Quick Start for Kubernetes by VMware on the AWS Cloud

Reference Deployment

VMware
Amazon Web Services

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Note An earlier version of this Quick Start was published under the name *Quick Start for Kubernetes by Heptio*.

Contents

About This Guide

This Quick Start deployment guide describes how to deploy a Kubernetes environment on the Amazon Web Services (AWS) Cloud, using AWS CloudFormation templates that automate the deployment.

The guide is for IT infrastructure architects, administrators, and DevOps professionals who are planning to implement or extend their Kubernetes workloads on the AWS Cloud.

Quick Links

The links in this section are for your convenience. Before you launch the Quick Start, please review the architecture, configuration, network security, and other considerations discussed in this guide.

- If you have an AWS account, and you're already familiar with AWS services and Kubernetes, you can launch the Quick Start to build the architecture shown in Figure 1 in a new or existing virtual private cloud (VPC). The deployment takes approximately ten minutes when you use the default Quick Start settings. If you're new to AWS or to Kubernetes, please review the implementation details and follow the step-by-step instructions provided later in this guide.

Launch (for new VPC) Launch (for existing VPC)

- If you want to take a look under the covers, you can view the AWS CloudFormation templates that automate the deployment.

View template (for new VPC) View template (for existing VPC)

About Quick Starts

Quick Starts are automated reference deployments for key workloads on the AWS Cloud. Each Quick Start launches, configures, and runs the AWS compute, network, storage, and other services required to deploy a specific workload on AWS, using AWS best practices for security and availability.

Overview

The Kubernetes Quick Start bootstraps your Kubernetes cluster with one master, two additional nodes by default, and a load balancer for HTTPS access to the Kubernetes API. This is a small cluster suitable for exploring Kubernetes networking, scaling, and administration. By running this Quick Start configuration, you'll be able to learn how Kubernetes works at a manageable scale, with key parts in place for a full-scale deployment. This is a step past the local or one-node deployment you might run to kick the tires.

Ubuntu 18.04 LTS is the base image for all nodes. With kubeadm for cluster administration and Calico or Weave for networking between pods, you'll immediately be able to deploy your own pods of networked container workloads on top of this architecture. Nodes have full access to one another, but won't be exposed over the public internet. You can use kubectl (a Kubernetes command-line tool) to expose workloads publicly.

> **Note** This stack is appropriate for proof of concept (PoC), experimentation, development, and small internal-facing projects. Consider this a test drive. This stack does not currently support upgrades and must be rebuilt for new versions.

Kubernetes on AWS

Kubernetes is the popular orchestration software used for managing cloud workloads through containers (like Docker). Kubernetes helps assign containers to machines in a scalable way, keep them running in the face of failures and facilitating them talking to each other.

The AWS Cloud provides the infrastructure services your containerized workloads run on, while Kubernetes coordinates the containers in a flexible and fault-tolerant way. Kubernetes handles many of the details of traditional system administration and decouples workload deployment from infrastructure deployment. Kubernetes also integrates with AWS to utilize Amazon Elastic Block Store (Amazon EBS) volumes and expose services using Elastic Load Balancing. By deploying Kubernetes on the AWS Cloud, you can take advantage of the functionality of Kubernetes along with the flexibility and security of AWS.

This guide provides infrastructure and configuration information for planning and deploying a Kubernetes cluster on the AWS Cloud. It doesn't cover general guidance and best practices for Kubernetes. For general open-source reference, consult the Kubernetes documentation.

A popular abbreviation for Kubernetes is **k8s** ("kates"), where the middle eight letters are replaced with "8."

Cost and Licenses

You are responsible for the cost of the AWS services used while running this Quick Start reference deployment. There is no additional cost for using the Quick Start.

The AWS CloudFormation templates for this Quick Start include configuration parameters that you can customize. Some of these settings, such as instance type, will affect the cost of deployment. By default, this will be three m4.large instances for the cluster and a t2.micro instance for a bastion host. For cost estimates, see the pricing pages for each AWS service you will be using. Prices are subject to change.

Kubernetes is free to deploy and uses the open-source Apache 2.0 license.

AWS Services

The core AWS components used by this Quick Start include the following services. (If you are new to AWS, see Getting Started with AWS.)

