, packages, and instructions for updating your instances to correct the issue.

You can use [Amazon Inspector](#) to check for unintended network accessibility of your nodes and for vulnerabilities on those Amazon EC2 instances.

## Pod security policy

The Kubernetes pod security policy admission controller validates pod creation and update requests against a set of rules. By default, Amazon EKS clusters ship with a fully permissive security policy with no restrictions. For more information, see [Pod Security Policies](#) in the Kubernetes documentation.

### Note

The pod security policy admission controller is only enabled on Amazon EKS clusters running Kubernetes version 1.13 or later. You must update your cluster's Kubernetes version to at least 1.13 to use pod security policies. For more information, see [Updating an Amazon EKS cluster Kubernetes version \(p. 36\)](#).

## Amazon EKS default pod security policy

Amazon EKS clusters with Kubernetes version 1.13 and higher have a default pod security policy named `eks.privileged`. This policy has no restriction on what kind of pod can be accepted into the system, which is equivalent to running Kubernetes with the `PodSecurityPolicy` controller disabled.

### Note

This policy was created to maintain backwards compatibility with clusters that did not have the `PodSecurityPolicy` controller enabled. You can create more restrictive policies for your cluster and for individual namespaces and service accounts and then delete the default policy to enable the more restrictive policies.

You can view the default policy with the following command.

```
kubectl get psp eks.privileged
```

Output:

NAME	PRIV	CAPS	SELINUX	RUNASUSER	FSGROUP	SUPGROUP	READONLYROOTFS
VOLUMES							
eks.privileged	true	*	RunAsAny	RunAsAny	RunAsAny	RunAsAny	false
*							

For more details, you can describe the policy with the following command.

```
kubectl describe psp eks.privileged
```

Output:

```
Name:  eks.privileged

Settings:
  Allow Privileged:      true
  Allow Privilege Escalation: 0xc0004ce5f8
  Default Add Capabilities: <none>
  Required Drop Capabilities: <none>
  Allowed Capabilities:    *
  Allowed Volume Types:    *
  Allow Host Network:      true
  Allow Host Ports:        0-65535
  Allow Host PID:          true
  Allow Host IPC:          true
  Read Only Root Filesystem: false
  SELinux Context Strategy: RunAsAny
    User:                  <none>
    Role:                   <none>
    Type:                   <none>
    Level:                  <none>
  Run As User Strategy: RunAsAny
    Ranges:                 <none>
  FSGroup Strategy: RunAsAny
    Ranges:                 <none>
  Supplemental Groups Strategy: RunAsAny
    Ranges:                 <none>
```

The following example shows the full YAML file for the `eks.privileged` pod security policy, its cluster role, and cluster role binding.

```
---
```

```
apiVersion: policy/v1beta1
kind: PodSecurityPolicy
metadata:
  name: eks.privileged
  annotations:
    kubernetes.io/description: 'privileged allows full unrestricted access to
    pod features, as if the PodSecurityPolicy controller was not enabled.'
    seccomp.security.alpha.kubernetes.io/allowedProfileNames: '*'
  labels:
    kubernetes.io/cluster-service: "true"
    eks.amazonaws.com/component: pod-security-policy
spec:
  privileged: true
  allowPrivilegeEscalation: true
  allowedCapabilities:
  - '*'
  volumes:
  - '*'
  hostNetwork: true
  hostPorts:
  - min: 0
    max: 65535
  hostIPC: true
  hostPID: true
  runAsUser:
    rule: 'RunAsAny'
  seLinux:
    rule: 'RunAsAny'
  supplementalGroups:
    rule: 'RunAsAny'
  fsGroup:
    rule: 'RunAsAny'
  readOnlyRootFilesystem: false

---
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: eks:podsecuritypolicy:privileged
  labels:
    kubernetes.io/cluster-service: "true"
    eks.amazonaws.com/component: pod-security-policy
rules:
- apiGroups:
  - policy
  resourceNames:
  - eks.privileged
  resources:
  - podsecuritypolicies
  verbs:
  - use

---
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  name: eks:podsecuritypolicy:authenticated
  annotations:
    kubernetes.io/description: 'Allow all authenticated users to create privileged pods.'
  labels:
    kubernetes.io/cluster-service: "true"
    eks.amazonaws.com/component: pod-security-policy
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: eks:podsecuritypolicy:privileged
```

```
subjects:
- kind: Group
  apiGroup: rbac.authorization.k8s.io
  name: system:authenticated
```

## To delete the default pod security policy

After you create custom pod security policies for your cluster, you can delete the default Amazon EKS `eks.privileged` pod security policy to enable your custom policies.

1. Create a file called `privileged-podsecuritypolicy.yaml` and paste the full `eks.privileged` YAML file contents from the preceding example into it (this allows you to delete the pod security policy, the `ClusterRole`, and the `ClusterRoleBinding` associated with it).
2. Delete the YAML with the following command.

```
kubectl delete -f privileged-podsecuritypolicy.yaml
```

## To install or restore the default pod security policy

If you are upgrading from an earlier version of Kubernetes, or have modified or deleted the default Amazon EKS `eks.privileged` pod security policy, you can restore it with the following steps.

1. Create a file called `privileged-podsecuritypolicy.yaml` and paste the YAML file contents below into it.

```
---
apiVersion: policy/v1beta1
kind: PodSecurityPolicy
metadata:
  name: eks.privileged
  annotations:
    kubernetes.io/description: 'privileged allows full unrestricted access to
      pod features, as if the PodSecurityPolicy controller was not enabled.'
    seccomp.security.alpha.kubernetes.io/allowedProfileNames: '*'
  labels:
    kubernetes.io/cluster-service: "true"
    eks.amazonaws.com/component: pod-security-policy
spec:
  privileged: true
  allowPrivilegeEscalation: true
  allowedCapabilities:
  - '*'
  volumes:
  - '*'
  hostNetwork: true
  hostPorts:
  - min: 0
    max: 65535
  hostIPC: true
  hostPID: true
  runAsUser:
    rule: 'RunAsAny'
  seLinux:
    rule: 'RunAsAny'
  supplementalGroups:
    rule: 'RunAsAny'
  fsGroup:
    rule: 'RunAsAny'
  readOnlyRootFilesystem: false
```

```
---
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: eks:podsecuritypolicy:privileged
  labels:
    kubernetes.io/cluster-service: "true"
    eks.amazonaws.com/component: pod-security-policy
rules:
- apiGroups:
  - policy
  resourceNames:
  - eks.privileged
  resources:
  - podsecuritypolicies
  verbs:
  - use
---
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  name: eks:podsecuritypolicy:authenticated
  annotations:
    kubernetes.io/description: 'Allow all authenticated users to create privileged
pods.'
  labels:
    kubernetes.io/cluster-service: "true"
    eks.amazonaws.com/component: pod-security-policy
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: eks:podsecuritypolicy:privileged
subjects:
- kind: Group
  apiGroup: rbac.authorization.k8s.io
  name: system:authenticated
```

2. Apply the YAML with the following command.

```
kubectl apply -f privileged-podsecuritypolicy.yaml
```



# AWS services integrated with Amazon EKS

Amazon EKS works with other AWS services to provide additional solutions for your business challenges. This topic identifies services that either use Amazon EKS to add functionality, or services that Amazon EKS uses to perform tasks.

## Contents

- [Creating Amazon EKS resources with AWS CloudFormation \(p. 289\)](#)
- [Logging Amazon EKS API calls with AWS CloudTrail \(p. 290\)](#)
- [Amazon EKS on AWS Outposts \(p. 292\)](#)
- [Deep Learning Containers \(p. 295\)](#)
- [Tutorial: Configure App Mesh integration with Kubernetes \(p. 295\)](#)

## Creating Amazon EKS resources with AWS CloudFormation

Amazon EKS is integrated with AWS CloudFormation, a service that helps you model and set up your AWS resources so that you can spend less time creating and managing your resources and infrastructure. You create a template that describes all the AWS resources that you want, for example an Amazon EKS cluster, and AWS CloudFormation takes care of provisioning and configuring those resources for you.

When you use AWS CloudFormation, you can reuse your template to set up your Amazon EKS resources consistently and repeatedly. Just describe your resources once, and then provision the same resources over and over in multiple AWS accounts and Regions.

## Amazon EKS and AWS CloudFormation templates

To provision and configure resources for Amazon EKS and related services, you must understand [AWS CloudFormation templates](#). Templates are formatted text files in JSON or YAML. These templates describe the resources that you want to provision in your AWS CloudFormation stacks. If you're unfamiliar with JSON or YAML, you can use AWS CloudFormation Designer to help you get started with AWS CloudFormation templates. For more information, see [What is AWS CloudFormation Designer?](#) in the *AWS CloudFormation User Guide*.

Amazon EKS supports creating clusters and node groups in AWS CloudFormation. For more information, including examples of JSON and YAML templates for your Amazon EKS resources, see [Amazon EKS resource type reference](#) in the *AWS CloudFormation User Guide*.

## Learn more about AWS CloudFormation

To learn more about AWS CloudFormation, see the following resources:

- [AWS CloudFormation](#)
- [AWS CloudFormation User Guide](#)
- [AWS CloudFormation Command Line Interface User Guide](#)

# Logging Amazon EKS API calls with AWS CloudTrail

Amazon EKS is integrated with AWS CloudTrail, a service that provides a record of actions taken by a user, role, or an AWS service in Amazon EKS. CloudTrail captures all API calls for Amazon EKS as events, including calls from the Amazon EKS console and from code calls to the Amazon EKS API operations.

If you create a trail, you can enable continuous delivery of CloudTrail events to an Amazon S3 bucket, including events for Amazon EKS. If you don't configure a trail, you can still view the most recent events in the CloudTrail console in **Event history**. Using the information collected by CloudTrail, you can determine the request that was made to Amazon EKS, the IP address from which the request was made, who made the request, when it was made, and additional details.

To learn more about CloudTrail, see the [AWS CloudTrail User Guide](#).

## Amazon EKS information in CloudTrail

CloudTrail is enabled on your AWS account when you create the account. When activity occurs in Amazon EKS, that activity is recorded in a CloudTrail event along with other AWS service events in **Event history**. You can view, search, and download recent events in your AWS account. For more information, see [Viewing events with CloudTrail event history](#).

For an ongoing record of events in your AWS account, including events for Amazon EKS, create a trail. A *trail* enables CloudTrail to deliver log files to an Amazon S3 bucket. By default, when you create a trail in the console, the trail applies to all AWS Regions. The trail logs events from all Regions in the AWS partition and delivers the log files to the Amazon S3 bucket that you specify. Additionally, you can configure other AWS services to further analyze and act upon the event data collected in CloudTrail logs. For more information, see the following:

- [Overview for creating a trail](#)
- [CloudTrail supported services and integrations](#)
- [Configuring Amazon SNS notifications for CloudTrail](#)
- [Receiving CloudTrail log files from multiple regions](#) and [Receiving CloudTrail log files from multiple accounts](#)

All Amazon EKS actions are logged by CloudTrail and are documented in the [Amazon EKS API Reference](#). For example, calls to the [CreateCluster](#), [ListClusters](#) and [DeleteCluster](#) sections generate entries in the CloudTrail log files.

Every event or log entry contains information about who generated the request. The identity information helps you determine the following:

- Whether the request was made with root or AWS Identity and Access Management (IAM) user credentials.
- Whether the request was made with temporary security credentials for a role or federated user.
- Whether the request was made by another AWS service.

For more information, see the [CloudTrail userIdentity](#) element.

## Understanding Amazon EKS log file entries

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, the date and time of the action, request parameters, and so on. CloudTrail log files aren't an ordered stack trace of the public API calls, so they don't appear in any specific order.

