



# INSTALLATION GUIDE

A guide for installing or migrating to CircleCI  
Server v3.2.0 on AWS or GCP

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# CircleCI Server v3.x Installation Phase 1

## Phase 1: Prerequisites

Install CircleCI server in 4 phases. There is a validation step at the end of each phase, allowing you to confirm success before moving to the next phase. Depending on your requirements, phases 3 and 4 may have multiple steps. This installation guide assumes you have already read the server 3.x [overview](#).



In the following steps replace any items or credentials displayed between `< >` with your details.

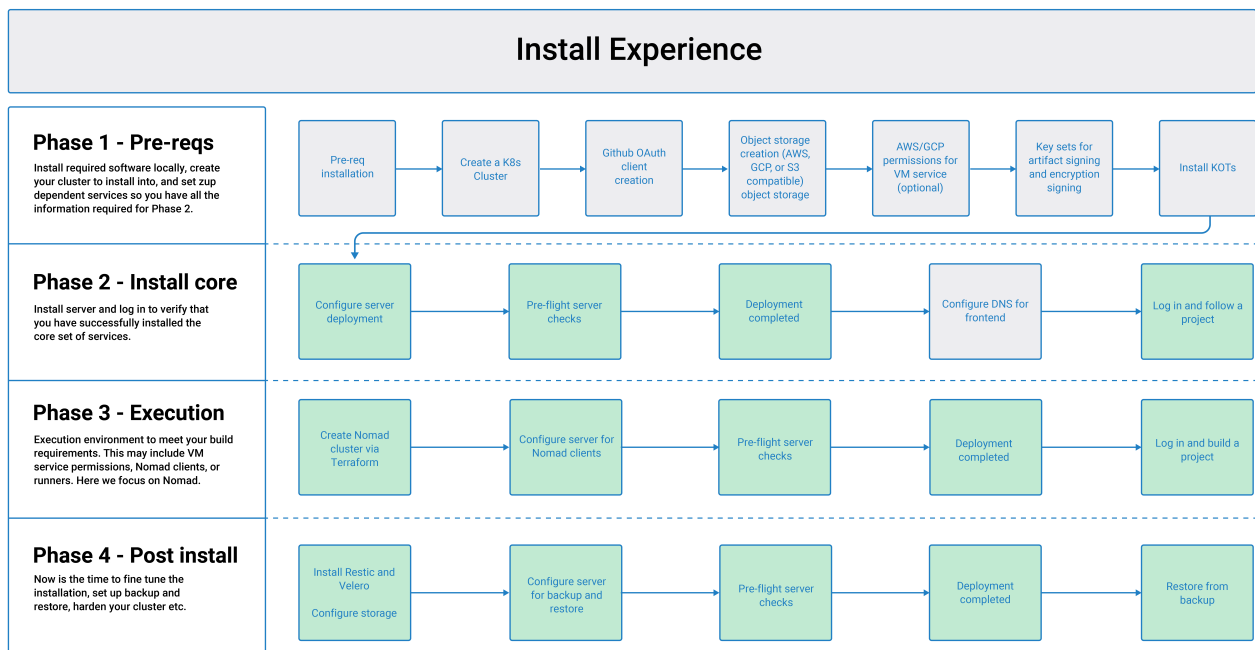


Figure 1. Installation Experience Flow Chart

## Install required software

Download and install the following software before continuing:

Tool	Version	Used for
<a href="#">Terraform</a>	0.15.4 or greater	Infrastructure Management
<a href="#">kubectl</a>	1.19 or greater	Kubernetes CLI
<a href="#">Helm</a>	3.4.0 or greater	Kubernetes Package Management
<a href="#">Kots</a>	1.47.3 or greater	Replicated Kubernetes Application Management

## Create a Kubernetes cluster

CircleCI server installs into an existing Kubernetes cluster. The application uses a large number of resources.

Depending on your usage, your Kubernetes cluster should meet the following requirements:

Number of daily active CircleCI users	Minimum Nodes	Total CPU	Total RAM	NIC speed
< 500	3	12 cores	32 GB	1 Gbps
500+	3	48 cores	240 GB	10 Gbps

Creating a Kubernetes cluster is your responsibility. Please note:

- Your cluster must have outbound access to pull Docker containers and verify your license. If you do not want to provide open outbound access, see our [list of ports](#) that will need access.
- You must have appropriate permissions to list, create, edit and delete pods in your cluster. Run this to verify your permissions:

```
kubectl auth can-i <list|create|edit|delete> pods
```

- There are no requirements regarding VPC setup or disk size for your cluster. It is recommended that you set up a new VPC rather than use an existing one.

## EKS

You can learn more about creating an Amazon EKS cluster [here](#). We recommend using `eksctl` to create your cluster, which will create a VPC and select the proper security groups for you.

1. [Install](#) and [configure](#) the AWS CLI for your AWS account.
2. Install `eksctl`.
3. Create your cluster by running the following (Cloud formation with `eksctl` and EKS can take upwards of 20 minutes to complete):

```
eksctl create cluster --name=circleci-server --nodes 4 --node-type m5.xlarge
```

4. Once the cluster has been created, you can use the following command to configure `kubectl` access:

```
eksctl utils write-kubeconfig --name circleci-server
```



You may see the following error `AWS STS Access - cannot get role ARN for current session: InvalidClientTokenID`. This means your AWS credentials are invalid, or your IAM user does not have permission to create an EKS cluster. Proper IAM permissions are necessary in order to use `eksctl`. See the AWS documentation regarding [IAM permissions](#).

## GKE

You can learn more about creating a GKE cluster [here](#).



Do not use Autopilot cluster. CircleCI requires functionality that is not supported by GKE Autopilot.

1. [Install](#) and [configure](#) the GCP CLI for your GCP account. This includes creating a Google Project, which will be required to create a cluster within your project. When you create your project make sure you also enabled API access. If you do not enable API access, the command we will run next, to create your cluster, will fail.
2. Create your cluster by entering running the following:

```
gcloud container clusters create circleci-server --project <YOUR_GOOGLE_CLOUD_PROJECT_ID>
--region europe-west1 --num-nodes 3 --machine-type n1-standard-4
```

3. Configure `kubectl` with your your credentials gcloud credentials:

```
gcloud container clusters get-credentials circleci-server --region europe-west1
```

4. Verify your cluster:

```
kubectl cluster-info
```

5. Create a service account for this cluster:

```
gcloud iam service-accounts create <YOUR_SERVICE_ACCOUNT_ID> --description
=<YOUR_SERVICE_ACCOUNT_DISPLAY_NAME> --display-name=<YOUR_SERVICE_ACCOUNT_DISPLAY_NAME>
```

6. Get the credentials for the service account:

```
gcloud iam service-accounts keys create <PATH_TO_STORE_CREDENTIALS> --iam-account
<SERVICE_ACCOUNT_ID>@<YOUR_GOOGLE_CLOUD_PROJECT_ID>.iam.gserviceaccount.com
```

## Create a new GitHub OAuth app

Registering and setting up a new GitHub OAuth app for CircleCI server allows for authorization control to your server installation using GitHub OAuth and for updates to GitHub projects/repos using build status information.