- Amazon VPC – The Amazon Virtual Private Cloud (Amazon VPC) service lets you provision a private, isolated section of the AWS Cloud where you can launch AWS services and other resources in a virtual network that you define. You have complete control over your virtual networking environment, including selection of your own IP address range, creation of subnets, and configuration of route tables and network gateways.
- Amazon EC2 – The Amazon Elastic Compute Cloud (Amazon EC2) service enables you to launch virtual machine instances with a variety of operating systems. You can choose from existing Amazon Machine Images (AMIs) or import your own virtual machine images.
- Elastic Load Balancing – Elastic Load Balancing automatically distributes incoming application traffic across multiple Amazon EC2 instances. It enables you to achieve fault tolerance in your applications, seamlessly providing the required amount of load balancing capacity needed to route application traffic. You can provision load balancers for your cluster workloads through Kubernetes, which will automatically handle setup and configuration. See the Kubernetes article Creating an External Load Balancer for details.
- Amazon EBS – Amazon Elastic Block Store (Amazon EBS) provides persistent block-level storage volumes for use with Amazon EC2 instances in the AWS Cloud. Each Amazon EBS volume is automatically replicated within its Availability Zone to protect you from component failure, offering high availability and durability. Amazon EBS volumes provide the consistent and low-latency performance needed to run your

workloads. Kubernetes can automatically attach/detach volumes and associate them with a container, even if the container moves to a new node. See the Kubernetes article on volumes for details.

Architecture

This Quick Start includes two templates. One automatically creates a VPC, subnets, and bastion host, which is what VMware recommends. The second template for more advanced use cases deploys Kubernetes in a pre-existing VPC and subnet.

Deploying this Quick Start for a new VPC with **default parameters** builds the following Kubernetes environment in the AWS Cloud.

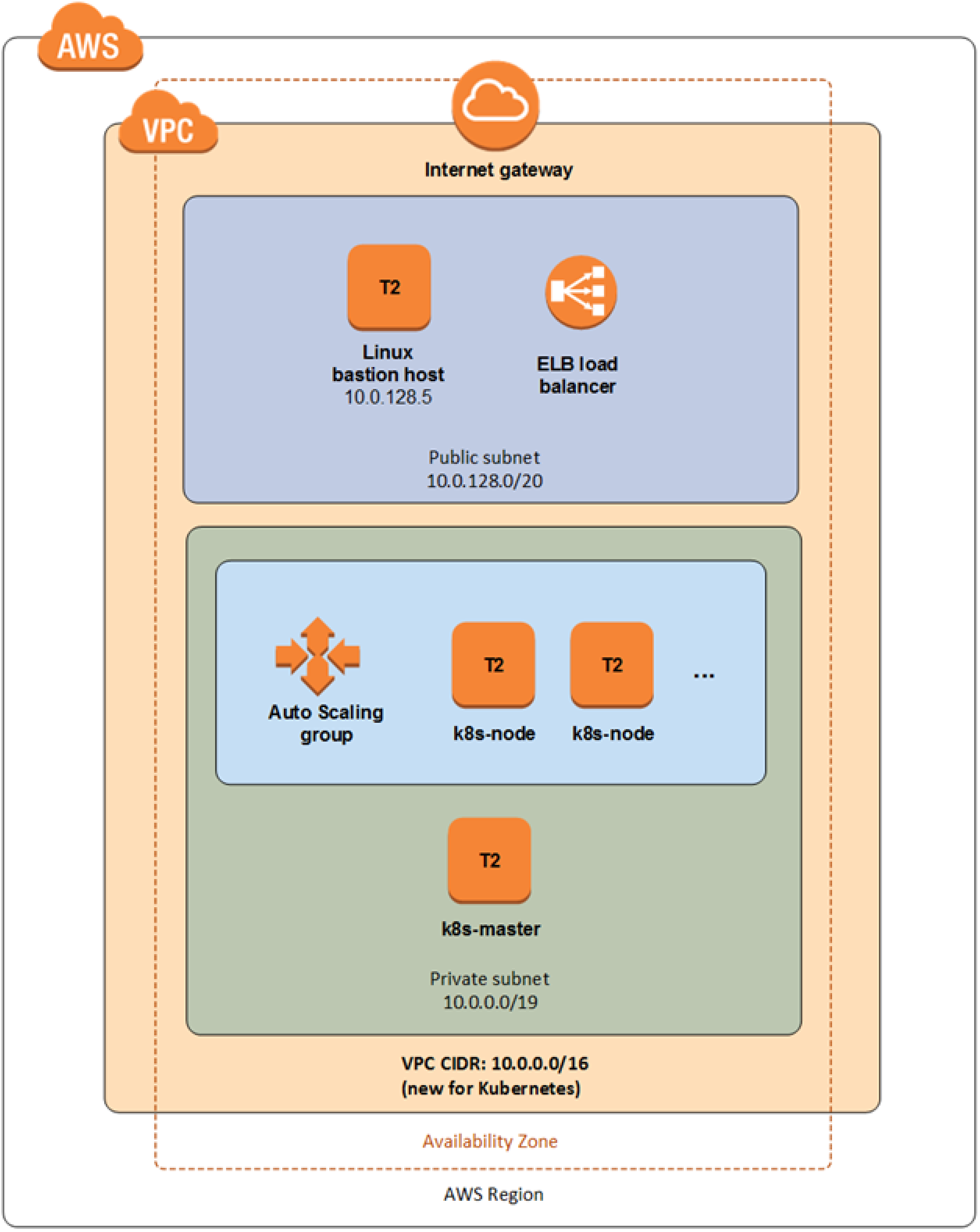


Figure 1: Kubernetes architecture on AWS

The Quick Start sets up the following:

- A VPC in a single Availability Zone.*
- Two subnets, one public and one private.*
- One EC2 instance acting as a bastion host in the public subnet.*
- One EC2 instance with automatic recovery for the master node in the private subnet.
- 1-20 EC2 instances in an Auto Scaling group for additional nodes in the private subnet.
- One Elastic Load Balancing (ELB) load balancer for HTTPS access to the Kubernetes API.
- Ubuntu 18.04 LTS for all nodes.
- kubeadm for bootstrapping Kubernetes on Linux.
- Docker for the container runtime, which Kubernetes depends on.
- Calico or Weave for pod networking. The default is Calico.
- CoreDNS or KubeDNS for cluster DNS. The default is CoreDNS. KubeDNS is being replaced by CoreDNS and is provided only for environments that cannot support CoreDNS.
- One stack-only security group that allows port 22 for SSH access (to the bastion host or directly to the stack, depending on configuration), port 6443 for HTTPS access to the API, and inter-node connectivity on all ports.

* The template that deploys the Quick Start into an existing VPC skips the tasks marked by asterisks.

Best Practices

The architecture built by this Quick Start supports AWS best practices for security.

- The master node uses simple automatic recovery with a 5-minute tolerance for failure. Auto recovery brings the node up with the same IP address to preserve cluster connectivity.
- The other nodes are part of an Auto Scaling group to take advantage of high availability on AWS.
- The Kubernetes cluster is part of a private subnet with no connectivity allowed in from the outside world except through a bastion host in the public subnet. Services are exposed to the outside world by integrating with the AWS Elastic Load Balancing

service. Kubernetes can create and manage ELB load balancers. One way of provisioning a load balancer from Kubernetes is by using kubectl, a Kubernetes command-line tool.

- The templates for this Quick Start create a single master node for Kubernetes and a set of worker nodes. All of these nodes run in a single AWS Availability Zone. This is appropriate for development clusters or for users who want to experiment with Kubernetes to understand if it is suitable for their application.

Planning the Deployment

Deployment Options

This Quick Start provides two deployment options:

- **Deploy Kubernetes into a new VPC** (end-to-end deployment) builds a new AWS environment consisting of the VPC, subnets, security groups, bastion hosts, and other infrastructure components, and then deploys Kubernetes into this new VPC. VMware recommends this deployment, because it configures the infrastructure in accordance with AWS best practices.
- **Deploy Kubernetes into an existing VPC** provisions Kubernetes in your existing AWS infrastructure. If you use a public subnet you can connect directly to the master node over SSH. If you use a private subnet, you will need a bastion host so you can proxy to the master node over SSH.

The Quick Start also lets you configure additional settings such as CIDR blocks, instance types, and Kubernetes settings, as discussed later in this guide.

Deployment Steps

Follow these steps to deploy Kubernetes on AWS. For detailed instructions, follow the links for each step.

Step 1. Prepare Your AWS account

Sign up for an AWS account. Choose your region, create a key pair, and request increases for account limits, if necessary.

Step 2. Launch the Quick Start

Launch the AWS CloudFormation template, specify parameter values, and create the stack. The Quick Start provides a pair of templates for end-to-end deployment and a single template for deploying into an existing VPC.

Step 3. (Optional) Test Your Kubernetes Cluster

Use kubectl to test your cluster. VMware also provides an example application and suggestions for next steps.

Step 1. Prepare Your AWS Account

> If you already have an AWS account, skip to step 2.

1. Create your AWS account at https://aws.amazon.com by following the on-screen instructions. Part of the sign-up process involves receiving a phone call and entering a PIN using the phone keypad.
2. Use the region selector in the navigation bar to choose the AWS Region where you want to deploy Kubernetes on AWS. For more information, see Regions and Availability Zones. Regions are dispersed and located in separate geographic areas. Each Region includes at least two Availability Zones that are isolated from one another but connected through low-latency links.

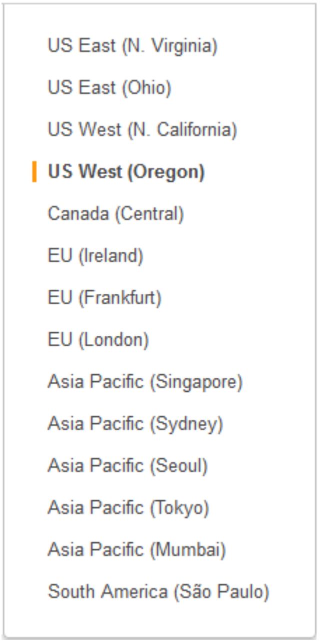


Figure 2: Choosing an AWS Region

Consider choosing an AWS Region closest to your data center or corporate network to reduce network latency between systems running on AWS and the systems and users on your corporate network.