The following example shows a CloudTrail log entry that demonstrates the `CreateCluster` action.

```
{
  "eventVersion": "1.05",
  "userIdentity": {
    "type": "IAMUser",
    "principalId": "AKIAIOSFODNN7EXAMPLE",
    "arn": "arn:aws:iam::111122223333:user/username",
    "accountId": "111122223333",
    "accessKeyId": "AKIAIOSFODNN7EXAMPLE",
    "userName": "username"
  },
  "eventTime": "2018-05-28T19:16:43Z",
  "eventSource": "eks.amazonaws.com",
  "eventName": "CreateCluster",
  "awsRegion": "region-code",
  "sourceIPAddress": "205.251.233.178",
  "userAgent": "PostmanRuntime/6.4.0",
  "requestParameters": {
    "resourcesVpcConfig": {
      "subnetIds": [
        "subnet-a670c2df",
        "subnet-4f8c5004"
      ]
    },
    "roleArn": "arn:aws:iam::111122223333:role/AWSServiceRoleForAmazonEKS-CAC1G1VH3ZKZ",
    "clusterName": "test"
  },
  "responseElements": {
    "cluster": {
      "clusterName": "test",
      "status": "CREATING",
      "createdAt": 1527535003.208,
      "certificateAuthority": {},
      "arn": "arn:aws:eks:region-code:111122223333:cluster/test",
      "roleArn": "arn:aws:iam::111122223333:role/AWSServiceRoleForAmazonEKS-CAC1G1VH3ZKZ",
      "version": "1.10",
      "resourcesVpcConfig": {
        "securityGroupIds": [],
        "vpcId": "vpc-21277358",
        "subnetIds": [
          "subnet-a670c2df",
          "subnet-4f8c5004"
        ]
      }
    }
  },
  "requestID": "a7a0735d-62ab-11e8-9f79-81ce5b2b7d37",
  "eventID": "eab22523-174a-499c-9dd6-91e7be3ff8e3",
  "readOnly": false,
  "eventType": "AwsApiCall",
  "recipientAccountId": "111122223333"
}
```

## Log Entries for Amazon EKS Service Linked Roles

The Amazon EKS service linked roles make API calls to AWS resources. You will see CloudTrail log entries with `username: AWSServiceRoleForAmazonEKS` and `username: AWSServiceRoleForAmazonEKSNodegroup` for calls made by the Amazon EKS service linked roles.

For more information about Amazon EKS and service linked roles, see [the section called “Using Service-Linked Roles” \(p. 259\)](#).

The following example shows a CloudTrail log entry that demonstrates a `DeleteInstanceProfile` action made by the `AWSServiceRoleForAmazonEKSNodegroup` service linked role, noted in the `sessionContext`.

```
{
  "eventVersion": "1.05",
  "userIdentity": {
    "type": "AssumedRole",
    "principalId": "ARO3WHGPEZ7SJ2CW55C5:EKS",
    "arn": "arn:aws:sts::111122223333:assumed-role/AWSServiceRoleForAmazonEKSNodegroup/
EKS",
    "accountId": "111122223333",
    "accessKeyId": "AKIAIOSFODNN7EXAMPLE",
    "sessionContext": {
      "sessionIssuer": {
        "type": "Role",
        "principalId": "ARO3WHGPEZ7SJ2CW55C5",
        "arn": "arn:aws:iam::111122223333:role/aws-service-role/eks-
nodegroup.amazonaws.com/AWSServiceRoleForAmazonEKSNodegroup",
        "accountId": "111122223333",
        "userName": "AWSServiceRoleForAmazonEKSNodegroup"
      },
      "webIdFederationData": {},
      "attributes": {
        "mfaAuthenticated": "false",
        "creationDate": "2020-02-26T00:56:33Z"
      }
    },
    "invokedBy": "eks-nodegroup.amazonaws.com"
  },
  "eventTime": "2020-02-26T00:56:34Z",
  "eventSource": "iam.amazonaws.com",
  "eventName": "DeleteInstanceProfile",
  "awsRegion": "us-east-1",
  "sourceIPAddress": "eks-nodegroup.amazonaws.com",
  "userAgent": "eks-nodegroup.amazonaws.com",
  "requestParameters": {
    "instanceProfileName": "eks-11111111-2222-3333-4444-abcdef123456"
  },
  "responseElements": null,
  "requestID": "11111111-2222-3333-4444-abcdef123456",
  "eventID": "11111111-2222-3333-4444-abcdef123456",
  "eventType": "AwsApiCall",
  "recipientAccountId": "111122223333"
}
```

## Amazon EKS on AWS Outposts

Beginning with Kubernetes version 1.14.8 with Amazon EKS platform version `eks . 5` and Kubernetes version 1.13.12 with Amazon EKS platform version `eks . 6`, you can create and run Amazon EKS nodes on AWS Outposts. AWS Outposts enables native AWS services, infrastructure, and operating models in on-premises facilities. In AWS Outposts environments, you can use the same AWS APIs, tools, and infrastructure that you use in the AWS Cloud. Amazon EKS nodes on AWS Outposts is ideal for low-latency workloads that need to be run in close proximity to on-premises data and applications. For more information about AWS Outposts, see the [AWS Outposts User Guide](#).

## Prerequisites

The following are the prerequisites for using Amazon EKS nodes on AWS Outposts:

- You must have installed and configured an Outpost in your on-premises data center.
- You must have a reliable network connection between your Outpost and its AWS Region.
- The AWS Region for the Outpost must support Amazon EKS. For a list of supported Regions, see [Amazon EKS service endpoints](#) in the *AWS General Reference*.

## Limitations

The following are the limitations of using Amazon EKS on Outposts:

- AWS Identity and Access Management, Application Load Balancer, Network Load Balancer, Classic Load Balancer, and Amazon Route 53 run in the AWS Region, not on Outposts. This will increase latencies between the services and the containers.
- AWS Fargate is not available on AWS Outposts.

## Network connectivity considerations

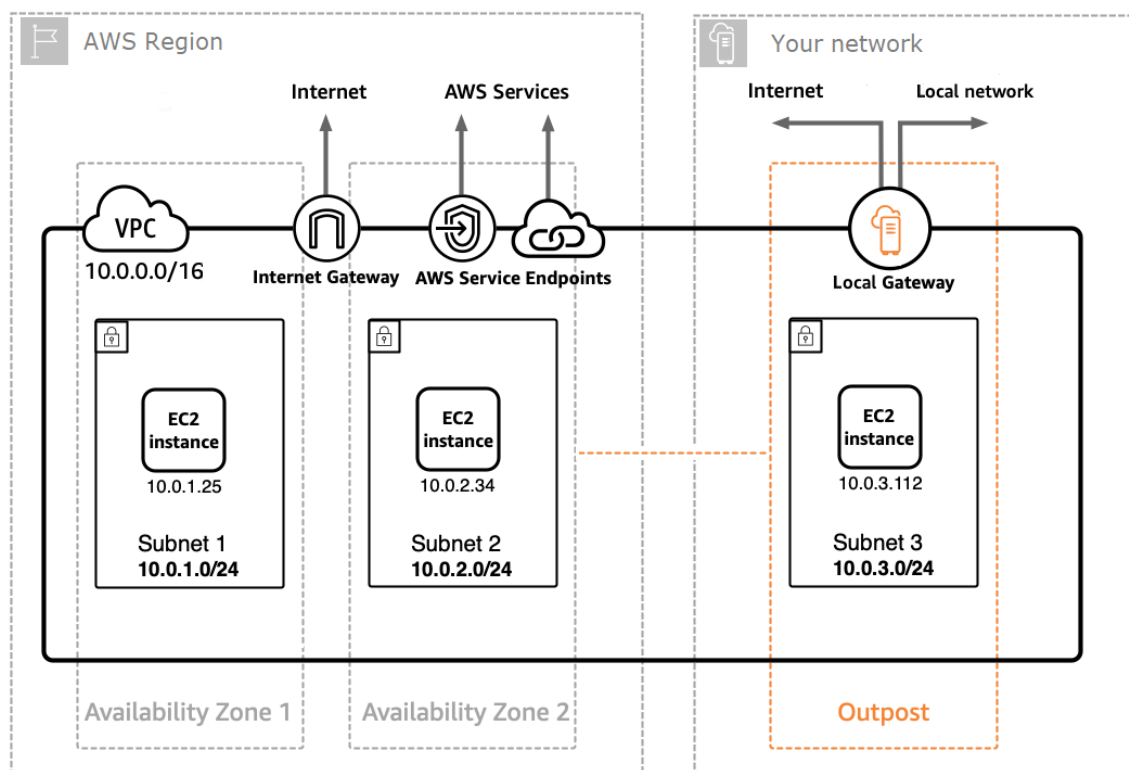
The following are network connectivity considerations for Amazon EKS AWS Outposts:

- If network connectivity between your Outpost and its AWS Region is lost, your nodes will continue to run. However, you cannot create new nodes or take new actions on existing deployments until connectivity is restored. In case of instance failures, the instance will not be automatically replaced. The Kubernetes control plane runs in the Region, and missing heartbeats caused by things like a loss of connectivity to the Availability Zone could lead to failures. The failed heartbeats will lead to pods on the Outposts being marked as unhealthy, and eventually the node status will time out and pods will be marked for eviction. For more information, see [Node Controller](#) in the Kubernetes documentation.
- We recommend that you provide reliable, highly available, and low-latency connectivity between your Outpost and its AWS Region.

## Creating Amazon EKS nodes on an Outpost

Creating Amazon EKS nodes on an Outpost is similar to creating Amazon EKS nodes in the AWS Cloud. When you create an Amazon EKS node on an Outpost, you must specify a subnet associated with your Outpost.

An Outpost is an extension of an AWS Region, and you can extend a VPC in an account to span multiple Availability Zones and any associated Outpost locations. When you configure your Outpost, you associate a subnet with it to extend your Regional VPC environment to your on-premises facility. Instances on an Outpost appear as part of your Regional VPC, similar to an Availability Zone with associated subnets.



To create Amazon EKS nodes on an Outpost with the AWS CLI, specify a security group and a subnet associated with your Outpost.

### To create an Amazon EKS node group on an Outpost

1. Create a VPC.

```
aws ec2 create-vpc --cidr-block 10.0.0.0/16
```

2. Create Outpost subnets. The `--outpost-arn` parameter must be specified for the subnet to be created for the Outpost. (This step is different for AWS Outposts.)

```
aws ec2 create-subnet --vpc-id vpc-xxxxxxx --cidr-block 10.0.3.0/24 \
  --outpost-arn arn:aws:outposts:us-west-2:123456789012:outpost/op-xxxxxxxxxxxxxxxxx
```

3. Create a cluster, specifying the subnets for the Outpost. (This step is different for AWS Outposts.)

```
aws eks --region region-code create-cluster --name eks-outpost --role-arn \
  arn:aws:iam::123456789012:role/eks-service-role-AWSServiceRoleForAmazonEKS-OUTPOST \
  --resources-vpc-config subnetIds=subnet-xxxxxxx,subnet-
  yyyyyyy,securityGroupIds=sg-xxxxxxx
```

4. Create the node group. Specify an instance type that is available on your Outpost. (This step is different for AWS Outposts.)

```
eksctl create nodegroup --cluster eks-outpost \
  --version auto \
  --name outpost-nodes \
  --node-type c5.large \
  --node-ami auto \
```

```
--nodes      3 \  
--nodes-min   1 \  
--nodes-max   4
```

5. Deploy applications and services.

```
kubectl apply -f kubernetes/deployment.yaml
```

## Deep Learning Containers

AWS Deep Learning Containers are a set of Docker images for training and serving models in TensorFlow on Amazon EKS and Amazon Elastic Container Service (Amazon ECS). Deep Learning Containers provide optimized environments with TensorFlow, Nvidia CUDA (for GPU instances), and Intel MKL (for CPU instances) libraries and are available in Amazon ECR.

To get started using AWS Deep Learning Containers on Amazon EKS, see [AWS Deep Learning Containers on Amazon EKS](#) in the *AWS Deep Learning AMI Developer Guide*.

## Tutorial: Configure App Mesh integration with Kubernetes

When you integrate AWS App Mesh with Kubernetes using the App Mesh controller for Kubernetes, you manage App Mesh resources, such as meshes, virtual services, virtual nodes, virtual routers, and routes through Kubernetes. You also automatically add the App Mesh sidecar container images to Kubernetes pod specifications. This tutorial guides you through the installation of the App Mesh controller for Kubernetes to enable this integration.

The controller is accompanied by the deployment of the following Kubernetes custom resource definitions: `meshes`, `virtual services`, `virtual nodes`, and `virtual routers`. The controller watches for creation, modification, and deletion of the custom resources and makes changes to the corresponding App Mesh [mesh](#), [virtual service](#), [virtual node](#), [virtual gateway](#), [gateway route](#), and [virtual router](#) (including [route](#)) resources through the App Mesh API. To learn more or contribute to the controller, see the [GitHub project](#).

The controller also installs a webhook that injects the following containers into Kubernetes pods that are labeled with a name that you specify.

- **App Mesh Envoy proxy** – Envoy uses the configuration defined in the App Mesh control plane to determine where to send your application traffic.
- **App Mesh proxy route manager** – Updates `iptables` rules in a pod's network namespace that route ingress and egress traffic through Envoy. This container runs as a Kubernetes init container inside of the pod.