1. In your browser navigate to **your GitHub instance > Settings > Developer Settings > OAuth Apps** and click the **New OAuth App** button.

## Register a new OAuth application

**Application name \***

circleci-server

Something users will recognize and trust.

**Homepage URL \***

https://circleci.someplace.com

The full URL to your application homepage.

**Application description**

Application description is optional

This is displayed to all users of your application.

**Authorization callback URL \***

https://circleci.someplace.com/auth/github

Your application's callback URL. Read our [OAuth documentation](#) for more information.


Register application

Cancel

Figure 2. New GitHub OAuth App

2. Complete the following fields based on your planned installation:
  - **Homepage URL:** The URL of your planned CircleCI installation.
  - **Authorization callback URL:** The authorization callback URL will be the URL of your planned CircleCI installation followed by `/auth/github`
3. Once completed you will be shown the **Client ID**. Select **Generate a new Client Secret** to generate a Client Secret for your new OAuth App. You will need these values when you configure CircleCI server.

circleci-server


nathanfishcircleci owns this application.

Transfer ownership

You can list your application in the [GitHub Marketplace](#) so that other users can discover it.

List this application in the Marketplace

0 users

Revoke all user tokens

Client ID

1d2249984d6ce6a5d599

Client secrets

Generate a new client secret

You need a client secret to authenticate as the application to the API.

Figure 3. Client ID and Secret



If using GitHub Enterprise, you will also need a personal access token and the domain name of your GitHub Enterprise instance.

## Frontend TLS certificates

By default, CircleCI server will create self-signed certificates to get you started. In production, you should supply a certificate from a trusted certificate authority. The [LetsEncrypt](#) certificate authority, for example, can issue a certificate for free using their [certbot](#) tool. In the sections below we cover using Google Cloud DNS and AWS Route53.

### Google Cloud DNS

1. If you host your DNS on Google Cloud you will need the **certbot-dns-google** plugin installed. You can install the plugin with the following command:

```
pip3 install certbot-dns-google
```

2. Then, the following commands will provision a certification for your installation:

```
certbot certonly --dns-google --dns-google-credentials <PATH_TO_CREDENTIALS> -d
"<CIRCLECI_SERVER_DOMAIN>" -d "app.<CIRCLECI_SERVER_DOMAIN>"
```

## AWS Route53

1. If you are using AWS Route53 for DNS you will need the **certbot-route53** plugin installed. You can install the plugin with the following command:

```
pip3 install certbot-dns-route53
```

2. Then execute this example to create a private key and certificate (including intermediate certificates) locally in `/etc/letsencrypt/live/<CIRCLECI_SERVER_DOMAIN>`:

```
certbot certonly --dns-route53 -d "<CIRCLECI_SERVER_DOMAIN>" -d "app.<CIRCLECI_SERVER_DOMAIN>"
```

You will need these certificates later, and they can be retrieved locally with the following commands:

```
ls -l /etc/letsencrypt/live/<CIRCLECI_SERVER_DOMAIN>
```

```
cat /etc/letsencrypt/live/<CIRCLECI_SERVER_DOMAIN>/fullchain.pem
```

```
cat /etc/letsencrypt/live/<CIRCLECI_SERVER_DOMAIN>/privkey.pem
```



It is important that your certificate contains both your domain and the app.\* subdomain as subjects. For example, if you host your installation at `server.example.com`, your certificate must cover `app.server.example.com` and `server.example.com`

## Encryption/signing keys

These keysets are used to encrypt and sign artifacts generated by CircleCI. You will need these values to configure server.



Store these values securely. If they are lost, job history and artifacts will not be recoverable.

### Artifact signing key

To generate, run the following:

```
docker run circleci/server-keysets:latest generate signing -a stdout
```



## Encryption signing key

To generate, run the following:

```
docker run circleci/server-keysets:latest generate encryption -a stdout
```

## Object storage and permissions

Server 3.x hosts build artifacts, test results, and other state object storage. We support the following:

- [AWS S3](#)
- [Minio](#)
- [Google Cloud Storage](#)

While any S3 compatible object storage may work, we test and support AWS S3 and Minio. For object storage providers that do not support S3 API, such as Azure blob storage, we recommend using Minio Gateway.

Please choose the option that best suits your needs. A Storage Bucket Name is required, in addition to the fields listed below, depending on whether you are using AWS or GCP. Ensure the bucket name you provide exists in your chosen object storage provider before proceeding.



If you are installing behind a proxy, object storage should be behind this proxy also, otherwise proxy details will need to be supplied at the job level within every project `.circleci/config.yml` to allow artifacts, test results, cache save and restore, and workspaces to work. For more information see the [Configuring a Proxy](#) guide.

## Create an S3 storage bucket

You will need the following details when you configure CircleCI server.

- **Storage Bucket Name** - The bucket name to be used for server.
- **Access Key ID** - Access Key ID for S3 bucket access.
- **Secret Key** - Secret Key for S3 bucket access.
- **AWS S3 Region** - AWS region of bucket if your provider is AWS. You will either have an AWS region or S3 Endpoint depending on your specific setup.
- **S3 Endpoint** - API endpoint of S3 storage provider, when your storage provider is not Amazon S3.

### Step 1: Create AWS S3 Bucket

```
aws s3api create-bucket \
  --bucket <YOUR_BUCKET_NAME> \
  --region <YOUR_REGION> \
  --create-bucket-configuration LocationConstraint=<YOUR_REGION>
```



us-east-1 does not support a LocationConstraint. If your region is `us-east-1`, omit the bucket configuration

#### Step 2: Create an IAM user for CircleCI server

```
aws iam create-user --user-name circleci-server
```

#### Step 3: create a policy document "policy.json" with the following content

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:*"
      ],
      "Resource": [
        "arn:aws:s3:::<YOUR_BUCKET_NAME>",
        "arn:aws:s3:::<YOUR_BUCKET_NAME>/*"
      ]
    }
  ]
}
```

#### Step 4: Attach policy to user

```
aws iam put-user-policy \
  --user-name circleci-server \
  --policy-name circleci-server \
  --policy-document file://policy.json
```

#### Step 5: Create Access Key for user circleci-server



You will need this when you configure your server installation later.

```
aws iam create-access-key --user-name circleci-server
```

The result should look like this:

```
{
  "AccessKey": {
    "UserName": "circleci-server",
    "Status": "Active",
    "CreateDate": "2017-07-31T22:24:41.576Z",
    "SecretAccessKey": <AWS_SECRET_ACCESS_KEY>,
    "AccessKeyId": <AWS_ACCESS_KEY_ID>
  }
}
```

## Create a Google Cloud storage bucket

You will need the following details when you configure CircleCI server.

- **Storage Bucket Name** - The bucket used for server.
- **Service Account JSON** - A JSON format key of the Service Account to use for bucket access.

A dedicated service account is recommended. Add to it the Storage Object Admin role, with a condition on the resource name limiting access to only the bucket specified above. For example, enter the following into the Google's Condition Editor of the IAM console:



Use `startsWith` and prefix the bucket name with `projects/_/buckets/`.