3. Create a key pair in your preferred region. To do this, in the navigation pane of the Amazon EC2 console, choose **Key Pairs**, **Create Key Pair**, type a name, and then choose **Create**.

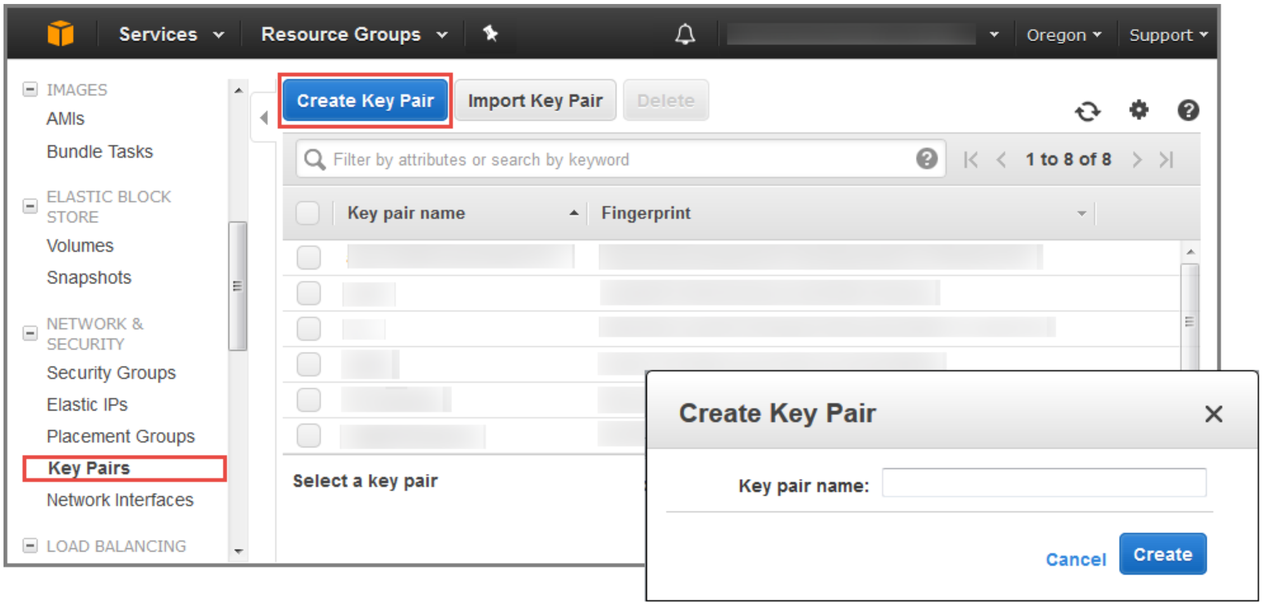
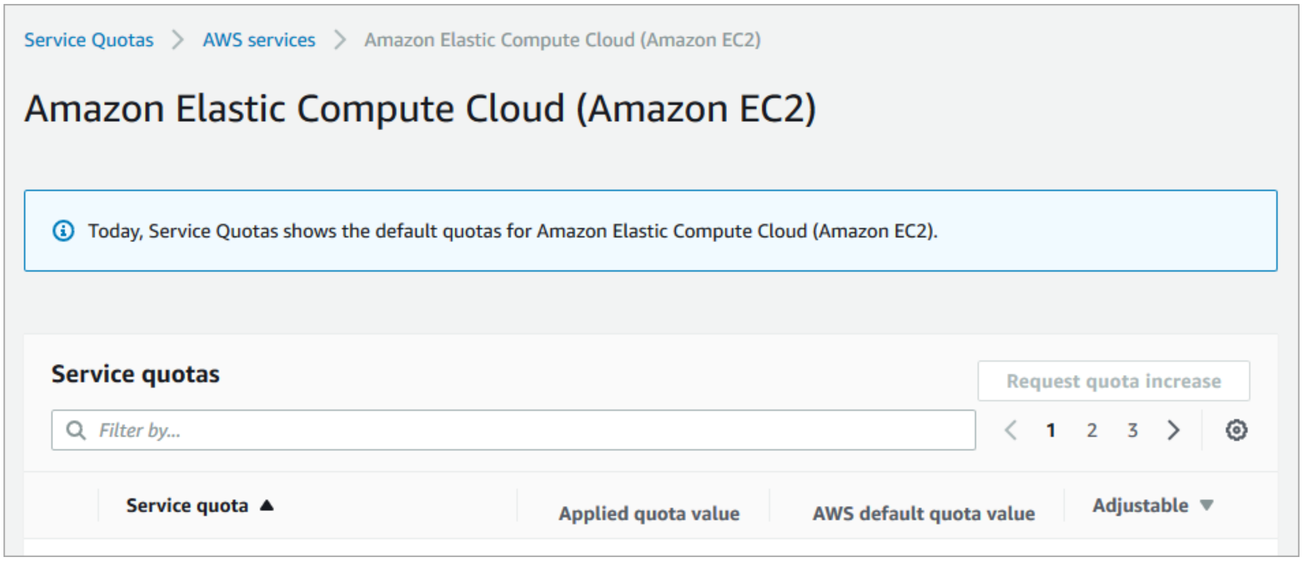