## Prerequisites

- An existing understanding of App Mesh concepts. For more information, see [What is AWS App Mesh](#).
- An existing Kubernetes cluster running version 1.13 or later. If you don't have an existing cluster, you can deploy one using the [Getting Started with Amazon EKS](#) guide. If you're running your own Kubernetes cluster on Amazon EC2, then ensure that Docker is authenticated to the Amazon ECR repository that the Envoy image is in. For more information, see [Envoy image](#) and [Registry authentication](#) in the AWS documentation and [Pull an Image from a Private Registry](#) in the Kubernetes documentation.

- The AWS CLI version 1.18.116 or later or 2.0.38 or later installed. To install or upgrade the AWS CLI, see [Installing the AWS CLI](#).
- A `kubectl` client that is configured to communicate with your Kubernetes cluster. If you're using Amazon Elastic Kubernetes Service, you can use the instructions for installing `kubectl` and configuring a `kubeconfig` file.
- Helm version 3.0 or later installed. If you don't have Helm installed, you can install it by completing the instructions in [Using Helm with Amazon EKS](#).

## Step 1: Install the integration components

Install the integration components one time to each cluster that hosts pods that you want to use with App Mesh.

### To install the integration components

1. The remaining steps of this procedure require a cluster without a pre-release version of the controller installed. If you have installed a pre-release version, or are not sure whether you have, you can download and run a script that will check to see whether a pre-release version is installed on your cluster.

```
curl -o pre_upgrade_check.sh https://raw.githubusercontent.com/aws/eks-charts/master/stable/appmesh-controller/upgrade/pre_upgrade_check.sh
./pre_upgrade_check.sh
```

If the script returns `Your cluster is ready for upgrade`. Please proceed to the installation instructions then you can proceed to the next step. If a different message is returned, then you'll need to complete the upgrade steps before continuing. For more information about upgrading a pre-release version, see [Upgrade](#) on GitHub.

2. Add the `eks-charts` repository to Helm.

```
helm repo add eks https://aws.github.io/eks-charts
```

3. Install the App Mesh Kubernetes custom resource definitions (CRD).

```
kubectl apply -k "https://github.com/aws/eks-charts/stable/appmesh-controller/crds?ref=master"
```

4. Create a Kubernetes namespace for the controller.

```
kubectl create ns appmesh-system
```

5. Set the following variables for use in later steps. Replace `cluster-name` and `region-code` with the values for your existing cluster.

```
export CLUSTER_NAME=cluster-name
export AWS_REGION=region-code
```

6. (Optional) If you want to run the controller on Fargate, then you need to create a Fargate profile. If you don't have `eksctl` installed, you can install it with the instructions in [Installing or Upgrading eksctl](#). If you'd prefer to create the profile using the console, see [Creating a Fargate profile](#).

```
eksctl create fargateprofile --cluster $CLUSTER_NAME --name appmesh-system --
namespace appmesh-system
```



7. Create an OpenID Connect (OIDC) identity provider for your cluster. If you don't have `eksctl` installed, you can install it with the instructions in [Installing or upgrading eksctl](#). If you'd prefer to create the provider using the console, see [Enabling IAM roles for service accounts on your cluster](#).

```
eksctl utils associate-iam-oidc-provider \
  --region=$AWS_REGION \
  --cluster $CLUSTER_NAME \
  --approve
```

8. Create an IAM role, attach the [AWSAppMeshFullAccess](#) and [AWSCloudMapFullAccess](#) AWS managed policies to it, and bind it to the `appmesh-controller` Kubernetes service account. The role enables the controller to add, remove, and change App Mesh resources.

#### Note

The command creates an AWS IAM role with an auto-generated name. You are not able to specify the IAM role name that is created.

```
eksctl create iamserviceaccount \
  --cluster $CLUSTER_NAME \
  --namespace appmesh-system \
  --name appmesh-controller \
  --attach-policy-arn arn:aws:iam::aws:policy/
AWSCloudMapFullAccess,arn:aws:iam::aws:policy/AWSAppMeshFullAccess \
  --override-existing-serviceaccounts \
  --approve
```

If you prefer to create the service account using the AWS Management Console or AWS CLI, see [Creating an IAM role and policy for your service account](#). If you use the AWS Management Console or AWS CLI to create the account, you also need to map the role to a Kubernetes service account. For more information, see [Specifying an IAM role for your service account](#).

9. Deploy the App Mesh controller. For a list of all configuration options, see [Configuration](#) on GitHub.

```
helm upgrade -i appmesh-controller eks/appmesh-controller \
  --namespace appmesh-system \
  --set region=$AWS_REGION \
  --set serviceAccount.create=false \
  --set serviceAccount.name=appmesh-controller
```

#### Important

If your cluster is in the `me-south-1` or `ap-east-1` Regions, then you need to add the following option to the previous command:

```
--set sidecar.image.repository=account-id.dkr.ecr.region-code.amazonaws.com/aws-
appmesh-envoy
```

Replace **account-id** and **region-code** with one of the appropriate sets of values.

- 772975370895.dkr.ecr.me-south-1.amazonaws.com/aws-appmesh-envoy:v1.15.0.0-prod
- 856666278305.dkr.ecr.ap-east-1.amazonaws.com/aws-appmesh-envoy:v1.15.0.0-prod

10. Confirm that the controller version is `v1.0.0` or later. You can review the [change log](#) on GitHub.

```
kubectl get deployment appmesh-controller \
  -n appmesh-system \
  -o json | jq -r ".spec.template.spec.containers[].image" | cut -f2 -d ':'
```

### Note

If you view the log for the running container, you may see a line that includes the following text, which can be safely ignored.

```
Neither -kubeconfig nor -master was specified. Using the inClusterConfig. This might not work.
```

## Step 2: Deploy App Mesh resources

When you deploy an application in Kubernetes, you also create the Kubernetes custom resources so that the controller can create the corresponding App Mesh resources. The following procedure helps you deploy App Mesh resources with some of their features. You can find example manifests for deploying other App Mesh resource features in the `v1beta2` sub-folders of many of the feature folders listed at [App Mesh walkthroughs](#) on GitHub.

### Important

Once the controller has created an App Mesh resource, we recommend that you only make changes to, or delete the App Mesh resource, using the controller. If you make changes to or delete the resource using App Mesh, the controller won't change or recreate the changed or deleted App Mesh resource for ten hours, by default. You can configure this duration to be less. For more information, see [Configuration](#) on GitHub.

### To deploy App Mesh resources

1. Create a Kubernetes namespace to deploy App Mesh resources to.
  - a. Save the following contents to a file named `namespace.yaml` on your computer.

```
apiVersion: v1
kind: Namespace
metadata:
  name: my-apps
  labels:
    mesh: my-mesh
    appmesh.k8s.aws/sidecarInjectorWebhook: enabled
```

- b. Create the namespace.

```
kubectl apply -f namespace.yaml
```

2. Create an App Mesh service mesh.
  - a. Save the following contents to a file named `mesh.yaml` on your computer. The file will be used to create a mesh resource named `my-mesh`. A service mesh is a logical boundary for network traffic between the services that reside within it.

```
apiVersion: appmesh.k8s.aws/v1beta2
kind: Mesh
metadata:
  name: my-mesh
spec:
  namespaceSelector:
    matchLabels:
      mesh: my-mesh
```

- b. Create the mesh.

```
kubectl apply -f mesh.yaml
```

- c. View the details of the Kubernetes mesh resource that was created.

```
kubectl describe mesh my-mesh
```

#### Output

```
Name:          my-mesh
Namespace:
Labels:        <none>
Annotations:   kubectl.kubernetes.io/last-applied-configuration:
                {"apiVersion":"appmesh.k8s.aws/v1beta2","kind":"Mesh","metadata":
                {"annotations":{},"name":"my-mesh"},"spec":{"namespaceSelector":{"matchLa...
API Version:   appmesh.k8s.aws/v1beta2
Kind:          Mesh
Metadata:
  Creation Timestamp:  2020-06-17T14:51:37Z
  Finalizers:
    finalizers.appmesh.k8s.aws/mesh-members
    finalizers.appmesh.k8s.aws/aws-appmesh-resources
  Generation:         1
  Resource Version:    6295
  Self Link:           /apis/appmesh.k8s.aws/v1beta2/meshes/my-mesh
  UID:                111a11b1-c11d-1e1f-gh1i-j11k1111m711
Spec:
  Aws Name:  my-mesh
  Namespace Selector:
    Match Labels:
      Mesh:  my-mesh
Status:
  Conditions:
    Last Transition Time:  2020-06-17T14:51:37Z
    Status:               True
    Type:                 MeshActive
  Mesh ARN:              arn:aws:appmesh:us-west-2:111122223333:mesh/my-mesh
  Observed Generation:    1
  Events:                 <none>
```

- d. View the details about the App Mesh service mesh that the controller created.

```
aws appmesh describe-mesh --mesh-name my-mesh
```

#### Output

```
{
  "mesh": {
    "meshName": "my-mesh",
    "metadata": {
      "arn": "arn:aws:appmesh:us-west-2:111122223333:mesh/my-mesh",
      "createdAt": "2020-06-17T09:51:37.920000-05:00",
      "lastUpdatedAt": "2020-06-17T09:51:37.920000-05:00",
      "meshOwner": "111122223333",
      "resourceOwner": "111122223333",
      "uid": "111a11b1-c11d-1e1f-gh1i-j11k1111m711",
      "version": 1
    },
    "spec": {},
    "status": {
      "status": "ACTIVE"
    }
  }
}
```

```
}  
  }  
}
```

3. Create an App Mesh virtual node. A virtual node acts as a logical pointer to a Kubernetes deployment.
  - a. Save the following contents to a file named `virtual-node.yaml` on your computer. The file will be used to create an App Mesh virtual node named `my-service-a` in the `my-apps` namespace. The virtual node represents a Kubernetes service that is created in a later step. The value for `hostname` is the fully qualified DNS hostname of the actual service that this virtual node represents.

```
apiVersion: appmesh.k8s.aws/v1beta2  
kind: VirtualNode  
metadata:  
  name: my-service-a  
  namespace: my-apps  
spec:  
  podSelector:  
    matchLabels:  
      app: my-app-1  
  listeners:  
    - portMapping:  
        port: 80  
        protocol: http  
  serviceDiscovery:  
    dns:  
      hostname: my-service-a.my-apps.svc.cluster.local
```

Virtual nodes have capabilities, such as end-to-end encryption and health checks, that aren't covered in this tutorial. For more information, see [Virtual nodes](#). To see all available settings for a virtual node that you can set in the preceding spec, run the following command.

```
aws appmesh create-virtual-node --generate-cli-skeleton yaml-input
```

- b. Deploy the virtual node.

```
kubectl apply -f virtual-node.yaml
```

- c. View the details of the Kubernetes virtual node resource that was created.

```
kubectl describe virtualnode my-service-a -n my-apps
```

#### Output

```
Name:          my-service-a  
Namespace:    my-apps  
Labels:       <none>  
Annotations:  kubectl.kubernetes.io/last-applied-configuration:  
               {"apiVersion":"appmesh.k8s.aws/v1beta2","kind":"VirtualNode","metadata":{"annotations":{},"name":"my-service-a","namespace":"my-app-1"},"s...  
API Version:  appmesh.k8s.aws/v1beta2  
Kind:        VirtualNode  
Metadata:  
  Creation Timestamp:  2020-06-17T14:57:29Z  
  Finalizers:  
    finalizers.appmesh.k8s.aws/aws-appmesh-resources  
  Generation:         2
```

```
Resource Version: 22545
Self Link: /apis/appmesh.k8s.aws/v1beta2/namespaces/my-apps/virtualnodes/
my-service-a
UID: 111a11b1-c11d-1e1f-gh1i-j11k11111m711
Spec:
  Aws Name: my-service-a_my-apps
  Listeners:
    Port Mapping:
      Port: 80
      Protocol: http
  Mesh Ref:
    Name: my-mesh
    UID: 111a11b1-c11d-1e1f-gh1i-j11k11111m711
  Pod Selector:
    Match Labels:
      App: nginx
  Service Discovery:
    Dns:
      Hostname: my-service-a.my-apps.svc.cluster.local
Status:
  Conditions:
    Last Transition Time: 2020-06-17T14:57:29Z
    Status: True
    Type: VirtualNodeActive
  Observed Generation: 2
  Virtual Node ARN: arn:aws:appmesh:us-west-2:11112223333:mesh/my-mesh/
virtualNode/my-service-a_my-apps
Events: <none>
```

- d. View the details of the virtual node that the controller created in App Mesh.