```
resource.name.startsWith("projects/_/buckets/<YOUR_BUCKET_NAME>")
```

### Step 1: Create a GCP bucket

If your server installation runs within a GKE cluster, ensure that your current IAM user is a cluster admin for this cluster, as RBAC (role-based access control) objects need to be created. More information can be found in the [GKE documentation](#).

```
gsutil mb gs://circleci-server-bucket
```

### Step 2: Create a Service Account

```
gcloud iam service-accounts create circleci-server --display-name "circleci-server service account"
```

You will need the email for the service account in the next step, run the following to find it:

```
gcloud iam service-accounts list \
  --filter="displayName:circleci-server account" \
  --format 'value(email)'
```

### Step 3: Grant Permissions to Service Account

```
gcloud iam roles create circleci_server \
  --project <PROJECT_ID> \
  --title "CircleCI Server" \
  --permissions \
  compute.disks.get,compute.disks.create,compute.disks.createSnapshot,compute.snapshots.get,compute.snapshots.create,compute.snapshots.useReadOnly,compute.snapshots.delete,compute.zones.get
```

```
gcloud projects add-iam-policy-binding <PROJECT_ID> \
  --member serviceAccount:<SERVICE_ACCOUNT_EMAIL> \
  --role projects/<PROJECT_ID>/roles/circleci_server
```

```
gsutil iam ch serviceAccount:<SERVICE_ACCOUNT_EMAIL>:objectAdmin gs://circleci-server-bucket
```

### Step 4: JSON Key File

After running the following, you should have a file named `circleci-server-keyfile` in your local working directory. You will need this when you configure your server installation.

```
gcloud iam service-accounts keys create circleci-server-keyfile \
  --iam-account <SERVICE_ACCOUNT_EMAIL>
```

# CircleCI Server v3.x Installation Phase 2

Before you begin with the CircleCI server v3.x core services installation phase, ensure all [prerequisites](#) are met.



In the following steps replace any items or credentials displayed between `< >` with your details.

## Phase 2: Core services installation

CircleCI server v3.x uses [KOTS](#) from [Replicated](#) to manage and distribute server v3.x. KOTS is a `kubectl` [plugin](#). To install the latest version, you can run `curl https://kots.io/install | bash`.

Ensure you are running the minimum KOTS version (1.47.3) by running:

```
kubectl kots version
```



The KOTS command will open up a tunnel to the admin console. If running on Windows inside WSL2, the port is not available on the host machine. Turning WSL off and back on should resolve the issue. For more information, please see <https://github.com/microsoft/WSL/issues/4199>.

From the terminal run (if you are installing behind a proxy see [Installing behind HTTP Proxy](#)):

```
kubectl kots install circleci-server
```

You will be prompted for a:

- namespace for the deployment
- password for the KOTS admin console

When complete, you should be provided with a URL to access the KOTS admin console, usually, `http://localhost:8800`.



If you need to get back to the KOTS admin console at a later date you can run: `kubectl kots admin-console -n <YOUR_CIRCLECI_NAMESPACE>`



Once you have created your namespace we recommend setting your `kubectl` context too with the following command: `kubectl config set-context --current --namespace <namespace>`

## Installing behind HTTP Proxy

If you wish to install CircleCI server behind a proxy, the following command structure should be used (for more information see the KOTS docs [here](#)):

```
kubectl kots install circleci-server --http-proxy <YOUR_HTTP_PROXY_URI> --https-proxy <https-proxy>
--no-proxy <YOUR_NO_PROXY_LIST>
```

The load balancer endpoints must be added to the no-proxy list for the following services: `output processor` and `vm-service`. This is because the no-proxy list is shared between the application and build-agent. The application and build-agent are assumed to be behind the same firewall and therefore cannot have a proxy between them.

For further information see the [Configuring a Proxy](#) guide.

## Frontend Settings

Frontend settings control the web application specific aspects of the CircleCI system.

The screenshot shows the CircleCI web interface for configuring the frontend. The left sidebar lists various settings categories, with 'Frontend Settings' expanded. The main content area displays the 'Frontend Settings' form. At the top, a notification states: 'This config is 172 versions newer than the currently deployed config.' with a link to 'Edit the currently deployed config.' The form includes the following fields and options:

- CircleCI Domain Name** (Required): A text input field for the domain name (e.g., circleci.example.com).
- Frontend Replicas**: A text input field for the number of replicas. The default value is 1.
- Frontend TLS Private Key** (Required): A text area for the PEM encoded TLS private key for the web application. The key is shown as a long string of characters.
- Frontend TLS Certificate** (Required): A text area for the PEM encoded TLS certificate for the web application. The certificate is shown as a long string of characters.
- Enable HTTPS Termination** (Checked): A checkbox that, when enabled, allows CircleCI to terminate TLS. Disabling this requires TLS to be terminated upstream.
- Automatically request and manage Let's Encrypt TLS certificates** (Recommended): A checkbox that, when enabled, allows Let's Encrypt to automatically request and manage certificates. It requires a publicly accessible DNS record.
- Private load balancers**: A checkbox that, when checked, makes the load balancers for the frontend private, resulting in no public IPs being assigned to them.
- Serve Unsafe Artifacts**: A checkbox that, when checked, allows specially-crafted artifacts to gain control of users' CircleCI accounts. A warning message is displayed below this option.

Figure 4. Frontend Settings

Complete the fields described below. You can either supply a private key and certificate or check the box to allow Let's Encrypt to automatically request and manage certificates for you. You can also disable TLS termination at this point, but the system will still need to be accessed over HTTPS.



If you are selecting the option to use private load balancers, the Let's Encrypt option will no longer work and become unavailable.

- **Domain Name (required)** - Enter the domain name you specified when creating your Frontend TLS key and certificate.
- **Frontend Replicas (optional)** - Used to increase the amount of traffic that can be handled by the frontend.
- **Frontend TLS Private Key (required)** - You created this during your pre-requisite steps. You can retrieve this value with the following command: `

```
cat /etc/letsencrypt/live/<CIRCLECI_SERVER_DOMAIN>/privkey.pem
```

- **Frontend TLS Certificate (required)** - You created this during your pre-requisite steps. You can retrieve this value with the following command:

```
cat /etc/letsencrypt/live/<CIRCLECI_SERVER_DOMAIN>/fullchain.pem
```

- **Private Load Balancer (optional)** - Load balancer doesn't generate external IP addresses.

### Artifact and Encryption Signing Settings

Encryption and artifact signing keys were created during prerequisites phase. You can enter them here now.

Complete the following fields:

- **Artifact Signing Key (required)**
- **Encryption Signing Key (required)**

### Github Settings

You created your Github OAuth application in the prerequisite phase, use the data to complete the following:

- **Github Type (required)** - Select Cloud or Enterprise (on premises).
- **OAuth Client ID (required)** - The OAuth Client ID provided by Github.
- **OAuth Client Secret (required)** - The OAuth Client Secret provided by Github.

### Object Storage Settings

You created your Object Storage Bucket and Keys in the prerequisite steps, use the data to complete the following:

#### S3 Compatible

You should have created your S3 Compatible bucket and optional IAM account during the prerequisite steps.

- **Storage Bucket Name (required)** - The bucket used for server.
- **Access Key ID (required)** - Access Key ID for S3 bucket access.

- **Secret Key (required)** - Secret Key for S3 bucket access.
- **AWS S3 Region (optional)** - AWS region of bucket if your provider is AWS. S3 Endpoint is ignored if this option is set.
- **S3 Endpoint (optional)** - API endpoint of S3 storage provider. Required if your provider is not AWS. AWS S3 Region is ignored if this option is set.
- **Storage Object Expiry (optional)** - Number of days to retain your test results and artifacts. Set to 0 to disable and retain objects indefinitely.

### Google Cloud Storage

You should have created your Google Cloud Storage bucket and service account during the prerequisite steps.

- **Storage Bucket Name (required)** - The bucket used for server.
- **Service Account JSON (required)** - A JSON format key of the Service Account to use for bucket access.
- **Storage Object Expiry (optional)** - Number of days to retain your test results and artifacts. Set to 0 to disable and retain objects indefinitely.

### Nomad

Set mTLS to `disabled`. This should be disabled by default but there is a known issue currently preventing this. Disabling allows you to ignore Nomad settings until phase 3 of the installation process where we will install build services.

### Postgres, MongoDB, Vault settings

You can skip these sections unless you plan on using an existing Postgres, MongoDB or Vault instance, in which case see the [Externalizing Services doc](#). By default CircleCI server will create its own Postgres, MongoDB and Vault instances within the CircleCI namespace. The instances inside the CircleCI namespace will be included in the CircleCI backup and restore process.

### Save and Deploy

Once you have completed the fields detailed above it is time to deploy. The deployment will install the core services and provide you an IP address for the Traefik load balancer. That IP address will be critical in setting up a DNS record and completing the first phase of the installation.



In this first stage we skipped a lot of fields in the config. Not to worry. We will revisit those in the next stages of installation.

### Create DNS Entry

Create a DNS entry for your Traefik load balancer, for example, `circleci.your.domain.com` and `app.circleci.your.domain.com`. The DNS entry should align with the DNS names used when creating your TLS certificate and GitHub OAuth app during the prerequisites steps. All traffic will be routed through this DNS record.

You will need the IP address or, if using AWS, the DNS name of the Traefik load balancer. You can find this with the following command:



```
kubectl get service circleci-server-traefik --namespace=<YOUR_CIRCLECI_NAMESPACE>
```

For more information on adding a new DNS record, see the following documentation:

- [Managing Records](#) (GCP)
- [Creating records by using the Amazon Route 53 Console](#) (AWS)

## Validation

You should now be able to navigate to your CircleCI server installation and log in to the application successfully. Now let's move on to build services. It may take a while for all your services to be up. You can periodically check by running the following command (you are looking for the "frontend" pod to be status of running and ready should show 1/1):

```
kubectl get pods -n <YOUR_CIRCLECI_NAMESPACE>
```

# CircleCI Server v3.x Installation Phase 3

Before you begin with the CircleCI server v3.x build services installation phase, ensure you have run through [Phase 1 – Prerequisites](#) and [Phase 2 - Core services installation](#).



In the following steps replace any items or credentials displayed between `< >` with your details.

## Phase 3: Build services installation

### Output Processor

#### Overview

Output processor is responsible for handling the output from Nomad clients. It is a key service to scale if you find your system slowing down. We recommend increasing the output processor replica set to scale the service up to meet demand.

Access the KOTS admin console. Get to the KOTS admin console by running the following, substituting your namespace: `kubectl kots admin-console -n <YOUR_CIRCLECI_NAMESPACE>`

Locate and enter the following in Settings:

1. **Output Processor Load Balancer (required)** - The following command will provide the IP address of the service

```
kubectl get service output-processor --namespace=<YOUR_CIRCLECI_NAMESPACE>
```

2. **Save your configuration.** You will deploy and validate your setup after you complete Nomad client setup.

### Nomad Clients

#### Overview

As mentioned in the [Overview](#), Nomad is a workload orchestration tool that CircleCI uses to schedule (via Nomad Server) and run (via Nomad Clients) CircleCI jobs.

Nomad clients are installed outside of the Kubernetes cluster, while their control plane (Nomad Server) is installed within the cluster. The communication between your Nomad Clients and the nomad control plane are secured with mTLS. The mTLS certificate, private key, and certificate authority will be output after you complete the Nomad Clients installation.

Once completed you will be able to update your CircleCI server configuration so your Nomad control plane is able to communicate with your Nomad Clients.

## Cluster Creation with Terraform

CircleCI curates Terraform modules to help install Nomad clients in your cloud provider of choice. You can browse the modules in our [public repository](#) including example Terraform config files (`main.tf`) for both AWS and GKEs for `main.tf`. Some information about your cluster and server installation is required to complete your `main.tf`. How to get this information is described in the following sections.

### AWS

You will need some information about your cluster and server installation to complete the required fields for the terraform configuration file (`main.tf`). A full example as well as a full list of variables can be found [here](#).

- **Server\_endpoint** - You will need to know the Nomad Server endpoint, which is the external IP address of the nomad-server-external Loadbalancer. You can get this information with the following command:

```
kubectl get service nomad-server-external --namespace=<YOUR_CIRCLECI_NAMESPACE>
```

- **Subnet ID (subnet), VPC ID (vpcId), and DNS server (dns\_server)** of your cluster. Run the following command to get the cluster VPC ID (`vpcId`), CIDR block (`serviceIpv4Cidr`), and subnets (`subnetIds`):

```
aws eks describe-cluster --name=<YOUR_CLUSTER_NAME>
```

This will return something similar to the following:

```

{...
  "resourcesVpcConfig": {
    "subnetIds": [
      "subnet-033a9fb4be69",
      "subnet-04e89f9eef89",
      "subnet-02907d9f35dd",
      "subnet-0fbc63006c5f",
      "subnet-0d683b6f6ba8",
      "subnet-079d0ca04301"
    ],
    "clusterSecurityGroupId": "sg-022c1b544e574",
    "vpcId": "vpc-02fdfff4c",
    "endpointPublicAccess": true,
    "endpointPrivateAccess": false
  },
  "kubernetesNetworkConfig": {
    "serviceIpv4Cidr": "10.100.0.0/16"
  },
  ...
}

```

Then, using the VPCID you just found, run the following command to get the CIDR Block for your cluster. For AWS, the DNS Server is the third IP in your CIDR block (CidrBlock), for example your CIDR block might be 10.100.0.0/16 so the third IP would be 10.100.0.2.