Figure 3: Creating a key pair

Amazon EC2 uses public-key cryptography to encrypt and decrypt login information. To log in to your instances, you must create a key pair. On Linux, the key pair is used to authenticate SSH login.

4. If necessary, request a service quota increase for the instance types used for the deployment. You might need to request an increase if you need additional Elastic IP addresses or if you already have an existing deployment that uses the same instance types as this architecture. To do this, on the Service Quotas console, for each instance type that you want a service quota increase, choose the instance type, choose **Request quota increase**, and then complete the fields in the quota increase form. It can take a few days for the new service quota to become effective.



Service Quotas > AWS services > Amazon Elastic Compute Cloud (Amazon EC2)

Amazon Elastic Compute Cloud (Amazon EC2)

Today, Service Quotas shows the default quotas for Amazon Elastic Compute Cloud (Amazon EC2).

Figure 4: Requesting a service quota increase

Step 2. Launch the Quick Start

> **Note** You are responsible for the cost of the AWS services used while running this Quick Start reference deployment. There is no additional cost for using this Quick Start.
>
> The AWS CloudFormation template for this Quick Start includes configuration parameters that you can customize. Some of these settings, such as instance type, will affect the cost of deployment. By default, the Quick Start uses three **m4.large** instances for the cluster and a t2.micro instance for the bastion host. For cost estimates, see the pricing pages for each AWS service you will be using. Prices are subject to change.

1. Choose one of the following options to launch the AWS CloudFormation template into your AWS account. We recommend that you choose **Option 1** to **deploy Kubernetes into a new VPC** in your AWS account. If you already have a VPC and subnet where you want to launch the cluster, you can use the Option 2 template and provide your

identifiers. For help choosing an option, see the deployment options earlier in this guide.

Option 1	Option 2
Deploy Kubernetes into a new VPC on AWS	**Deploy Kubernetes into an existing VPC**
Launch	Launch

Important There are no hard requirements for deploying Kubernetes into an existing VPC. The cluster makes no assumptions about whether it is in a private or public subnet. If you choose a public subnet, you will have to retrieve the master node's public IP or DNS information, and connect directly to it over SSH. If you choose a private subnet, you must have a bastion host in that VPC so you can proxy to the master node over SSH. In either case, we recommend making a one-time connection to copy a kubectl configuration file from the master node, and using kubectl for future connections. Both connection methods are discussed in the section Step 3. (Optional) Test Your Kubernetes Cluster.

Each deployment takes about 10 minutes, but will take longer with the smaller instance types. VMware doesn't recommend using the **t2.nano** instance type, because this size will never terminate.

2. Check the AWS Region that's displayed in the upper-right corner of the navigation bar, and change it if necessary. This is where the network infrastructure for Kubernetes will be built. The template is launched in the US West (Oregon) Region by default.

3. On the **Select Template** page, keep the default setting for the template URL, and then choose **Next**.

4. On the **Specify Details** page, change the stack name if needed. Review the parameters for the template. Provide values where input is required. For all other parameters, review the default settings and customize them as necessary. When all parameters are set, choose **Next**.

   In the following tables, parameters are listed by category and described separately for the two deployment options:

   – Parameters for deploying Kubernetes into a new VPC

   – Parameters for deploying Kubernetes into an existing VPC

- ## Option 1: Parameters for deploying Kubernetes into a new VPC

View template

Required:

Parameter label (name)	Default	Description
Availability Zone (AvailabilityZone)	*Requires input*	The Availability Zone for this cluster. Generally, VMware recommends that you run one cluster per Availability Zone and use tooling to coordinate across zones.
Admin Ingress Location (AdminIngressLocation)	*Requires input*	CIDR block (IP address range) to allow SSH access to the bastion host and HTTPS access to the Kubernetes API. Use 0.0.0.0/0 to allow access from all locations.
SSH Key (KeyName)	*Requires input*	The name of an existing Amazon EC2 key pair, to enable SSH access to the instances. When you created an AWS account, this is the key pair you created in your preferred region.