#### Note

Even though the name of the virtual node created in Kubernetes is `my-service-a`, the name of the virtual node created in App Mesh is `my-service-a_my-app-1`. The controller appends the Kubernetes namespace name to the App Mesh virtual node name when it creates the App Mesh resource. The namespace name is added because in Kubernetes you can create virtual nodes with the same name in different namespaces, but in App Mesh a virtual node name must be unique within a mesh.

```
aws appmesh describe-virtual-node --mesh-name my-mesh --virtual-node-name my-
service-a_my-apps
```

#### Output

```
{
  "virtualNode": {
    "meshName": "my-mesh",
    "metadata": {
      "arn": "arn:aws:appmesh:us-west-2:11112223333:mesh/my-mesh/
virtualNode/my-service-a_my-apps",
      "createdAt": "2020-06-17T09:57:29.840000-05:00",
      "lastUpdatedAt": "2020-06-17T09:57:29.840000-05:00",
      "meshOwner": "11112223333",
      "resourceOwner": "11112223333",
      "uid": "111a11b1-c11d-1e1f-gh1i-j11k11111m711",
      "version": 1
    },
    "spec": {
      "backends": [],
      "listeners": [
        {
          "portMapping": {
            "port": 80,
```

```
        "protocol": "http"
      }
    },
    "serviceDiscovery": {
      "dns": {
        "hostname": "my-service-a.my-apps.svc.cluster.local"
      }
    }
  },
  "status": {
    "status": "ACTIVE"
  },
  "virtualNodeName": "my-service-a_my-apps"
}
```

4. Create an App Mesh virtual router. Virtual routers handle traffic for one or more virtual services within your mesh.
  - a. Save the following contents to a file named `virtual-router.yaml` on your computer. The file will be used to create a virtual router to route traffic to the virtual node named `my-service-a` that was created in the previous step. The controller will create the App Mesh virtual router and route resources. You can specify many more capabilities for your routes and use protocols other than `http`. For more information, see [Virtual routers](#) and [Routes](#). Notice that the virtual node name referenced is the Kubernetes virtual node name, not the App Mesh virtual node name that was created in App Mesh by the controller.

```
apiVersion: appmesh.k8s.aws/v1beta2
kind: VirtualRouter
metadata:
  namespace: my-apps
  name: my-service-a-virtual-router
spec:
  listeners:
    - portMapping:
        port: 80
        protocol: http
  routes:
    - name: my-service-a-route
      httpRoute:
        match:
          prefix: /
        action:
          weightedTargets:
            - virtualNodeRef:
                name: my-service-a
                weight: 1
```

(Optional) To see all available settings for a virtual router that you can set in the preceding spec, run any of the following command.

```
aws appmesh create-virtual-router --generate-cli-skeleton yaml-input
```

To see all available settings for a route that you can set in the preceding spec, run any of the following command.

```
aws appmesh create-route --generate-cli-skeleton yaml-input
```

- b. Deploy the virtual router.

```
kubectl apply -f virtual-router.yaml
```

- c. View the Kubernetes virtual router resource that was created.

```
kubectl describe virtualrouter my-service-a-virtual-router -n my-apps
```

Abbreviated output

```
Name:          my-service-a-virtual-router
Namespace:     my-app-1
Labels:        <none>
Annotations:   kubectl.kubernetes.io/last-applied-configuration:
                {"apiVersion":"appmesh.k8s.aws/v1beta2","kind":"VirtualRouter","metadata":{"annotations":{},"name":"my-service-a-
                virtual-router"},"namespace":"my-apps"}
API Version:   appmesh.k8s.aws/v1beta2
Kind:          VirtualRouter
...
Spec:
  Aws Name:    my-service-a-virtual-router_my-apps
  Listeners:
    Port Mapping:
      Port:     80
      Protocol: http
  Mesh Ref:
    Name: my-mesh
    UID:  111a11b1-c11d-1e1f-gh1i-j11k1111m711
  Routes:
    Http Route:
      Action:
        Weighted Targets:
          Virtual Node Ref:
            Name: my-service-a
            Weight: 1
        Match:
          Prefix: /
      Name: my-service-a-route
  Status:
    Conditions:
      Last Transition Time: 2020-06-17T15:14:01Z
      Status:              True
      Type:                VirtualRouterActive
    Observed Generation:  1
    Route ARNs:
      My - Service - A - Route: arn:aws:appmesh:us-west-2:11122223333:mesh/my-mesh/
                                virtualRouter/my-service-a-virtual-router_my-apps/route/my-service-a-route
      Virtual Router ARN:      arn:aws:appmesh:us-west-2:11122223333:mesh/my-mesh/
                                virtualRouter/my-service-a-virtual-router_my-apps
    Events:                   <none>
```

- d. View the virtual router resource that the controller created in App Mesh. You specify `my-service-a-virtual-router_my-app-1` for name, because when the controller created the virtual router in App Mesh, it appended the Kubernetes namespace name to the name of the virtual router.

```
aws appmesh describe-virtual-router --virtual-router-name my-service-a-virtual-
router_my-apps --mesh-name my-mesh
```

Output

```
{
  "virtualRouter": {
    "meshName": "my-mesh",
    "metadata": {
      "arn": "arn:aws:appmesh:us-west-2:111122223333:mesh/my-mesh/virtualRouter/my-service-a-virtual-router_my-apps",
      "createdAt": "2020-06-17T10:14:01.547000-05:00",
      "lastUpdatedAt": "2020-06-17T10:14:01.547000-05:00",
      "meshOwner": "111122223333",
      "resourceOwner": "111122223333",
      "uid": "111a11b1-c11d-1e1f-gh1i-j11k1111m711",
      "version": 1
    },
    "spec": {
      "listeners": [
        {
          "portMapping": {
            "port": 80,
            "protocol": "http"
          }
        }
      ]
    },
    "status": {
      "status": "ACTIVE"
    },
    "virtualRouterName": "my-service-a-virtual-router_my-apps"
  }
}
```

- e. View the route resource that the controller created in App Mesh. A route resource was not created in Kubernetes because the route is part of the virtual router configuration in Kubernetes. The route information was shown in the Kubernetes resource detail in sub-step c. The controller did not append the Kubernetes namespace name to the App Mesh route name when it created the route in App Mesh because route names are unique to a virtual router.

```
aws appmesh describe-route \
  --route-name my-service-a-route \
  --virtual-router-name my-service-a-virtual-router_my-apps \
  --mesh-name my-mesh
```

#### Output

```
{
  "route": {
    "meshName": "my-mesh",
    "metadata": {
      "arn": "arn:aws:appmesh:us-west-2:111122223333:mesh/my-mesh/virtualRouter/my-service-a-virtual-router_my-apps/route/my-service-a-route",
      "createdAt": "2020-06-17T10:14:01.577000-05:00",
      "lastUpdatedAt": "2020-06-17T10:14:01.577000-05:00",
      "meshOwner": "111122223333",
      "resourceOwner": "111122223333",
      "uid": "111a11b1-c11d-1e1f-gh1i-j11k1111m711",
      "version": 1
    },
    "routeName": "my-service-a-route",
    "spec": {
      "httpRoute": {
        "action": {
          "weightedTargets": [
```



```
        {
          "virtualNode": "my-service-a_my-apps",
          "weight": 1
        }
      ],
    },
    "match": {
      "prefix": "/"
    }
  }
},
"status": {
  "status": "ACTIVE"
},
"virtualRouterName": "my-service-a-virtual-router_my-apps"
}
```

5. Create an App Mesh virtual service. A virtual service is an abstraction of a real service that is provided by a virtual node directly or indirectly by means of a virtual router. Dependent services call your virtual service by its name. Though the name doesn't matter to App Mesh, we recommend naming the virtual service the fully qualified domain name of the actual service that the virtual service represents. By naming your virtual services this way, you don't need to change your application code to reference a different name. The requests are routed to the virtual node or virtual router that is specified as the provider for the virtual service.
  - a. Save the following contents to a file named `virtual-service.yaml` on your computer. The file will be used to create a virtual service that uses a virtual router provider to route traffic to the virtual node named `my-service-a` that was created in a previous step. The value for `awsName` in the `spec` is the fully qualified domain name (FQDN) of the actual Kubernetes service that this virtual service abstracts. The Kubernetes service is created in [the section called "Step 3: Create or update services" \(p. 307\)](#). For more information, see [Virtual services](#).

```
apiVersion: appmesh.k8s.aws/v1beta2
kind: VirtualService
metadata:
  name: my-service-a
  namespace: my-apps
spec:
  awsName: my-service-a.my-apps.svc.cluster.local
  provider:
    virtualRouter:
      virtualRouterRef:
        name: my-service-a-virtual-router
```

To see all available settings for a virtual service that you can set in the preceding spec, run the following command.

```
aws appmesh create-virtual-service --generate-cli-skeleton yaml-input
```

- b. Create the virtual service.

```
kubectl apply -f virtual-service.yaml
```

- c. View the details of the Kubernetes virtual service resource that was created.

```
kubectl describe virtualservice my-service-a -n my-apps
```

Output

```
Name:          my-service-a
Namespace:     my-app-1
Labels:        <none>
Annotations:   kubectl.kubernetes.io/last-applied-configuration:
                {"apiVersion":"appmesh.k8s.aws/v1beta2","kind":"VirtualService","metadata":{"annotations":{},"name":"my-service-
a","namespace":"my-app-1"}}...
API Version:   appmesh.k8s.aws/v1beta2
Kind:          VirtualService
Metadata:
  Creation Timestamp:  2020-06-17T15:48:40Z
  Finalizers:
    finalizers.appmesh.k8s.aws/aws-appmesh-resources
  Generation:         1
  Resource Version:    13598
  Self Link:           /apis/appmesh.k8s.aws/v1beta2/namespaces/my-apps/
virtualservices/my-service-a
  UID:                 111a11b1-c11d-1e1f-gh1i-j11k1111m711
Spec:
  Aws Name:  my-service-a.my-apps.svc.cluster.local
  Mesh Ref:
    Name:  my-mesh
    UID:  111a11b1-c11d-1e1f-gh1i-j11k1111m711
  Provider:
    Virtual Router:
      Virtual Router Ref:
        Name:  my-service-a-virtual-router
Status:
  Conditions:
    Last Transition Time:  2020-06-17T15:48:40Z
    Status:               True
    Type:                 VirtualServiceActive
    Observed Generation:  1
    Virtual Service ARN:  arn:aws:appmesh:us-west-2:111122223333:mesh/my-mesh/
virtualservice/my-service-a.my-apps.svc.cluster.local
  Events:  <none>
```

- d. View the details of the virtual service resource that the controller created in App Mesh. The Kubernetes controller did not append the Kubernetes namespace name to the App Mesh virtual service name when it created the virtual service in App Mesh because the virtual service's name is a unique FQDN.

```
aws appmesh describe-virtual-service --virtual-service-name my-service-a.my-
apps.svc.cluster.local --mesh-name my-mesh
```

#### Output

```
{
  "virtualService": {
    "meshName": "my-mesh",
    "metadata": {
      "arn": "arn:aws:appmesh:us-west-2:111122223333:mesh/my-mesh/
virtualService/my-service-a.my-apps.svc.cluster.local",
      "createdAt": "2020-06-17T10:48:40.182000-05:00",
      "lastUpdatedAt": "2020-06-17T10:48:40.182000-05:00",
      "meshOwner": "111122223333",
      "resourceOwner": "111122223333",
      "uid": "111a11b1-c11d-1e1f-gh1i-j11k1111m711",
      "version": 1
    },
    "spec": {
      "provider": {
```

```
        "virtualRouter": {
            "virtualRouterName": "my-service-a-virtual-router_my-apps"
        }
    },
    "status": {
        "status": "ACTIVE"
    },
    "virtualServiceName": "my-service-a.my-apps.svc.cluster.local"
}
}
```

Though not covered in this tutorial, the controller can also deploy App Mesh [virtual gateways](#) and [gateway routes](#). For a walkthrough of deploying these resources with the controller, see [Configuring Ingress Gateway](#), or a [sample manifest](#) that includes the resources on GitHub.

## Step 3: Create or update services

Any pods that you want to use with App Mesh must have the App Mesh sidecar containers added to them. The injector automatically adds the sidecar containers to any pod deployed with a label that you specify.

1. Enable proxy authorization. We recommend that you enable each Kubernetes deployment to stream only the configuration for its own App Mesh virtual node.
  - a. Save the following contents to a file named `proxy-auth.json` on your computer. Make sure to replace the *alternate-colored values* with your own.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": "appmesh:StreamAggregatedResources",
      "Resource": [
        "arn:aws:appmesh:region-code:111122223333:mesh/my-mesh/virtualNode/my-service-a_my-apps"
      ]
    }
  ]
}
```

- b. Create the policy.

```
aws iam create-policy --policy-name my-policy --policy-document file://proxy-auth.json
```

- c. Create an IAM role, attach the policy you created in the previous step to it, create a Kubernetes service account and bind the policy to the Kubernetes service account. The role enables the controller to add, remove, and change App Mesh resources.