```
aws ec2 describe-vpcs --filters Name=vpc-id,Values=<YOUR_VPCID>
```

This will return something like the following:

```

{...
  "CidrBlock": "192.168.0.0/16",
  "DhcpOptionsId": "dopt-9cff",
  "State": "available",
  "VpcId": "vpc-02fdfff4c"
  ...
}

```

Once you have filled in the appropriate information you can deploy your nomad clients by running the following from within the directory of the `main.tf` file.

```
terraform init
```

```
terraform plan
```

```
terraform apply
```

After Terraform is done spinning up the Nomad client(s), it will output the certificates and keys needed for configuring the Nomad control plane in CircleCI server. Make sure to copy them somewhere safe. The apply process usually only takes a minute.

### GKE

You will need the IP address of the Nomad control plane (Nomad Server), which was created when you deployed CircleCI Server. You can get the IP address by issuing the following command:

```
kubectl get service nomad-server-external --namespace=<YOUR_CIRCLECI_NAMESPACE>
```

You will also need the following information:

- The GPC Project you want to run nomad clients in.
- The GPC Zone you want to run nomad clients in.
- The GPC Region you want to run nomad clients in.
- The GPC Network you want to run nomad clients in.
- The ID of the GPC subnet you want to run nomad clients in.

You can copy the following example to your local environment and fill in the appropriate information for your specific setup. Once you have filled in the appropriate information you can deploy your nomad clients by running.

```
terraform init
```

```
terraform plan
```

```
terraform apply
```

After Terraform is done spinning up the Nomad client(s), it will output the certificates and key needed for configuring the Nomad control plane in CircleCI server. Make sure to copy them somewhere safe.

## Configure and Deploy

Now that you have successfully deployed your Nomad clients, you can configure CircleCI Server and the Nomad control plane. Access the KOTS admin console. Get to the KOTS admin console by running the following, substituting your namespace: `kubectl kots admin-console -n <YOUR_CIRCLECI_NAMESPACE>`

Enter the following in Settings:

- **Nomad Load Balancer (required)**

```
kubectl get service nomad-server-external --namespace=<YOUR_CIRCLECI_NAMESPACE>
```

- **Nomad Server Certificate (required)** - Provided in the output from `terraform apply`
- **Nomad Server Private Key (required)** - Provided in the output from `terraform apply`
- **Nomad Server Certificate Authority (CA) Certificate (required)** - Provided in the output from `terraform apply`

Click the **Save config** button to update your installation and re-deploy server.

## Nomad Clients Validation

CircleCI has created a project called [realitycheck](#) which allows you to test your Server installation. We are going to follow the project so we can verify that the system is working as expected. As you continue through the next phase, sections of realitycheck will move from red to green.

To run realitycheck you will need to clone the repository. Depending on your Github setup you can do one of the following.

### Github Cloud

```
git clone -b server-3.0 https://github.com/circleci/realitycheck.git
```

### Github Enterprise

```
git clone -b server-3.0 https://github.com/circleci/realitycheck.git
git remote set-url origin <YOUR_GH_REPO_URL>
git push
```

Once you have successfully cloned the repository you can follow it from within your CircleCI server installation. You will need to set the following variables. For full instructions please see the [repository readme](#).

Table 1. Environmental Variables

Name	Value
CIRCLE_HOSTNAME	<YOUR_CIRCLECI_INSTALLATION_URL>

Name	Value
CIRCLE_TOKEN	<YOUR_CIRCLECI_API_TOKEN>

Table 2. Contexts

Name	Environmental Variable Key
Environmental Variable Value	org-global
CONTEXT_END_TO_END_TEST_VAR	Leave blank
individual-local	MULTI_CONTEXT_END_TO_END_VAR

Once you have configured the environmental variables and contexts, rerun the realitycheck tests. You should see the features and resource jobs complete successfully. Your test results should look something like the following:

Pipeline	Status	Workflow	Branch / Commit	Start	Duration	Actions
realitycheck 3	Running	vm_jobs	master 368b13d	19s ago	1m 48s	...
Jobs						
		remote_docker 60			1m 19s	
		machine_dlc 62			1m 29s	
		machine 63			1m 23s	
		docker_layer_caching 61			1m 19s	
	Success	resource_class_jobs	master 368b13d	29s ago	29s	...
Jobs						
		xlarge 55			20s	
		small 58			2s	
		medium+ 57			20s	
		medium 59			3s	
		large 56			21s	
	Success	feature_jobs	master 368b13d	2m ago	31s	...
Jobs						
		write_workspace 51			6s	
		save_and_restore_cache 49			27s	
		read_workspace 54			2s	
		multi-contexts 52			6s	
		contexts 53			5s	
		artifacts_test_results 50			7s	

## VM service

VM service configures VM and remote docker jobs. You can configure a number of options for VM service, such as scaling rules. VM service is unique to EKS and GKE installations because it specifically relies on features of these cloud providers.

## EKS

### 1. Get the Information Needed to Create Security Groups

The following will return your VPC ID (`vpcId`), CIDR Block (`serviceIpv4Cidr`), Cluster Security Group ID (`clusterSecurityGroupId`) and Cluster ARN (`arn`) values, which you will need throughout this section:

```
aws eks describe-cluster --name=<your-cluster-name>
```

## 2. Create a security group

Run the following commands to create a security group for VM service.

```
aws ec2 create-security-group --vpc-id "<YOUR_VPCID>" --description "CircleCI VM Service security group" --group-name "circleci-vm-service-sg"
```

This will output a GroupID to be used in the next steps:

```
{
  "GroupId": "sg-0cd93e7b30608b4fc"
}
```

## 3. Apply security group Nomad

Use the security group you just created and CIDR block values to apply the security group to the following:

```
aws ec2 authorize-security-group-ingress --group-id "<YOUR_GroupId>" --protocol tcp --port 22 --cidr "<YOUR_serviceIpv4Cidr>"
```

```
aws ec2 authorize-security-group-ingress --group-id "<YOUR_GroupId>" --protocol tcp --port 2376 --cidr "<YOUR_serviceIpv4Cidr>"
```



If you created your Nomad Clients in a different subnet from CircleCI server, you will need to rerun the above two commands with each subnet CIDR.

## 4. Apply the Security Group for SSH

Run the following command to apply the security group rules so users can SSH into their jobs:

```
aws ec2 authorize-security-group-ingress --group-id "<YOUR_GroupId>" --protocol tcp --port 54782
```

## 5. Create user

Create a new user with programmatic access:

```
aws iam create-user --user-name circleci-server-vm-service
```



## 6. Create Policy

Create a `policy.json` file with the following content. You should fill in Cluster Security Group ID (`clusterSecurityGroupId`) and Cluster ARN (`arn`) below.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Action": "ec2:RunInstances",
      "Effect": "Allow",
      "Resource": [
        "arn:aws:ec2::*:image/*",
        "arn:aws:ec2::*:snapshot/*",
        "arn:aws:ec2::*:key-pair/*",
        "arn:aws:ec2::*:launch-template/*",
        "arn:aws:ec2::*:network-interface/*",
        "arn:aws:ec2::*:placement-group/*",
        "arn:aws:ec2::*:volume/*",
        "arn:aws:ec2::*:subnet/*",
        "arn:aws:ec2::*:security-group/<YOUR_clusterSecurityGroupId>"
      ]
    },
    {
      "Action": "ec2:RunInstances",
      "Effect": "Allow",
      "Resource": "arn:aws:ec2::*:instance/*",
      "Condition": {
        "StringEquals": {
          "aws:RequestTag/ManagedBy": "circleci-server-vm-service"
        }
      }
    },
    {
      "Action": [
        "ec2:CreateVolume"
      ],
      "Effect": "Allow",
      "Resource": [
        "arn:aws:ec2::*:volume/*"
      ],
      "Condition": {
```

```

        "StringEquals": {
            "aws:RequestTag/ManagedBy": "circleci-server-vm-service"
        }
    },
    {
        "Action": [
            "ec2:Describe*"
        ],
        "Effect": "Allow",
        "Resource": "*"
    },
    {
        "Effect": "Allow",
        "Action": [
            "ec2:CreateTags"
        ],
        "Resource": "arn:aws:ec2:*:*:*/*/*",
        "Condition": {
            "StringEquals": {
                "ec2:CreateAction" : "CreateVolume"
            }
        }
    },
    {
        "Effect": "Allow",
        "Action": [
            "ec2:CreateTags"
        ],
        "Resource": "arn:aws:ec2:*:*:*/*/*",
        "Condition": {
            "StringEquals": {
                "ec2:CreateAction" : "RunInstances"
            }
        }
    },
    {
        "Action": [
            "ec2:CreateTags",
            "ec2:StartInstances",
            "ec2:StopInstances",

```

```

        "ec2:TerminateInstances",
        "ec2:AttachVolume",
        "ec2:DetachVolume",
        "ec2>DeleteVolume"
    ],
    "Effect": "Allow",
    "Resource": "arn:aws:ec2:*:*:*/*",
    "Condition": {
        "StringEquals": {
            "ec2:ResourceTag/ManagedBy": "circleci-server-vm-service"
        }
    }
},
{
    "Action": [
        "ec2:RunInstances",
        "ec2:StartInstances",
        "ec2:StopInstances",
        "ec2:TerminateInstances"
    ],
    "Effect": "Allow",
    "Resource": "arn:aws:ec2:*:*:subnet/*",
    "Condition": {
        "StringEquals": {
            "ec2:Vpc": "<YOUR_arn>"
        }
    }
}
]
}

```

## 7. Attach Policy to User

Once you have created the policy.json file attach it to an IAM policy and created user.

```
aws iam put-user-policy --user-name circleci-server-vm-service --policy-name circleci-server-vm-
service --policy-document file://policy.json
```

## 8. Create an access key and secret for the user

If you have not already, you will need an access key and secret for the `circleci-server-vm-service` user. You can create that by running the following command:

```
aws iam create-access-key --user-name circleci-server-vm-service
```

## 9. Configure Server

Configure VM Service through the KOTs admin console. The following fields need to be completed for VM service to operate correctly.

- **AWS Region (required)** - This is the region the application is in.
- **Subnets (required)** - Choose a subnet (public or private) where the VMs should be deployed. If you haven't created a unique subnet you can use the subnet of the cluster. Note that all subnets must be in the same availability zone.
- **Security Group ID (required)** - This is the security group that will be attached to the VMs. It was created previously.
- **AWS IAM Access Key ID (required)** - AWS Access Key ID for EC2 access.
- **AWS IAM Secret Key (required)** - IAM Secret Key for EC2 access.
- **AWS Windows AMI ID (optional)** - If you require Windows builders, you can supply an AMI ID for them here.

Once you have configured the fields, **save your config** and deploy your updated application.

## GKE

You will need additional information about your cluster to complete the next section. Run the following:

```
gcloud container clusters describe
```

This command will return something like the following, which will include network, region and other details that you will need to complete the next section:

```

addonsConfig:
  gcePersistentDiskCsiDriverConfig:
    enabled: true
  kubernetesDashboard:
    disabled: true
  networkPolicyConfig:
    disabled: true
clusterIpv4Cidr: 10.100.0.0/14
createTime: '2021-08-20T21:46:18+00:00'
currentMasterVersion: 1.20.8-gke.900
currentNodeCount: 3
currentNodeVersion: 1.20.8-gke.900
databaseEncryption:
...

```

## 1. Create firewall rules

Run the following commands to create a firewall rules for VM service in GKE:

```

gcloud compute firewall-rules create "circleci-vm-service-internal-nomad-fw" --network
"<network>" --action allow --source-ranges "0.0.0.0/0" --rules "TCP:22,TCP:2376"

```



You can find the Nomad clients CIDR based on the region by referring to the [table here](#) if you have used auto-mode.

```

gcloud compute firewall-rules create "circleci-vm-service-internal-k8s-fw" --network "<network>"
--action allow --source-ranges "<clusterIpv4Cidr>" --rules "TCP:22,TCP:2376"

```

```

gcloud compute firewall-rules create "circleci-vm-service-external-fw" --network "<network>"
--action allow --rules "TCP:54782"

```

## 2. Create user

We recommend you create a unique service account used exclusively by VM Service. The Compute Instance Admin (Beta) role is broad enough to allow VM Service to operate. If you wish to make permissions more granular, you can use the Compute Instance Admin (beta) role documentation as reference.

```

gcloud iam service-accounts create circleci-server-vm --display-name "circleci-server-vm service
account"

```

### 3. Get the service account email address

```
gcloud iam service-accounts list --filter="displayName:circleci-server-vm service account"
--format 'value(email)'
```

### 4. Apply role to service account

Apply the Compute Instance Admin (Beta) role to the service account.

```
gcloud projects add-iam-policy-binding <YOUR_PROJECT_ID> --member
serviceAccount:<YOUR_SERVICE_ACCOUNT_EMAIL> --role roles/compute.instanceAdmin --condition=None
```

And

```
gcloud projects add-iam-policy-binding <YOUR_PROJECT_ID> --member
serviceAccount:<YOUR_SERVICE_ACCOUNT_EMAIL> --role roles/iam.serviceAccountUser --condition=None
```

### 5. Get JSON Key File

After running the following, you should have a file named `circleci-server-vm-keyfile` in your local working directory. You will need this when you configure your server installation.

```
gcloud iam service-accounts keys create circleci-server-vm-keyfile --iam-account
<YOUR_SERVICE_ACCOUNT_EMAIL>
```

### 6. Configure Server

Configure VM service through the KOTS admin console:

- **VM Service Load Balancer (required)** This can be found using the following command:

```
kubectl get service vm-service --namespace=<YOUR_CIRCLECI_NAMESPACE>
```

- **GCP project ID (required)** - Name of the GCP project the cluster resides.
- **GCP Zone (required)** - GCP zone the virtual machines instances should be created in for example "us-east1-b".
- **GCP VPC Network (required)** - Name of the VPC Network.
- **GCP VPC Subnet (optional)** - Name of the VPC Subnet. If using auto-subnetting, leave this field blank.
- **GCP Service Account JSON Key File (required)** - Copy and paste the contents of your service account JSON file.
- **GCP Windows Image (optional)** - Name of the image used for Windows builds. Leave this field blank if you do not require them.