Advanced:

Parameter label (name)	Default	Description
Networking Provider (NetworkingProvider)	calico	The networking provider to use for communication between pods in the Kubernetes cluster. Supported configurations are calico and weave.
Node Capacity (K8sNodeCapacity)	2	The number of nodes that will run workloads (in addition to the master node instance). You can choose 1-20 nodes for deployment, and scale up your cluster later with more nodes.
Instance Type (InstanceType)	m4.large	EC2 instance type for the cluster.
Disk Size (GiB) (DiskSizeGb)	40	The size of the root disk for the EC2 instances for the cluster, in GiB. You can specify a value between 8 and 1024.
Instance Type (Bastion Host) (BastionInstanceType)	t2.micro	EC2 instance type for the bastion host.
S3 Bucket (QSS3BucketName)	aws-quickstart	**Change this setting only if you've set up assets, like your own networking configuration, in an S3 bucket.** This and the next parameter let you access scripts from the scripts/ and templates/ directories of your own fork of VMware's Quick Start assets, uploaded to S3 and stored at `${bucketname}.s3.amazonaws.com/${prefix}/scripts/somefile.txt`. The Quick Start bucket name can include

Parameter label (name)	Default	Description
		numbers, lowercase letters, uppercase letters, and hyphens (-). It cannot start or end with a hyphen (-).
S3 Key Prefix (QSS3KeyPrefix)	quickstart-vmware/	**Change this setting only if you've set up assets, like your own networking configuration, in an S3 bucket.** This and the previous parameter let you access scripts from the scripts/ and templates/ directories of your own fork of VMware's Quick Start assets, uploaded to S3 and stored at ${bucketname}.s3.amazonaws.com/${prefix}/scripts/somefile.txt. The Quick Start key prefix can include numbers, lowercase letters, uppercase letters, hyphens (-), and forward slashes (/). It cannot start or end with a forward slash (/), which is automatically added.

- ### Option 2: Parameters for deploying Kubernetes into an existing VPC

View template

Amazon EC2 Configuration:

Parameter label (name)	Default	Description
VPC (VPCID)	*Requires input*	ID of an existing VPC in this region. **Make sure that the VPC corresponds to your desired Availability Zone and subnet.**
Availability Zone (AvailabilityZone)	*Requires input*	The Availability Zone for this cluster. Generally, VMware recommends that you run one cluster per Availability Zone and use tooling to coordinate across zones. **Make sure that the Availability Zone corresponds to your desired VPC and subnet.**
Instance Type (InstanceType)	m4.large	EC2 instance type for the cluster.
Disk Size (GiB) (DiskSizeGb)	40	The size of the root disk for the EC2 instances for the cluster, in GiB. You can specify a value between 8 and 1024.
Subnet (ClusterSubnetId)	*Requires input*	The subnet for this cluster. **Make sure that the subnet corresponds to your desired VPC and Availability Zone.** A public subnet will work out of the box. A private subnet will require a bastion host configured to work within that VPC, for external SSH access.
Load Balancer Subnet (LoadBalancerSubnetId)	*Requires input*	An existing subnet that you want to use for load balancing HTTPS access to the Kubernetes API server. This must be a public subnet and must belong to the Availability Zone you've selected.

Access Configuration:

Parameter label (name)	Default	Description
SSH Ingress Location (SSHLocation)	*Requires input*	CIDR block (IP address range) to allow SSH access to the instances. Use 0.0.0.0/0 to allow access from all locations.
API Ingress Location (ApiLbLocation)	*Requires input*	CIDR block (IP address range) to allow HTTPS access to the Kubernetes API. Use 0.0.0.0/0 to allow access from all locations.
SSH Key (KeyName)	*Requires input*	The name of an existing Amazon EC2 key pair, to enable SSH access to the instances. When you created an AWS account, this is the key pair you created in your preferred region.

Kubernetes Configuration:

Parameter label (name)	Default	Description
Node Capacity (K8sNodeCapacity)	2	The number of nodes that will run workloads (in addition to the master node instance). You can choose 1-20 nodes for deployment, and scale up your cluster later with more nodes.
Networking Provider (NetworkingProvider)	calico	The networking provider to use for communication between pods in the Kubernetes cluster. Supported configurations are calico and weave.