```
eksctl create iamserviceaccount \
  --cluster $CLUSTER_NAME \
  --namespace my-apps \
  --name my-service-a \
  --attach-policy-arn arn:aws:iam::111122223333:policy/my-policy \
  --override-existing-serviceaccounts \
  --approve
```

If you prefer to create the service account using the AWS Management Console or AWS CLI, see [Creating an IAM Role and policy for your service account](#). If you use the AWS Management Console or AWS CLI to create the account, you also need to map the role to a Kubernetes service account. For more information, see [Specifying an IAM role for your service account](#).

2. (Optional) If you want to deploy your deployment to Fargate pods, then you need to create a Fargate profile. If you don't have `eksctl` installed, you can install it with the instructions in [Installing or Upgrading eksctl](#). If you'd prefer to create the profile using the console, see [Creating a Fargate profile](#).

```
eksctl create fargateprofile --cluster my-cluster --region region-code --name my-service-a --namespace my-apps
```

3. Create a Kubernetes service and deployment. If you have an existing deployment that you want to use with App Mesh, then you need to deploy a virtual node, as you did in sub-step 3 of [the section called "Step 2: Deploy App Mesh resources" \(p. 298\)](#), and update your deployment to make sure that its label matches the label that you set on the virtual node, so that the sidecar containers are automatically added to the pods and the pods are redeployed.
  - a. Save the following contents to a file named `example-service.yaml` on your computer. If you change the namespace name and are using Fargate pods, make sure that the namespace name matches the namespace name that you defined in your Fargate profile.

```
apiVersion: v1
kind: Service
metadata:
  name: my-service-a
  namespace: my-apps
  labels:
    app: my-app-1
spec:
  selector:
    app: my-app-1
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: my-service-a
  namespace: my-apps
  labels:
    app: my-app-1
spec:
  replicas: 3
  selector:
    matchLabels:
      app: my-app-1
  template:
    metadata:
      labels:
        app: my-app-1
    spec:
      serviceAccountName: my-service-a
      containers:
        - name: nginx
          image: nginx:1.19.0
          ports:
            - containerPort: 80
```

### Important

The value for the `app matchLabels` selector in the spec must match the value that you specified when you created the virtual node in sub-step 3 of [the section called "Step 2: Deploy App Mesh resources" \(p. 298\)](#), or the sidecar containers won't be injected into the pod. In the previous example, the value for the label is `my-app-1`. If you deploy a virtual gateway, rather than a virtual node, then the Deployment manifest should include only the Envoy container. For more information about the image to use, see [Envoy image](#). For a sample manifest, see the [deployment example](#) on GitHub.

- b. Deploy the service.

```
kubectl apply -f example-service.yaml
```

- c. View the service and deployment.

```
kubectl -n my-apps get pods
```

### Output

NAME	READY	STATUS	RESTARTS	AGE
my-service-a-54776556f6-2cxd9	2/2	Running	0	10s
my-service-a-54776556f6-w26kf	2/2	Running	0	18s
my-service-a-54776556f6-zw5kt	2/2	Running	0	26s

- d. View the details for one of the pods that was deployed.

```
kubectl -n my-apps describe pod my-service-a-54776556f6-2cxd9
```

### Abbreviated output

```
Name:          my-service-a-54776556f6-2cxd9
Namespace:     my-app-1
Priority:       0
Node:          ip-192-168-44-157.us-west-2.compute.internal/192.168.44.157
Start Time:    Wed, 17 Jun 2020 11:08:59 -0500
Labels:        app=nginx
               pod-template-hash=54776556f6
Annotations:   kubernetes.io/psp: eks.privileged
Status:        Running
IP:            192.168.57.134
IPs:
  IP:          192.168.57.134
Controlled By: ReplicaSet/my-service-a-54776556f6
Init Containers:
  proxyinit:
    Container ID:  docker://
e0c4810d584c21ae0cb6e40f6119d2508f029094d0e01c9411c6cf2a32d77a59
    Image:         111345817488.dkr.ecr.us-west-2.amazonaws.com/aws-appmesh-proxy-
route-manager:v2
    Image ID:      docker-pullable://111345817488.dkr.ecr.us-west-2.amazonaws.com/
aws-appmesh-proxy-route-manager
    Port:          <none>
    Host Port:     <none>
    State:         Terminated
      Reason:      Completed
      Exit Code:    0
      Started:     Fri, 26 Jun 2020 08:36:22 -0500
      Finished:    Fri, 26 Jun 2020 08:36:22 -0500
```

```

Ready:      True
Restart Count: 0
Requests:
  cpu:      10m
  memory:   32Mi
Environment:
  APPMESH_START_ENABLED:      1
  APPMESH_IGNORE_UID:         1337
  APPMESH_ENVOY_INGRESS_PORT: 15000
  APPMESH_ENVOY_EGRESS_PORT:  15001
  APPMESH_APP_PORTS:          80
  APPMESH_EGRESS_IGNORED_IP:  169.254.169.254
  APPMESH_EGRESS_IGNORED_PORTS: 22
  AWS_ROLE_ARN:                arn:aws:iam::111122223333:role/eksctl-app-
mesh-addon-iamserviceaccount-my-a-Role1-NMNCVWB6PL0N
  AWS_WEB_IDENTITY_TOKEN_FILE: /var/run/secrets/eks.amazonaws.com/
serviceaccount/token
...
Containers:
  nginx:
    Container ID:  docker://
be6359dc6ecd3f18a1c87df7b57c2093e1f9db17d5b3a77f22585ce3bcab137a
    Image:         nginx:1.19.0
    Image ID:      docker-pullable://nginx
    Port:          80/TCP
    Host Port:     0/TCP
    State:         Running
      Started:     Fri, 26 Jun 2020 08:36:28 -0500
    Ready:         True
    Restart Count: 0
    Environment:
      AWS_ROLE_ARN:                arn:aws:iam::111122223333:role/eksctl-app-mesh-
addon-iamserviceaccount-my-a-Role1-NMNCVWB6PL0N
      AWS_WEB_IDENTITY_TOKEN_FILE: /var/run/secrets/eks.amazonaws.com/
serviceaccount/token
    ...
  envoy:
    Container ID:
docker://905b55cbf33ef3b3debc51cb448401d24e2e7c2dbfc6a9754a2c49dd55a216b6
    Image:         840364872350.dkr.ecr.us-west-2.amazonaws.com/aws-appmesh-
envoy:v1.12.4.0-prod
    Image ID:      docker-pullable://840364872350.dkr.ecr.us-west-2.amazonaws.com/
aws-appmesh-envoy
    Port:          9901/TCP
    Host Port:     0/TCP
    State:         Running
      Started:     Fri, 26 Jun 2020 08:36:36 -0500
    Ready:         True
    Restart Count: 0
    Requests:
      cpu:      10m
      memory:   32Mi
    Environment:
      APPMESH_VIRTUAL_NODE_NAME:  mesh/my-mesh/virtualNode/my-service-a_my-apps
      APPMESH_PREVIEW:            0
      ENVOY_LOG_LEVEL:            info
      AWS_REGION:                 us-west-2
      AWS_ROLE_ARN:                arn:aws:iam::111122223333:role/eksctl-app-mesh-
addon-iamserviceaccount-my-a-Role1-NMNCVWB6PL0N
      AWS_WEB_IDENTITY_TOKEN_FILE: /var/run/secrets/eks.amazonaws.com/
serviceaccount/token
    ...
Events:
  Type    Reason      Age    From
  Message

```

```
-----  
Normal Pulling 30s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Pulling image "111345817488.dkr.ecr.us-west-2.amazonaws.com/aws-appmesh-proxy-  
route-manager:v2"  
Normal Pulled 23s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Successfully pulled image "111345817488.dkr.ecr.us-west-2.amazonaws.com/aws-  
appmesh-proxy-route-manager:v2"  
Normal Created 21s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Created container proxyinit  
Normal Started 21s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Started container proxyinit  
Normal Pulling 20s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Pulling image "nginx:1.19.0"  
Normal Pulled 16s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Successfully pulled image "nginx:1.19.0"  
Normal Created 15s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Created container nginx  
Normal Started 15s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Started container nginx  
Normal Pulling 15s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Pulling image "840364872350.dkr.ecr.us-west-2.amazonaws.com/aws-appmesh-  
envoy:v1.12.4.0-prod"  
Normal Pulled 8s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Successfully pulled image "840364872350.dkr.ecr.us-west-2.amazonaws.com/aws-  
appmesh-envoy:v1.12.4.0-prod"  
Normal Created 7s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Created container envoy  
Normal Started 7s kubelet, ip-192-168-44-157.us-west-2.compute.internal  
Started container envoy
```

In the preceding output, you can see that the proxyinit and envoy containers were added to the pod by the controller. If you deployed the example service to Fargate, then the envoy container was added to the pod by the controller, but the proxyinit container was not.

4. (Optional) Install add-ons such as Prometheus, Grafana, AWS X-Ray, Jaeger, and Datadog. For more information, see [App Mesh add-ons](#) on GitHub.

## Step 4: Clean up

Remove all of the example resources created in this tutorial. The controller also removes the resources that were created in the my-mesh App Mesh service mesh.

```
kubectl delete namespace my-apps
```

If you created a Fargate profile for the example service, then remove it.

```
eksctl delete fargateprofile --name my-service-a --cluster my-cluster --region region-code
```

Delete the mesh.

```
kubectl delete mesh my-mesh
```

(Optional) You can remove the Kubernetes integration components.

```
helm delete appmesh-controller -n appmesh-system
```

(Optional) If you deployed the Kubernetes integration components to Fargate, then delete the Fargate profile.

```
eksctl delete fargateprofile --name appmesh-system --cluster my-cluster --region region-code
```



# Amazon EKS troubleshooting

This chapter covers some common errors that you may see while using Amazon EKS and how to work around them.

## Insufficient capacity

If you receive the following error while attempting to create an Amazon EKS cluster, then one of the Availability Zones you specified does not have sufficient capacity to support a cluster.

Cannot create cluster '*example-cluster*' because *region-1d*, the targeted Availability Zone, does not currently have sufficient capacity to support the cluster. Retry and choose from these Availability Zones: *region-1a*, *region-1b*, *region-1c*

Retry creating your cluster with subnets in your cluster VPC that are hosted in the Availability Zones returned by this error message.

## Nodes fail to join cluster

There are a few common reasons that prevent nodes from joining the cluster:

- The `aws-auth-cm.yaml` file does not have the correct IAM role ARN for your nodes. Ensure that the node IAM role ARN (not the instance profile ARN) is specified in your `aws-auth-cm.yaml` file. For more information, see [Launching self-managed Amazon Linux nodes \(p. 102\)](#).
- The **ClusterName** in your node AWS CloudFormation template does not exactly match the name of the cluster you want your nodes to join. Passing an incorrect value to this field results in an incorrect configuration of the node's `/var/lib/kubelet/kubeconfig` file, and the nodes will not join the cluster.
- The node is not tagged as being *owned* by the cluster. Your nodes must have the following tag applied to them, where `<cluster-name>` is replaced with the name of your cluster.

Key	Value
<code>kubernetes.io/cluster/&lt;cluster-name&gt;</code>	owned

- The nodes may not be able to access the cluster using a public IP address. Ensure that nodes deployed in public subnets are assigned a public IP address. If not, you can associate an elastic IP address to a node after it's launched. For more information, see [Associating an elastic IP address with a running instance or network interface](#). If the public subnet is not set to automatically assign public IP addresses to instances deployed to it, then we recommend enabling that setting. For more information, see [Modifying the public IPv4 addressing attribute for your subnet](#). If the node is deployed to a private subnet, then the subnet must have a route to a NAT gateway that has a public IP address assigned to it.
- The STS endpoint for the Region that you're deploying the nodes to is not enabled for your account. To enable the region, see [Activating and deactivating AWS STS in an AWS Region](#).

## Unauthorized or access denied (kubectl)

If you receive one of the following errors while running `kubectl` commands, then your `kubectl` is not configured properly for Amazon EKS or the IAM user or role credentials that you are using do not map to a Kubernetes RBAC user with sufficient permissions in your Amazon EKS cluster.

- `could not get token: AccessDenied: Access denied`
- `error: You must be logged in to the server (Unauthorized)`
- `error: the server doesn't have a resource type "svc"`

This could be because the cluster was created with one set of AWS credentials (from an IAM user or role), and `kubectl` is using a different set of credentials.

When an Amazon EKS cluster is created, the IAM entity (user or role) that creates the cluster is added to the Kubernetes RBAC authorization table as the administrator (with `system:masters` permissions). Initially, only that IAM user can make calls to the Kubernetes API server using `kubectl`. For more information, see [Managing users or IAM roles for your cluster \(p. 225\)](#). If you use the console to create the cluster, you must ensure that the same IAM user credentials are in the AWS SDK credential chain when you are running `kubectl` commands on your cluster.

If you install and configure the AWS CLI, you can configure the IAM credentials for your user. For more information, see [Configuring the AWS CLI](#) in the *AWS Command Line Interface User Guide*.

If you assumed a role to create the Amazon EKS cluster, you must ensure that `kubectl` is configured to assume the same role. Use the following command to update your `kubeconfig` file to use an IAM role. For more information, see [Create a kubeconfig for Amazon EKS \(p. 221\)](#).