Click the **Save config** button to update your installation and re-deploy server.

### Additional VM Service Configuration

- **Number of <VM type> VMs to keep prescaled (optional)** - By default, this field is set to 0 which will create and provision instances of a resource type on demand. You have the option of preallocating up to 5 instances per resource type. Preallocating instances lowers the start time allowing for faster machine and remote\_docker builds.



that preallocated instances are always running and could potentially increase costs. Decreasing this number may also take up to 24 hours for changes to take effect. You have the option of terminating those instances manually, if required.

### VM Service Validation

Once you have configured and deployed CircleCI server you should validate that VM Service is operational. You can re-run the reality checker project within your CircleCI installation and you should see the VM Service Jobs complete with green. At this point all tests should pass with green.

## Runner

### Overview

CircleCI runner does not require any additional server configuration. Server ships ready to work with runner. However, you do need to create a runner and configure the runner agent to be aware your server installation. For complete instructions for setting up runner see the [runner documentation](#).



Runner requires a namespace per organization. Server can have many organizations. If your company has multiple organizations within your CircleCI installation you will need to set up a runner namespace for each organization within your server installation.

# CircleCI Server v3.x Installation Phase 4

Before you begin with the CircleCI server v3.x post installation phase, ensure you have run through [Phase 1 - Prerequisites](#), [Phase 2 - Core services installation](#) and [Phase 3 - Build services installation](#).

## Phase 4: Post installation

### Orbs

Server installations include their own local orb registry. This registry is private to the server installation. All orbs referenced in project configs reference the orbs in the *server* orb registry. You are responsible for maintaining orbs. This includes:

- Copying orbs from the public registry
- Updating orbs that may have been copied prior
- Registering your company's private orbs if they exist

For more information, and steps to complete these tasks see the [Orbs on Server guide](#).

### Email Notifications

Build notifications are sent via email. Access the KOTS admin console. Get to the KOTS admin console by running the following, substituting your namespace: `kubectl kots admin-console -n <YOUR_CIRCLECI_NAMESPACE>` and locate the **Email Notifications** section in **Settings** and fill in the following details to configure email notifications for your installation.

- **Email Submission server hostname (required)** - Host name of the submission server (e.g., for Sendgrid use smtp.sendgrid.net).
- **Username (required)** - Username to authenticate to submission server. This is commonly the same as the user's e-mail address.
- **Password (required)** - Password to authenticate to submission server.
- **Port (optional)** - Port of the submission server. This is usually either 25 or 587. While port 465 is also commonly used for email submission, it is often used with implicit TLS instead of StartTLS. Server only supports StartTLS for encrypted submission.



Outbound connections on port 25 are blocked on most cloud providers. Should you select this port, be aware that your notifications may fail to send. Enable StartTLS: Enabling this will encrypt mail submission.

- **Email from address (required)** - The from address for the email.



StartTLS is used to encrypt mail by default, and you should only disable this if you can otherwise guarantee the confidentiality of traffic.

Click the **Save config** button to update your installation and re-deploy server.



# CircleCI Server v3.x Migration

Migrating from 2.19.x to 3.x requires you to back up your 2.19 instance data (Mongo, Postgres, and Vault) and then restore that data in a waiting Server 3.x instance. If you run into trouble you can fallback to your 2.19 instance. Migration does require an already operating Server 3.x installation. Depending on the size of your data stores, the migration can take anywhere from a few minutes to a few hours. We recommend using a staging environment before completing this process in a production environment. This will not only allow you to gain a better understanding of the migration process, but will also give you a feel for how long the migration will take to complete.

## Prerequisites

1. Your current CircleCI Server installation is 2.19.
2. You have taken a backup of the 2.19 instance. If you are using external datastores, they will need to be backed up separately.
3. You have a new CircleCI Server 3.x [installation](#).
4. You have successfully run [reality check](#) with contexts prior to starting.
5. The migration script must be run from a machine with:
  - `kubectl` configured for the server 3.x instance
  - `ssh` access to the 2.19 services box

## External Datastores Only

1. Backups have been taken of all external data stores.
2. Postgres has been updated to version 12.

## Internal Datastore Only

1. You have taken a backup of the 2.19 instance.
2. You have successfully run [reality check](#) on the new server 3.x instance with contexts prior to starting.

## Migration



Migrating to server v3.x will shut down your v2.19 application. Your v2.19 application will not be started back up, although you may manually start it back up using the administrative console.



Starting the migration process will cause downtime. It is recommended you schedule a maintenance window.



Running server 2.19 and server 3.x at the same time can cause issues to your 2.19 build data. Server 2.19 should NOT be restarted if server 3.x is running.

## Step 1 - Clone the repository and run the migration script

The instructions below will clone the repository containing the server v2.19.x to server v3.x migration script. The migration script will:

- Stop your v2.19.x application
- Perform pre-flight checks to confirm namespace and datastores for 2.19.x.
- Create a tarball of your v2.19.x application's PostgreSQL and Mongo databases.
- Archive existing application data for Vault and CircleCI encryption/signing keys.
- Export the 2.19.x tarball to your v3.x installation. Exported data stores are stored in a directory named `circleci_export`, located relative to wherever the migration script is run from. This can be useful for debugging purposes.
- Perform pre-flight checks to confirm namespace and datastores for 3.x instance.
- Scale v3.x application deployments down to zero.
- Import the data from the previously exported tarball to your new v3.x instance.
- Scale v3.x application deployments up to one.



If you have externalized services then you can run `bash migrate.sh -v -p -m`. These `-v -p -m` flags will skip the migration of Vault, Postgres, and Mongo, respectively. Skipping all three will copy your keys from `/data/circle/circleci-encryption-keys` on the v2.19.x services machine, allowing you to `cat` these files and upload their contents to the 3.x configuration page.

In a terminal:

1. Run `git clone https://github.com/CircleCI-Public/server-scripts`.
2. Change into the `migrate` directory: `cd server-scripts/migrate`.
3. Run the migration script: `./migrate.sh`.
4. You will be prompted for the following information:
  - Username of your server 2.19 installation
  - Hostname of your server 2.19 installation
  - The path to your SSH key file for your server 2.19.x installation
  - Kubernetes namespace of your server 3.x installation
5. After the script has completed, the Signing and Encryption keys from the 2.19 instance will need to be added to the new 3.0 instance via the KOTS Admin Console. The keys will be located in `circleci_export/circle-data`.
6. The 3.x instance will either need to be updated to point at the same storage bucket that the 2.19 instance used, or the data needs to be copied over to a new bucket. The latter will ensure the 2.19 instance continues to work as expected, and so is the recommended approach if this migration is part of a test.