Advanced:

Parameter label (name)	Default	Description
S3 Bucket (QSS3BucketName)	aws-quickstart	**Change this setting only if you've set up assets, like your own networking configuration, in an S3 bucket.** This and the next parameter let you access scripts from the scripts/ and templates/ directories of your own fork of VMware's Quick Start assets, uploaded to S3 and stored at ${bucketname}.s3.amazonaws.com/${prefix}/scripts/somefile.txt. The Quick Start bucket name can include numbers, lowercase letters, uppercase letters, and hyphens (-). It cannot start or end with a hyphen (-).
S3 Key Prefix (QSS3KeyPrefix)	quickstart-vmware/	**Change this setting only if you've set up assets, like your own networking configuration, in an S3 bucket.** This and the previous parameter let you access scripts from the scripts/ and templates/ directories of your own fork of VMware's Quick Start assets, uploaded to S3 and stored at `${bucketname}.s3.amazonaws.com/${prefix}/scripts`

Parameter label (name)	Default	Description
		`/somefile.txt`. The Quick Start key prefix can include numbers, lowercase letters, uppercase letters, hyphens (-), and forward slashes (/). It cannot start or end with a forward slash (/), which is automatically added.
Cluster Association (ClusterAssociation)	—	A string, unique within your AWS account, that associates resources in this Kubernetes cluster with one another. This adds a tag, which has the key **KubernetesCluster** and the value of this parameter, to resources created as part of this stack. Leave blank to use the Quick Start stack name.

5. On the **Options** page, you can specify tags (key-value pairs) for resources in your stack and set advanced options. The template automatically names the nodes with **k8s-master** or **k8s-node** as appropriate, and tags the EC2 instances and new security group with the key of **KubernetesCluster** and the value of the stack name (or the value of the **Cluster Association** parameter if you're using the existing VPC deployment option). This is required for the Kubernetes/AWS Cloud integration. When you're done, choose **Next**.
6. On the **Review** page, review and confirm the template settings. Under **Capabilities**, select the check box to acknowledge that the template will create IAM resources.
7. Choose **Create** to deploy the stack(s). If you create a new VPC, two stacks are created. The VPC has the name you specified, and the Kubernetes cluster has the same name with **-K8sStack-** and a random string appended.
8. Monitor the status of the stack. When the status is **CREATE_COMPLETE**, the Kubernetes cluster is ready.
9. Use the **GetKubeConfigCommand** in the **Outputs** tab for the VPC stack to configure your local kubectl environment so you can connect to the resources that were created. To connect to your cluster over SSH, see Next Steps for Kubernetes on AWS in the VMware GitHub repository.

Step 3. (Optional) Test Your Kubernetes Cluster

1. On your local machine, download and configure kubectl. (See step 3.4 to connect to the cluster directly over SSH if you don't want to use kubectl.)
2. From a machine with the appropriate key pair (the one you selected for the stack deployment), run the **scp** command to download a configuration for your local kubectl environment. kubectl is a command-line cluster management tool for Kubernetes. The **GetKubeConfigCommand** is displayed in the **Outputs** tab for the VPC stack. This

command will securely copy a file called "kubeconfig" that was automatically generated on the master node and contains connection information and credentials for the cluster. You will need to download the file so kubectl can use it to connect to this cluster you just created. The command to download the file should look something like this:

```
SSH_KEY="<path/to/varMyKey.pem>"; scp -i $SSH_KEY -o ProxyCommand="ssh -i
\"${SSH_KEY}\" ubuntu@<BastionHostPublicIP> nc %h %p"
ubuntu@<MasterPrivateIP>:~/kubeconfig ./kubeconfig
```

If you deployed into an existing VPC, you should (a) modify the command to use the IP address of a bastion host within that VPC, or (b) connect directly to the master node's public IP or public DNS name (learn how to describe the master instance and obtain the IP or public DNS name). The second method works only if you're using a public subnet.

3. For ease of use, set this local environment variable so kubectl uses the downloaded file:

```
export KUBECONFIG=$(pwd)/kubeconfig
```

4. (Optional) To connect to the cluster directly over SSH — for example, if you don't want to configure kubectl locally — use the **SSHProxyCommand** shown in the **Outputs** tab for the VPC stack. While logged into the master node, you can run kubectl commands directly.

5. Run this command to list all Kubernetes nodes, either locally or from the master node (proxied or otherwise):

```
kubectl get nodes
```

If you kept the default settings for the Quick Start, you should see one master node and two additional nodes.

Name	Status	Age
ip-10-10-10-10	Ready, master	1h
ip-172-172-172-172	Ready	1h
ip-192-192-192-192	Ready	1h

Now that you've seen the Kubernetes cluster working, you can take it for a test drive so Kubernetes is doing something interesting! See Next Steps for Kubernetes on AWS in the VMware GitHub repository for some ideas on how to start using your cluster.

Troubleshooting

Q. I encountered a CREATE_FAILED error when I launched the Quick Start.

A. When you deploy the Quick Start, if you encounter a CREATE_FAILED error instead of the CREATE_COMPLETE status code, we recommend that you relaunch the template with **Rollback on failure** set to **No**. (This setting is under **Advanced** in the AWS CloudFormation console, **Options** page.) With this setting, the stack's state will be retained and the instance will be left running, so you can troubleshoot the issue. You can then investigate the logs in `/var/log`. The two most important logs are `cfn-init.log` and `cfn-init-cmd.log`. You can also view the `cfn-init-cmd.log` log in the Amazon CloudWatch console.