```
aws --region region-code eks update-kubeconfig --name cluster_name --role-arn  
arn:aws:iam::aws_account_id:role/role_name
```

To map an IAM user to a Kubernetes RBAC user, see [Managing users or IAM roles for your cluster \(p. 225\)](#) or watch a [video](#) about how to map a user.

## aws-iam-authenticator Not found

If you receive the error `"aws-iam-authenticator": executable file not found in $PATH`, then your `kubectl` is not configured for Amazon EKS. For more information, see [Installing aws-iam-authenticator \(p. 218\)](#).

### Note

The `aws-iam-authenticator` is not required if you have the AWS CLI version 1.16.156 or higher installed.

## hostname doesn't match

Your system's Python version must be 2.7.9 or later. Otherwise, you receive `hostname doesn't match` errors with AWS CLI calls to Amazon EKS. For more information, see [What are "hostname doesn't match" errors?](#) in the Python Requests FAQ.

## getsockopt: no route to host

Docker runs in the 172.17.0.0/16 CIDR range in Amazon EKS clusters. We recommend that your cluster's VPC subnets do not overlap this range. Otherwise, you will receive the following error:

```
Error: : error upgrading connection: error dialing backend: dial tcp 172.17.nn.nn:10250:
getsockopt: no route to host
```

## Managed node group errors

If you receive the error "Instances failed to join the kubernetes cluster" in the AWS Management Console, ensure that either the cluster's private endpoint access is enabled, or that you have correctly configured CIDR blocks for public endpoint access. For more information, see [Amazon EKS cluster endpoint access control](#) (p. 49).

If your managed node group encounters a health issue, Amazon EKS returns an error message to help you to diagnose the issue. The following error messages and their associated descriptions are shown below.

- **AutoScalingGroupNotFound:** We couldn't find the Auto Scaling group associated with the managed node group. You may be able to recreate an Auto Scaling group with the same settings to recover.
- **Ec2SecurityGroupNotFound:** We couldn't find the cluster security group for the cluster. You must recreate your cluster.
- **Ec2SecurityGroupDeletionFailure:** We could not delete the remote access security group for your managed node group. Remove any dependencies from the security group.
- **Ec2LaunchTemplateNotFound:** We couldn't find the Amazon EC2 launch template for your managed node group. You may be able to recreate a launch template with the same settings to recover.
- **Ec2LaunchTemplateVersionMismatch:** The Amazon EC2 launch template version for your managed node group does not match the version that Amazon EKS created. You may be able to revert to the version that Amazon EKS created to recover.
- **IamInstanceProfileNotFound:** We couldn't find the IAM instance profile for your managed node group. You may be able to recreate an instance profile with the same settings to recover.
- **IamNodeRoleNotFound:** We couldn't find the IAM role for your managed node group. You may be able to recreate an IAM role with the same settings to recover.
- **AsgInstanceLaunchFailures:** Your Auto Scaling group is experiencing failures while attempting to launch instances.
- **NodeCreationFailure:** Your launched instances are unable to register with your Amazon EKS cluster. Common causes of this failure are insufficient [node IAM role](#) (p. 265) permissions or lack of outbound internet access for the nodes. Your nodes must be able to access the internet using a public IP address to function properly. For more information, see [??? \(p. 171\)](#). Your nodes must also have ports open to the internet. For more information, see [??? \(p. 173\)](#).
- **InstanceLimitExceeded:** Your AWS account is unable to launch any more instances of the specified instance type. You may be able to request an Amazon EC2 instance limit increase to recover.
- **InsufficientFreeAddresses:** One or more of the subnets associated with your managed node group does not have enough available IP addresses for new nodes.
- **AccessDenied:** Amazon EKS or one or more of your managed nodes is unable to communicate with your cluster API server. For more information about resolving this error, see [the section called "Fixing AccessDenied errors for managed node groups"](#) (p. 316).
- **InternalFailure:** These errors are usually caused by an Amazon EKS server-side issue.

## Fixing AccessDenied errors for managed node groups

The most common cause of AccessDenied errors when performing operations on managed node groups is missing the `eks:node-manager` ClusterRole or ClusterRoleBinding. Amazon EKS sets up these resources in your cluster as part of onboarding with managed node groups, and these are required for managing the node groups.

The ClusterRole may change over time, but it should look similar to the following example:

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: eks:node-manager
rules:
- apiGroups:
  - ''
  resources:
  - pods
  verbs:
  - get
  - list
  - watch
  - delete
- apiGroups:
  - ''
  resources:
  - nodes
  verbs:
  - get
  - list
  - watch
  - patch
- apiGroups:
  - ''
  resources:
  - pods/eviction
  verbs:
  - create
```

The ClusterRoleBinding may change over time, but it should look similar to the following example:

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  name: eks:node-manager
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: eks:node-manager
subjects:
- apiGroup: rbac.authorization.k8s.io
  kind: User
  name: eks:node-manager
```

Verify that the `eks:node-manager` ClusterRole exists.

```
kubectl describe clusterrole eks:node-manager
```

If present, compare the output to the previous ClusterRole example.

Verify that the `eks:node-manager` `ClusterRoleBinding` exists.

```
kubectl describe clusterrolebinding eks:node-manager
```

If present, compare the output to the previous `ClusterRoleBinding` example.

If you've identified a missing or broken `ClusterRole` or `ClusterRoleBinding` as the cause of an `AccessDenied` error while requesting managed node group operations, you can restore them. Save the following contents to a file named `eks-node-manager-role.yaml`.

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: eks:node-manager
rules:
- apiGroups:
  - ''
  resources:
  - pods
  verbs:
  - get
  - list
  - watch
  - delete
- apiGroups:
  - ''
  resources:
  - nodes
  verbs:
  - get
  - list
  - watch
  - patch
- apiGroups:
  - ''
  resources:
  - pods/eviction
  verbs:
  - create
---
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  name: eks:node-manager
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: eks:node-manager
subjects:
- apiGroup: rbac.authorization.k8s.io
  kind: User
  name: eks:node-manager
```

Apply the file.

```
kubectl apply -f eks-node-manager-role.yaml
```

Retry the node group operation to see if that resolved your issue.

## CNI log collection tool

The Amazon VPC CNI plugin for Kubernetes has its own troubleshooting script (which is available on nodes at `/opt/cni/bin/aws-cni-support.sh`) that you can use to collect diagnostic logs for support cases and general troubleshooting.

Use the following command to run the script on your node:

```
sudo bash /opt/cni/bin/aws-cni-support.sh
```

### Note

If the script is not present at that location, then the CNI container failed to run. You can manually download and run the script with the following command:

```
curl -O https://raw.githubusercontent.com/aws-labs/amazon-eks-ami/master/log-collector-script/linux/eks-log-collector.sh
sudo bash eks-log-collector.sh
```

The script collects the following diagnostic information. The CNI version that you have deployed can be earlier than the script version.

```
This is version 0.6.1. New versions can be found at https://github.com/aws-labs/amazon-eks-ami

Trying to collect common operating system logs...
Trying to collect kernel logs...
Trying to collect mount points and volume information...
Trying to collect SELinux status...
Trying to collect iptables information...
Trying to collect installed packages...
Trying to collect active system services...
Trying to collect Docker daemon information...
Trying to collect kubelet information...
Trying to collect L-IPAMD information...
Trying to collect sysctls information...
Trying to collect networking information...
Trying to collect CNI configuration information...
Trying to collect running Docker containers and gather container data...
Trying to collect Docker daemon logs...
Trying to archive gathered information...

Done... your bundled logs are located in /var/log/eks_i-0717c9d54b6cfaa19_2020-03-24_0103-UTC_0.6.1.tar.gz
```

The diagnostic information is collected and stored at

```
/var/log/eks_i-0717c9d54b6cfaa19_2020-03-24_0103-UTC_0.6.1.tar.gz
```

## Container runtime network not ready

You may receive a Container runtime network not ready error and authorization errors similar to the following:

```
4191 kubelet.go:2130] Container runtime network not ready: NetworkReady=false
reason:NetworkPluginNotReady message:docker: network plugin is not ready: cni config
uninitialized
```

```
4191 reflector.go:205] k8s.io/kubernetes/pkg/kubelet/kubelet.go:452: Failed to list
*v1.Service: Unauthorized
4191 kubelet_node_status.go:106] Unable to register node "ip-10-40-175-122.ec2.internal"
with API server: Unauthorized
4191 reflector.go:205] k8s.io/kubernetes/pkg/kubelet/kubelet.go:452: Failed to list
*v1.Service: Unauthorized
```

The errors are most likely related to the AWS IAM Authenticator configuration map not being applied to the nodes. The configuration map provides the `system:bootstrappers` and `system:nodes` Kubernetes RBAC permissions for nodes to register to the cluster. For more information, see **To enable nodes to join your cluster** on the **Self-managed nodes** tab of [Launching self-managed Amazon Linux nodes \(p. 102\)](#). Ensure that you specify the **Role ARN** of the instance role in the configuration map, not the **Instance Profile ARN**.

The authenticator does not recognize a **Role ARN** if it includes a [path](#) other than `/`, such as the following example:

```
arn:aws:iam::111122223333:role/development/apps/prod-iam-role-NodeInstanceRole-621LVEXAMPLE
```

When specifying a **Role ARN** in the configuration map that includes a path other than `/`, you must drop the path. The ARN above would be specified as the following:

```
arn:aws:iam::111122223333:role/prod-iam-role-NodeInstanceRole-621LVEXAMPLE
```

## TLS handshake timeout

When a node is unable to establish a connection to the public API server endpoint, you may see an error similar to the following error.

```
server.go:233] failed to run Kubelet: could not init cloud provider "aws": error finding
instance i-1111f2222f333e44c: "error listing AWS instances: \"RequestError: send request
failed\\ncaused by: Post net/http: TLS handshake timeout\\n\""
```

The `kubelet` process will continually respawn and test the API server endpoint. The error can also occur temporarily during any procedure that performs a rolling update of the cluster in the control plane, such as a configuration change or version update.

To resolve the issue, check the route table and security groups to ensure that traffic from the nodes can reach the public endpoint.

## Troubleshooting IAM

This topic covers some common errors that you may see while using Amazon EKS with IAM and how to work around them.

### AccessDeniedException

If you receive an `AccessDeniedException` when calling an AWS API operation, then the AWS Identity and Access Management (IAM) user or role credentials that you are using do not have the required permissions to make that call.

```
An error occurred (AccessDeniedException) when calling the DescribeCluster operation:
```

```
User: arn:aws:iam::111122223333:user/user_name is not authorized to perform:
eks:DescribeCluster on resource: arn:aws:eks:region:111122223333:cluster/cluster_name
```

In the above example message, the user does not have permissions to call the Amazon EKS `DescribeCluster` API operation. To provide Amazon EKS admin permissions to a user, see [Amazon EKS identity-based policy examples \(p. 257\)](#).

For more general information about IAM, see [Controlling access using policies](#) in the *IAM User Guide*.

## aws-auth ConfigMap does not grant access to the cluster

[AWS IAM authenticator](#) does not permit a path in the role ARN used in the configuration map. Therefore, before you specify `rolearn`, remove the path. For example, change `arn:aws:iam::123456789012:role/team/developers/eks-admin` to `arn:aws:iam::123456789012:role/eks-admin`.

## I Am not authorized to perform iam:PassRole

If you receive an error that you're not authorized to perform the `iam:PassRole` action, then you must contact your administrator for assistance. Your administrator is the person that provided you with your user name and password. Ask that person to update your policies to allow you to pass a role to Amazon EKS.

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 EKS. However, the action requires the service to have permissions 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 asks her administrator to update her policies to allow her to perform the `iam:PassRole` action.

## I want to view my access keys

After you create your IAM user access keys, you can view your access key ID at any time. However, you can't view your secret access key again. If you lose your secret key, you must create a new access key pair.