If a different hostname is being used in the 3.x environment, the GitHub webhooks will still be pointing to the hostname used in the 2.19 environment. The easiest way to update this is to click **Stop Building** and then **Set Up Project**. After doing this, the contexts and environment variables associated with the project will still be present.

## Step 2 - Validate your migration to Server 3.0

Re-run [reality check](#) with contexts on your new server 3.x environment by pushing a fresh commit.

## Step 3 - Update your team

Once you have successfully run [reality check](#), notify your team of the new CircleCI UI and URL, if it has changed.

## Frequently Asked Questions

### Where did all my job and build history go?

- All of your existing jobs and build history have been moved to the Legacy Jobs view. You can view the complete job history using one of the following methods:
  - Selecting Projects → PROJECT\_NAME and selecting the `legacy jobs` view link at the bottom of the project's build history
  - Using the following URL pattern: `https://<APP_DOMAIN>/pipelines/github/<ORG>/<PROJECT>/jobs`
  - For a specific job, append a job number to the URL:  
`https://<APP_DOMAIN>/pipelines/github/<ORG>/<PROJECT>/jobs/<JOB_NUMBER>`

### Why does nothing happen when I select "Start Building" on my project after migration?

- By default, a newly added project (a project that has never been followed) will trigger a build automatically after it has been followed for the first time. If the project was or ever has been followed in 2.0 or 3.0, it will not be considered a new project or first build and a build will not be triggered after follow. To trigger a build, perform an activity that will trigger a Github webhook such as pushing up a new commit or branch.

### I got an error "Error from server (NotFound):"

- The script assumes specific naming patterns for your Postgres and MongoDB. If you get this error, it may indicate a non-standard installation, a missing DB migration, or other issues. In this case it is best to contact support with a support bundle and the output from the migration script.

# CircleCI Server v3.x Hardening Your Cluster

This section provides supplemental information on hardening your Kubernetes cluster.

## Network Topology

A server installation basically runs three different type of compute instances: The Kubernetes nodes, Nomad clients and external VMs.

It is highly recommended that you deploy these into separate subnets with distinct CIDR blocks. This will make it easier for you to control traffic between the different components of the system and isolate them from each other.

As always, the rule is to make as many of the resources as private as possible, applies. If your users will access your CircleCI server installation via VPN, there is no need to assign any public IP addresses at all, as long as you have a working NAT gateway setup. Otherwise, you will need at least one public subnet for the CircleCI server Traefik load balancer.

However, in this case, it is also recommended to place Nomad clients and VMs in a public subnet to enable your users to SSH into jobs and scope access via networking rules.

Currently, custom subnetting is not supported for GCP. Custom subnetting support will be available in a future update/release.

## Network Traffic

This section spells out the minimum requirements that are needed for a server installation to work. Depending on your workloads, you might need to add additional rules to egress for Nomad clients and VMs. Nomenclature between cloud providers differs, therefore, you will probably need to implement these rules using firewall rules and/or security groups.

Where you see "external," this usually means all external IPv4 addresses. Depending on your particular setup, you might be able to be more specific (e.g., if you are using a proxy for all external traffic).

It is assumed that you have configured the load balancers for Nomad, vm-service and output processor to be internal load balancers - this is the default.

The rules spelled out here are assumed to be stateful and for TCP connections only, unless stated otherwise. If you are working with stateless rules, you will need to create matching ingress or egress rules to the ones listed here.

## Kubernetes Load Balancers

Depending on your setup, your load balancers might be transparent (i.e. they are not treated as a distinct layer in your networking topology). In this case, you can apply the rules from this section directly to the underlying destination or source of the network traffic. Refer to the documentation of your cloud provider to make sure you understand how to correctly apply networking security rules given the type of load balancing you are using with your installation.

## Ingress

If the traffic rules for your load balancers have not been created automatically, here are their respective ports:

Name	Port	Source	Purpose
*-server-traefik	80	External	User Interface & Frontend API
*-server-traefik	443	External	User Interface & Frontend API
vm-service	3000	Nomad clients	Communication with Nomad clients
nomad	4647	Nomad clients	Communication with Nomad clients
output-processor	8585	Nomad clients	Communication with Nomad clients

## Egress

The only type of egress needed is TCP traffic to the K8s nodes on the K8s load balancer ports (30000-32767). This is not needed if your load balancers are transparent.

## Common Rules for Compute Instances

These rules apply to all compute instances, but not to the load balancers.

### Ingress

If you want to access your instances via SSH, you will need to open port 22 for TCP connections for the instances in question. It is recommended to scope the rule as closely as possible to allowed source IPs and/or only add such a rule ad hoc when needed.

### Egress

You most likely want all of your instances to access internet resources. This will require you to allow egress for UDP and TCP on port 53 to the DNS server within your VPC, as well as TCP ports 80 and 443 for HTTP and HTTPS traffic, respectively. Instances building jobs (i.e. the Nomad clients and external VMs) also will likely need to pull code from your VCS via SSH (TCP port 22). SSH is also used to communicate with external VMs, so it should be allowed for all instances with the destination of the VM subnet and your VCS at the very least.

## Kubernetes Nodes

### Intra-node traffic

The traffic within your K8s cluster is regulated by networking policies by default. For most purposes, this should be sufficient to regulate the traffic between pods and there is no additional requirement to pare

down traffic between K8s nodes any further (i.e. it is fine to allow all traffic between K8s nodes).

To make use of networking policies within your cluster, you may need to take additional steps, depending on your cloud provider and setup. Here are some resources to get you started:

- [Kubernetes Network Policy Overview](#)
- [Creating a Cluster Network Policy on Google Cloud](#)
- [Installing Calico on Amazon EKS](#)

## Ingress

If you are using a managed service, you can check the rules created for the traffic coming from the load balancers and the allowed port range. The standard port range for K8s load balancers (30000-32767) should be all that is needed here for ingress. If you are using transparent load balancers, you will need to apply the ingress rules listed for load balancers above.

## Egress

Port	Destination	Purpose
2376	VMs	Communication with VMs
4647	Nomad clients	Communication with the Nomad clients
all traffic	other nodes	Allow intra-cluster traffic

## Nomad Clients

Nomad clients do not need to communicate with each other; you can block traffic between Nomad client instances completely.

## Ingress

Port	Source	Purpose
4647	K8s nodes	Communication with Nomad server
64535-65535	External	Rerun jobs with SSH functionality

## Egress

Port	Destination	Purpose
2376	VMs	Communication with VMs
3000	VM Service load balancers	Internal communication
4647	Nomad Load Balancer	Internal communication
8585	Output Processor Load Balancer	Internal communication

## External VMs

Similar to Nomad clients, there is no need for external VMs to communicate with each other.

### Ingress

Port	Source	Purpose
22	Kubernetes nodes	Internal communication
22	Nomad clients	Internal communication
2376	Kubernetes nodes	Internal communication
2376	Nomad clients	Internal communication
54782	External	Rerun jobs with SSH functionality

### Egress

You will only need the egress rules for internet access and SSH for your VCS.