> **Important** When you set **Rollback on failure** to **No**, you'll continue to incur AWS charges for this stack. Please make sure to delete the stack when you've finished troubleshooting.

The following table lists specific CREATE_FAILED error messages you might encounter.

Error message	Possible cause	What to do
We currently do not have sufficient m4.large capacity in the AZ you requested	You have exceeded your Amazon EC2 capacity	Switch to an instance type that supports higher capacity, or complete the request form in the AWS Support Center to increase the Amazon EC2 limit for the instance type or region. Limit increases are tied to the region they were requested for.
Instance *ID* did not stabilize	You have exceeded your IOPS for the region	Request a limit increase by completing the request form in the AWS Support Center.
K8sMasterInstance Value for parameter availabilityZone is invalid	The Availability Zone and subnet don't match	Check your settings for the **Availability Zone** and **Subnet** parameters to make sure they match.
K8sMasterInstance Security group and subnet belong to different networks	The VPC and subnet don't match	Check your settings for the **VPC** and **Subnet** parameters to make sure they match.

Q. The Quick Start CloudFormation stack doesn't delete properly.

A. This is typically caused when resources such as ELB load balancers are created inside the stack's VPC. Kubernetes creates these resources when you create a service with `type: LoadBalancer`.

To clean up, you must delete the load balancers manually, by using the Amazon EC2 console or the AWS Command Line Interface (AWS CLI). For instructions on how to delete load balancers by using the console, see the AWS documentation.

To delete load balancers by using the AWS CLI:

1. Find the VPC ID that was created with your CloudFormation stack. You can find the VPC ID in the AWS CloudFormation console, in the **Resources** tab for the stack.
2. Run the following code to delete all load balancers in the stack:

```
# Set to the VPC that you want to delete. Example: vpc-1234abcd
export VPC_ID='<vpc-id>'
# Set to the region in which you created the Quick Start.  Example: us-west-1
export AWS_DEFAULT_REGION='<aws-region>'

aws elb describe-load-balancers --query "LoadBalancerDescriptions[?VPCId ==
\`${VPC_ID}\`].LoadBalancerName" --output text \
   | xargs -n 1 echo \
   | while read lb; do
         aws elb delete-load-balancer --load-balancer-name="${lb}"
     done
```

3. In the AWS CloudFormation console, delete the CloudFormation stack.

   The process of freeing some of the resources associated with load balancers is asynchronous, so stack deletion might take some time.

For additional troubleshooting information, see Troubleshooting AWS CloudFormation. If the problem you encounter isn't covered on that page or in the table, visit the AWS Support Center. If you're filing a support ticket, please attach the `install.log` file from the master instance (located in the `/root/install` folder) to the ticket.

Security

This stack exposes port 22 on the bastion host and port 443 on the API ELB load balancer to the IP address range(s) that you specify. All nodes within the stack can reach one another on all ports.

To expose more ports, we recommend using Elastic Load Balancing. This will work automatically with the Kubernetes/AWS Cloud integration. See Next Steps for Kubernetes on AWS in the VMware GitHub repository.

For general AWS security considerations, visit the AWS Security Center.

Additional Resources

AWS services

- Amazon EC2 user guide for Linux
  https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/
- AWS CloudFormation
  https://aws.amazon.com/documentation/cloudformation/
- Amazon VPC
  https://aws.amazon.com/documentation/vpc/

Kubernetes documentation

- Kubernetes Open-Source Documentation
  https://kubernetes.io/docs/
- kubeadm for Managing Kubernetes on Linux
  https://kubernetes.io/docs/admin/kubeadm/
- Calico Networking
  http://docs.projectcalico.org/v2.0/getting-started/kubernetes/
- Weave Networking
  https://github.com/weaveworks/weave
- VMware AWS Quick Start Next Steps
  https://github.com/heptio/aws-quickstart/blob/master/docs/next-steps.md

Quick Start reference deployments

- AWS Quick Start home page
  https://aws.amazon.com/quickstart/

GitHub Repository

You can visit the AWS GitHub repository to download the templates and scripts for this public release of the Quick Start. VMware will be updating this Quick Start on a regular basis; you can find the latest development version hosted by VMware at https://github.com/heptio/aws-quickstart.

Document Revisions

Date	Change	In sections
February 2019	Rebranded Quick Start for VMware	Changes throughout guide
June 2018	Expanded troubleshooting information; updates for Kubernetes version 1.10.3	Troubleshooting
April 2017	Kubernetes 1.6.2 release	
March 2017	Kubernetes 1.5.5 release	Step 3
February 2017	Initial publication	—

Notices

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