Access keys consist of two parts: an access key ID (for example, `AKIAIOSFODNN7EXAMPLE`) and a secret access key (for example, `wJalrXUtnFEMI/K7MDENG/bPxrFiCYEXAMPLEKEY`). Like a user name and password, you must use both the access key ID and secret access key together to authenticate your requests. Manage your access keys as securely as you do your user name and password.

### Important

Do not provide your access keys to a third party, even to help [find your canonical user ID](#). By doing this, you might give someone permanent access to your account.

When you create an access key pair, you are prompted to save the access key ID and secret access key in a secure location. The secret access key is available only at the time you create it. If you lose your secret access key, you must add new access keys to your IAM user. You can have a maximum of two access keys. If you already have two, you must delete one key pair before creating a new one. To view instructions, see [Managing Access Keys](#) in the *IAM User Guide*.



## I'm an administrator and want to allow others to access Amazon EKS

To allow others to access Amazon EKS, you must create an IAM entity (user or role) for the person or application that needs access. They will use the credentials for that entity to access AWS. You must then attach a policy to the entity that grants them the correct permissions in Amazon EKS.

To get started right away, see [Creating Your First IAM Delegated User and Group](#) in the *IAM User Guide*.

## I want to allow people outside of my AWS account to access my Amazon EKS 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 EKS supports these features, see [How Amazon EKS works with IAM](#) (p. 254).
- To learn how to provide access to your resources across AWS accounts that you own, see [Providing Access to an IAM User in Another AWS Account That You Own](#) in the *IAM User Guide*.
- To learn how to provide access to your resources to third-party AWS accounts, see [Providing Access to AWS Accounts Owned by Third Parties](#) in the *IAM User Guide*.
- To learn how to provide access through identity federation, see [Providing Access to Externally Authenticated Users \(Identity Federation\)](#) in the *IAM User Guide*.
- To learn the difference between using roles and resource-based policies for cross-account access, see [How IAM Roles Differ from Resource-based Policies](#) in the *IAM User Guide*.

# Related projects

These open source projects extend the functionality of Kubernetes clusters running on AWS, including clusters managed by Amazon EKS.

## Management tools

Related management tools for Amazon EKS and Kubernetes clusters.

### eksctl

`eksctl` is a simple CLI tool for creating clusters on Amazon EKS.

- Project URL: <https://eksctl.io/>
- Project documentation: <https://eksctl.io/>
- AWS open source blog: [eksctl: Amazon EKS cluster with one command](#)

### AWS service operator

AWS Service Operator allows you to create AWS resources using `kubectl`.

- Project URL: <https://github.com/aws/aws-service-operator-k8s>
- Project documentation: <https://github.com/aws/aws-service-operator-k8s/blob/master/README.md>
- AWS open source blog: [AWS service operator for Kubernetes now available](#)

### AWS controllers for Kubernetes

AWS Controllers for Kubernetes allow you to create and manage AWS resources directly from your Kubernetes cluster.

- Project URL: <https://aws.github.io/aws-controllers-k8s/>
- AWS open source blog: [AWS service operator for Kubernetes now available](#)

### Flux CD

Flux is a tool that allows you to manage your cluster configuration using Git. It uses an operator in the cluster to trigger deployments inside of Kubernetes. For more information about operators, see [Awesome Operators in the Wild](#) on GitHub.

- Project URL: <https://fluxcd.io/>
- Project documentation: <https://docs.fluxcd.io/>

### CDK for Kubernetes

The CDK for Kubernetes (`cdk8s`) lets you define Kubernetes apps and components using familiar programming languages. `cdk8s` apps synthesize into standard Kubernetes manifests which can be applied to any Kubernetes cluster.

- Project URL: <https://cdk8s.io/>
- Project documentation: <https://github.com/awslabs/cdk8s/tree/master/docs/getting-started>
- AWS containers blog: [Introducing cdk8s+: Intent-driven APIs for Kubernetes objects](#)

## Networking

Related networking projects for Amazon EKS and Kubernetes clusters.

### Amazon VPC CNI plugin for Kubernetes

Amazon EKS supports native VPC networking via the Amazon VPC CNI plugin for Kubernetes. Using this CNI plugin allows Kubernetes pods to have the same IP address inside the pod as they do on the VPC network. For more information, see [Pod networking \(CNI\)](#) (p. 176) and [CNI configuration variables](#) (p. 177).

- Project URL: <https://github.com/aws/amazon-vpc-cni-k8s>
- Project documentation: <https://github.com/aws/amazon-vpc-cni-k8s/blob/master/README.md>

### AWS Application Load Balancer (ALB) ingress controller for Kubernetes

The AWS ALB Ingress Controller satisfies Kubernetes ingress resources by provisioning Application Load Balancers.

- Project URL: <https://github.com/kubernetes-sigs/aws-alb-ingress-controller>
- Project documentation: <https://github.com/kubernetes-sigs/aws-alb-ingress-controller/tree/master/docs>
- AWS open source blog: [Kubernetes ingress with AWS ALB ingress controller](#)

### ExternalDNS

ExternalDNS synchronizes exposed Kubernetes services and ingresses with DNS providers including Amazon Route 53 and AWS Service Discovery.

- Project URL: <https://github.com/kubernetes-incubator/external-dns>
- Project documentation: <https://github.com/kubernetes-incubator/external-dns/blob/master/docs/tutorials/aws.md>

### App Mesh Controller

The App Mesh Controller for Kubernetes helps to manage App Mesh for your cluster. The controller allows you to manage the service mesh using custom resources within your cluster and manages the injection of networking proxy sidecars to pods to enable the mesh.

- Project URL: <https://github.com/aws/aws-app-mesh-controller-for-k8s>
- Project documentation: <https://docs.aws.amazon.com/app-mesh/latest/userguide/mesh-k8s-integration.html>
- AWS blog: [Getting started with App Mesh and Amazon EKS](#)

## Security

Related security projects for Amazon EKS and Kubernetes clusters.

### AWS IAM authenticator

A tool to use AWS IAM credentials to authenticate to a Kubernetes cluster if you're not using the AWS CLI version 1.16.156 or higher. For more information, see [Installing aws-iam-authenticator](#) (p. 218).

- Project URL: <https://github.com/kubernetes-sigs/aws-iam-authenticator>
- Project documentation: <https://github.com/kubernetes-sigs/aws-iam-authenticator/blob/master/README.md>
- AWS open source blog: [Deploying the AWS IAM authenticator to kops](#)

## Machine learning

Related machine learning projects for Amazon EKS and Kubernetes clusters.

### Kubeflow

A machine learning toolkit for Kubernetes.

- Project URL: <https://www.kubeflow.org/>
- Project documentation: <https://www.kubeflow.org/docs/>
- AWS open source blog: [Kubeflow on Amazon EKS](#)

## Auto Scaling

Related auto scaling projects for Amazon EKS and Kubernetes clusters.

### Cluster autoscaler

Cluster Autoscaler is a tool that automatically adjusts the size of the Kubernetes cluster based on CPU and memory pressure.

- Project URL: <https://github.com/kubernetes/autoscaler/tree/master/cluster-autoscaler>
- Project documentation: <https://github.com/kubernetes/autoscaler/blob/master/cluster-autoscaler/cloudprovider/aws/README.md>
- Amazon EKS workshop: [https://eksworkshop.com/scaling/deploy\\_ca/](https://eksworkshop.com/scaling/deploy_ca/)

### Escalator

Escalator is a batch or job optimized horizontal autoscaler for Kubernetes.

- Project URL: <https://github.com/atlassian/escalator>
- Project documentation: <https://github.com/atlassian/escalator/blob/master/docs/README.md>

## Monitoring

Related monitoring projects for Amazon EKS and Kubernetes clusters.

### Prometheus

Prometheus is an open-source systems monitoring and alerting toolkit.

- Project URL: <https://prometheus.io/>
- Project documentation: <https://prometheus.io/docs/introduction/overview/>
- Amazon EKS workshop: [https://eksworkshop.com/intermediate/240\\_monitoring/](https://eksworkshop.com/intermediate/240_monitoring/)

## Continuous integration / continuous deployment

Related CI/CD projects for Amazon EKS and Kubernetes clusters.

### Jenkins X

CI/CD solution for modern cloud applications on Amazon EKS and Kubernetes clusters.

- Project URL: <https://jenkins-x.io/>
- Project documentation: <https://jenkins-x.io/docs/>

# Document history for Amazon EKS

The following table describes the major updates and new features for the Amazon EKS User Guide. We also update the documentation frequently to address the feedback that you send us.

update-history-change	update-history-description	update-history-date
<a href="#">The ability to launch Arm nodes is generally available</a>	You can now launch Arm nodes in managed and self-managed node groups.	August 17, 2020
<a href="#">Managed node group launch templates and custom AMI</a>	You can now deploy a managed node group using an Amazon EC2 launch template. The launch template can specify a custom AMI, if you choose.	August 17, 2020
<a href="#">EFS support for AWS Fargate</a>	You can now use Amazon EFS with AWS Fargate.	August 17, 2020
<a href="#">Amazon EKS platform version update</a>	New platform version with security fixes and enhancements, including UDP support for services of type <code>LoadBalancer</code> when using NLB with Kubernetes 1.15 or later. For more information, see the <a href="#">Allow UDP for AWS NLB</a> issue on GitHub.	August 12, 2020
<a href="#">Amazon EKS Region expansion (p. 326)</a>	Amazon EKS is now available in the Africa (Cape Town) ( <code>af-south-1</code> ) and Europe (Milan) ( <code>eu-south-1</code> ) Regions.	August 6, 2020
<a href="#">Fargate usage metrics</a>	AWS Fargate provides CloudWatch usage metrics which provide visibility into your accounts usage of Fargate On-Demand resources.	August 3, 2020
<a href="#">Kubernetes version 1.17</a>	Added Kubernetes version 1.17 support for new clusters and version upgrades.	July 10, 2020
<a href="#">Create and manage App Mesh resources from within Kubernetes with the App Mesh controller for Kubernetes</a>	You can create and manage App Mesh resources from within Kubernetes. The controller also automatically injects the Envoy proxy and init containers into pods that you deploy.	June 18, 2020
<a href="#">Amazon EKS now supports Amazon EC2 Inf1 nodes</a>	You can add Amazon EC2 Inf1 nodes to your cluster.	June 4, 2020
<a href="#">Amazon EKS Region expansion (p. 326)</a>	Amazon EKS is now available in the AWS GovCloud (US-East)	May 13, 2020

	(us-gov-east-1) and AWS GovCloud (US-West) (us-gov-west-1) Regions.	
<a href="#">Kubernetes 1.12 deprecated on Amazon EKS</a>	Kubernetes version 1.12 is no longer supported on Amazon EKS. Please update any 1.12 clusters to version 1.13 or higher in order to avoid service interruption.	May 12, 2020
<a href="#">Kubernetes version 1.16</a>	Added Kubernetes version 1.16 support for new clusters and version upgrades.	April 30, 2020
<a href="#">Added the AWSServiceRoleForAmazonEKS service-linked role</a>	Added the <b>AWSServiceRoleForAmazonEKS</b> service-linked role.	April 16, 2020
<a href="#">Kubernetes version 1.15</a>	Added Kubernetes version 1.15 support for new clusters and version upgrades.	March 10, 2020
<a href="#">Amazon EKS Region expansion (p. 326)</a>	Amazon EKS is now available in the Beijing (cn-north-1) and Ningxia (cn-northwest-1) Regions.	February 26, 2020
<a href="#">Amazon FSx for Lustre CSI driver</a>	Added topic for installing the Amazon FSx for Lustre CSI Driver on Kubernetes 1.14 Amazon EKS clusters.	December 23, 2019
<a href="#">Restrict network access to the public access endpoint of a cluster</a>	Amazon EKS now enables you to restrict the CIDR ranges that can communicate to the public access endpoint of the Kubernetes API server.	December 20, 2019
<a href="#">Resolve the private access endpoint address for a cluster from outside of a VPC</a>	Amazon EKS now enables you to resolve the private access endpoint of the Kubernetes API server from outside of a VPC.	December 13, 2019
<a href="#">(Beta) Amazon EC2 A1 Amazon EC2 instance nodes</a>	Launch <a href="#">Amazon EC2 A1</a> Amazon EC2 instance nodes that register with your Amazon EKS cluster.	December 4, 2019
<a href="#">Creating a cluster on AWS Outposts</a>	Amazon EKS now supports creating clusters on an AWS Outpost.	December 3, 2019
<a href="#">AWS Fargate on Amazon EKS</a>	Amazon EKS Kubernetes clusters now support running pods on Fargate.	December 3, 2019
<a href="#">Amazon EKS Region expansion (p. 326)</a>	Amazon EKS is now available in the Canada (Central) (ca-central-1) Region.	November 21, 2019

<a href="#">Managed node groups</a>	Amazon EKS managed node groups automate the provisioning and lifecycle management of nodes (Amazon EC2 instances) for Amazon EKS Kubernetes clusters.	November 18, 2019
<a href="#">Amazon EKS platform version update</a>	New platform versions to address <a href="#">CVE-2019-11253</a> .	November 6, 2019
<a href="#">Kubernetes 1.11 deprecated on Amazon EKS</a>	Kubernetes version 1.11 is no longer supported on Amazon EKS. Please update any 1.11 clusters to version 1.12 or higher in order to avoid service interruption.	November 4, 2019
<a href="#">Amazon EKS Region expansion (p. 326)</a>	Amazon EKS is now available in the South America (São Paulo) (sa-east-1) Region.	October 16, 2019
<a href="#">Windows support</a>	Amazon EKS clusters running Kubernetes version 1.14 now support Windows workloads.	October 7, 2019
<a href="#">Autoscaling</a>	Added a chapter to cover some of the different types of Kubernetes autoscaling that are supported on Amazon EKS clusters.	September 30, 2019
<a href="#">Kubernetes Dashboard update</a>	Updated topic for installing the Kubernetes Dashboard on Amazon EKS clusters to use the beta 2.0 version.	September 28, 2019
<a href="#">Amazon EFS CSI driver</a>	Added topic for installing the Amazon EFS CSI Driver on Kubernetes 1.14 Amazon EKS clusters.	September 19, 2019
<a href="#">Amazon EC2 Systems Manager parameter for Amazon EKS optimized AMI ID</a>	Added topic for retrieving the Amazon EKS optimized AMI ID using an Amazon EC2 Systems Manager parameter. The parameter eliminates the need for you to look up AMI IDs.	September 18, 2019
<a href="#">Amazon EKS resource tagging</a>	Manage tagging of your Amazon EKS clusters.	September 16, 2019
<a href="#">Amazon EBS CSI driver</a>	Added topic for installing the Amazon EBS CSI driver on Kubernetes 1.14 Amazon EKS clusters.	September 9, 2019



<a href="#">New Amazon EKS optimized AMI patched for CVE-2019-9512 and CVE-2019-9514</a>	Amazon EKS has updated the Amazon EKS optimized AMI to address <a href="#">CVE-2019-9512</a> and <a href="#">CVE-2019-9514</a> .	September 6, 2019
<a href="#">Announcing deprecation of Kubernetes 1.11 in Amazon EKS</a>	Amazon EKS will deprecate Kubernetes version 1.11 on November 4, 2019. On this day, you will no longer be able to create new 1.11 clusters and all Amazon EKS clusters running Kubernetes version 1.11 will be updated to the latest available platform version of Kubernetes version 1.12.	September 4, 2019
<a href="#">Kubernetes version 1.14</a>	Added Kubernetes version 1.14 support for new clusters and version upgrades.	September 3, 2019
<a href="#">IAM roles for service accounts</a>	With IAM roles for service accounts on Amazon EKS clusters, you can associate an IAM role with a Kubernetes service account. With this feature, you no longer need to provide extended permissions to the node IAM role so that pods on that node can call AWS APIs.	September 3, 2019
<a href="#">Amazon EKS Region expansion (p. 326)</a>	Amazon EKS is now available in the Middle East (Bahrain) ( <code>me-south-1</code> ) Region.	August 29, 2019
<a href="#">Amazon EKS platform version update</a>	New platform versions to address <a href="#">CVE-2019-9512</a> and <a href="#">CVE-2019-9514</a> .	August 28, 2019
<a href="#">Amazon EKS platform version update</a>	New platform versions to address <a href="#">CVE-2019-11247</a> and <a href="#">CVE-2019-11249</a> .	August 5, 2019
<a href="#">Amazon EKS Region expansion (p. 326)</a>	Amazon EKS is now available in the Asia Pacific (Hong Kong) ( <code>ap-east-1</code> ) Region.	July 31, 2019
<a href="#">Kubernetes 1.10 deprecated on Amazon EKS</a>	Kubernetes version 1.10 is no longer supported on Amazon EKS. Please update any 1.10 clusters to version 1.11 or higher in order to avoid service interruption.	July 30, 2019
<a href="#">Added topic on ALB ingress controller</a>	The AWS ALB Ingress Controller for Kubernetes is a controller that triggers the creation of an Application Load Balancer when ingress resources are created.	July 11, 2019

<a href="#">New Amazon EKS optimized AMI</a>	Removing unnecessary kubect1 binary from AMIs.	July 3, 2019
<a href="#">Kubernetes version 1.13</a>	Added Kubernetes version 1.13 support for new clusters and version upgrades.	June 18, 2019
<a href="#">New Amazon EKS optimized AMI patched for AWS-2019-005</a>	Amazon EKS has updated the Amazon EKS optimized AMI to address the vulnerabilities described in <a href="#">AWS-2019-005</a> .	June 17, 2019
<a href="#">Announcing deprecation of Kubernetes 1.10 in Amazon EKS</a>	Amazon EKS will deprecate Kubernetes version 1.10 on July 22, 2019. On this day, you will no longer be able to create new 1.10 clusters and all Amazon EKS clusters running Kubernetes version 1.10 will be updated to the latest available platform version of Kubernetes version 1.11.	May 21, 2019
<a href="#">Amazon EKS platform version update</a>	New platform version for Kubernetes 1.11 and 1.10 clusters to support custom DNS names in the Kubelet certificate and improve etcd performance.	May 21, 2019
<a href="#">Getting started with eksctl</a>	This getting started guide helps you to install all of the required resources to get started with Amazon EKS using eksctl, a simple command line utility for creating and managing Kubernetes clusters on Amazon EKS.	May 10, 2019
<a href="#">AWS CLI get-token command (p. 326)</a>	The <code>aws eks get-token</code> command was added to the AWS CLI so that you no longer need to install the AWS IAM Authenticator for Kubernetes to create client security tokens for cluster API server communication. Upgrade your AWS CLI installation to the latest version to take advantage of this new functionality. For more information, see <a href="#">Installing the AWS command line interface</a> in the <i>AWS Command Line Interface User Guide</i> .	May 10, 2019

<a href="#">Amazon EKS platform version update</a>	New platform version for Kubernetes 1.12 clusters to support custom DNS names in the Kubelet certificate and improve etcd performance. This fixes a bug that caused node Kubelet daemons to request a new certificate every few seconds.	May 8, 2019
<a href="#">Prometheus tutorial</a>	Added topic for deploying Prometheus to your Amazon EKS cluster.	April 5, 2019
<a href="#">Amazon EKS control plane logging</a>	Amazon EKS control plane logging makes it easy for you to secure and run your clusters by providing audit and diagnostic logs directly from the Amazon EKS control plane to CloudWatch Logs in your account.	April 4, 2019
<a href="#">Kubernetes version 1.12 (p. 326)</a>	Added Kubernetes version 1.12 support for new clusters and version upgrades.	March 28, 2019
<a href="#">Added App Mesh getting started guide</a>	Added documentation for getting started with App Mesh and Kubernetes.	March 27, 2019
<a href="#">Amazon EKS API server endpoint private access</a>	Added documentation for disabling public access for your Amazon EKS cluster's Kubernetes API server endpoint.	March 19, 2019
<a href="#">Added topic for installing the Kubernetes Metrics Server</a>	The Kubernetes Metrics Server is an aggregator of resource usage data in your cluster.	March 18, 2019
<a href="#">Added list of related open source projects</a>	These open source projects extend the functionality of Kubernetes clusters running on AWS, including clusters managed by Amazon EKS.	March 15, 2019
<a href="#">Added topic for installing Helm locally</a>	The <code>helm</code> package manager for Kubernetes helps you install and manage applications on your Kubernetes cluster. This topic helps you install and run the <code>helm</code> and <code>tiller</code> binaries locally so that you can install and manage charts using the <code>helm</code> CLI on your local system.	March 11, 2019

<a href="#">Amazon EKS platform version update</a>	New platform version updating Amazon EKS Kubernetes 1.11 clusters to patch level 1.11.8 to address <a href="#">CVE-2019-1002100</a> .	March 8, 2019
<a href="#">Increased cluster limit</a>	Amazon EKS has increased the number of clusters that you can create in a Region from 3 to 50.	February 13, 2019
<a href="#">Amazon EKS Region expansion (p. 326)</a>	Amazon EKS is now available in the Europe (London) (eu-west-2), Europe (Paris) (eu-west-3), and Asia Pacific (Mumbai) (ap-south-1) Regions.	February 13, 2019
<a href="#">New Amazon EKS optimized AMI patched for ALAS-2019-1156</a>	Amazon EKS has updated the Amazon EKS optimized AMI to address the vulnerability described in <a href="#">ALAS-2019-1156</a> .	February 11, 2019
<a href="#">New Amazon EKS optimized AMI patched for ALAS2-2019-1141</a>	Amazon EKS has updated the Amazon EKS optimized AMI to address the CVEs referenced in <a href="#">ALAS2-2019-1141</a> .	January 9, 2019
<a href="#">Amazon EKS Region expansion (p. 326)</a>	Amazon EKS is now available in the Asia Pacific (Seoul) (ap-northeast-2) Region.	January 9, 2019
<a href="#">Amazon EKS region expansion (p. 326)</a>	Amazon EKS is now available in the following additional regions: Europe (Frankfurt) (eu-central-1), Asia Pacific (Tokyo) (ap-northeast-1), Asia Pacific (Singapore) (ap-southeast-1), and Asia Pacific (Sydney) (ap-southeast-2).	December 19, 2018
<a href="#">Amazon EKS cluster updates</a>	Added documentation for Amazon EKS <a href="#">cluster Kubernetes version updates</a> and <a href="#">node replacement</a> .	December 12, 2018
<a href="#">Amazon EKS Region expansion (p. 326)</a>	Amazon EKS is now available in the Europe (Stockholm) (eu-north-1) Region.	December 11, 2018
<a href="#">Amazon EKS platform version update</a>	New platform version updating Kubernetes to patch level 1.10.11 to address <a href="#">CVE-2018-1002105</a> .	December 4, 2018
<a href="#">Added version 1.0.0 support for the Application Load Balancer ingress controller</a>	The Application Load Balancer ingress controller releases version 1.0.0 with formal support from AWS.	November 20, 2018

<a href="#">Added support for CNI network configuration</a>	The Amazon VPC CNI plugin for Kubernetes version 1.2.1 now supports custom network configuration for secondary pod network interfaces.	October 16, 2018
<a href="#">Added support for MutatingAdmissionWebhook and ValidatingAdmissionWebhook</a>	Amazon EKS platform version 1.10-eks.2 now supports MutatingAdmissionWebhook and ValidatingAdmissionWebhook admission controllers.	October 10, 2018
<a href="#">Added partner AMI information</a>	Canonical has partnered with Amazon EKS to create node AMIs that you can use in your clusters.	October 3, 2018
<a href="#">Added instructions for AWS CLI update-kubeconfig command</a>	Amazon EKS has added the update-kubeconfig to the AWS CLI to simplify the process of creating a kubeconfig file for accessing your cluster.	September 21, 2018
<a href="#">New Amazon EKS optimized AMIs</a>	Amazon EKS has updated the Amazon EKS optimized AMIs (with and without GPU support) to provide various security fixes and AMI optimizations.	September 13, 2018
<a href="#">Amazon EKS Region expansion (p. 326)</a>	Amazon EKS is now available in the Europe (Ireland) (eu-west-1) region.	September 5, 2018
<a href="#">Amazon EKS platform version update</a>	New platform version with support for Kubernetes <a href="#">aggregation layer</a> and the <a href="#">Horizontal Pod Autoscaler</a> (HPA).	August 31, 2018
<a href="#">New Amazon EKS optimized AMIs and GPU support</a>	Amazon EKS has updated the Amazon EKS optimized AMI to use a new AWS CloudFormation node template and <a href="#">bootstrap script</a> . In addition, a new <a href="#">Amazon EKS optimized AMI with GPU support</a> is available.	August 22, 2018
<a href="#">New Amazon EKS optimized AMI patched for ALAS2-2018-1058</a>	Amazon EKS has updated the Amazon EKS optimized AMI to address the CVEs referenced in <a href="#">ALAS2-2018-1058</a> .	August 14, 2018
<a href="#">Amazon EKS optimized AMI build scripts</a>	Amazon EKS has open-sourced the build scripts that are used to build the Amazon EKS optimized AMI. These build scripts are now available on GitHub.	July 10, 2018
<a href="#">Amazon EKS initial release (p. 326)</a>	Initial documentation for service launch	June 5, 2018