

# Getting Started

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This tutorial will walk you through a complete Sidero setup and the formation, scaling, and destruction of a workload cluster.

To complete this tutorial, you will need a few things:

- ISC DHCP server. While any DHCP server will do, we will be presenting the configuration syntax for ISC DHCP. This is the standard DHCP server available on most Linux distributions (NOT dnsmasq) as well as on the Ubiquiti EdgeRouter line of products.
- Machine or Virtual Machine on which to run Sidero itself. The requirements for this machine are very low, it can be x86 or arm64 and it should have at least 4GB of RAM.
- Machines on which to run Kubernetes clusters. These have the same minimum specifications as the Sidero machine.
- Workstation on which `talosctl`, `kubectl`, and `clusterctl` can be run.

## Useful Terms

**ClusterAPI** or **CAPI** is the common system for managing Kubernetes clusters in a declarative fashion.

**Management Cluster** is the cluster on which Sidero itself runs. It is generally a special-purpose Kubernetes cluster whose sole responsibility is maintaining the CRD database of Sidero and providing the services necessary to manage your workload Kubernetes clusters.

**Sidero** is the ClusterAPI-powered system which manages baremetal infrastructure for Kubernetes.

**Talos** is the Kubernetes-focused Linux operating system built by the same people who bring to you Sidero. It is a very small, entirely API-driven OS which is meant to provide a reliable and self-maintaining base on which Kubernetes clusters may run. More information about Talos can be found at <https://talos.dev>.

**Workload Cluster** is a cluster, managed by Sidero, on which your Kubernetes workloads may be run. The workload clusters are where you run your own applications and infrastructure. Sidero creates them from your available resources, maintains them over time as your needs and resources change, and removes them whenever it is told to do so.

# 1 - Prerequisite: CLI tools

Prerequisite: CLI tools

You will need three CLI tools installed on your workstation in order to interact with Sidero:

- kubectl
- clusterctl
- talosctl

## Install kubectl

Since `kubectl` is the standard Kubernetes control tool, many distributions already exist for it. Feel free to check your own package manager to see if it is available natively.

Otherwise, you may install it directly from the main distribution point. The main article for this can be found [here](#).

```
sudo curl -Lo /usr/local/bin/kubectl \
"https://dl.k8s.io/release/$(\`curl -L -s https://dl.k8s.io/release/stable.txt\`)/bin/linux/amd64/kubectl"
sudo chmod +x /usr/local/bin/kubectl
```

## Install clusterctl

The `clusterctl` tool is the standard control tool for ClusterAPI (CAPI). It is less common, so it is also less likely to be in package managers.

The main article for installing `clusterctl` can be found [here](#).

```
sudo curl -Lo /usr/local/bin/clusterctl \
"https://github.com/kubernetes-sigs/cluster-api/releases/download/v1.5.0/clusterctl-$(uname -s | tr '[:upper:]' '[:lower:]')-amd64"
sudo chmod +x /usr/local/bin/clusterctl
```

Note: This version of Sidero is only compatible with CAPI v1beta1, so please install the latest version of `clusterctl` v1.x.

## Install talosctl

The `talosctl` tool is used to interact with the Talos (our Kubernetes-focused operating system) API. The latest version can be found on our [Releases](#) page.

```
sudo curl -Lo /usr/local/bin/talosctl \
"https://github.com/talos-systems/talos/releases/latest/download/talosctl-$(uname -s | tr '[:upper:]' '[:lower:]')-amd64"
sudo chmod +x /usr/local/bin/talosctl
```

## 2 - Prerequisite: Kubernetes

Prerequisite: Kubernetes

In order to run Sidero, you first need a Kubernetes “cluster”. There is nothing special about this cluster. It can be, for example:

- a Kubernetes cluster you already have
- a single-node cluster running in Docker on your laptop
- a cluster running inside a virtual machine stack such as VMWare
- a Talos Kubernetes cluster running on a spare machine

Two important things are needed in this cluster:

- Kubernetes v1.26 or later
- Ability to expose TCP and UDP Services to the workload cluster machines

For the purposes of this tutorial, we will create this cluster in Docker on a workstation, perhaps a laptop.

If you already have a suitable Kubernetes cluster, feel free to skip this step.

## Create a Local Management Cluster

The `talosctl` CLI tool has built-in support for spinning up Talos in docker containers. Let's use this to our advantage as an easy Kubernetes cluster to start from.

Issue the following to create a single-node Docker-based Kubernetes cluster:

```
export HOST_IP="192.168.1.150"

talosctl cluster create \
--name sidero-demo \
-p 67:67/udp,69:69/udp,8081:8081/tcp,51821:51821/udp \
--workers 0 \
--config-patch '[{"op": "add", "path": "/cluster/allowSchedulingOnControlPlanes", "value": true}]' \
--endpoint $HOST_IP
```

The `192.168.1.150` IP address should be changed to the IP address of your Docker host. This is *not* the Docker bridge IP but the standard IP address of the workstation.

Note that there are four ports mentioned in the command above. The first (67) is for DHCP proxy. The second (69) is for TFTP. The third (8081) is for the web server (which serves netboot artifacts and configuration). The fourth (51821) is for the SideroLink Wireguard network.

Exposing them here allows us to access the services that will get deployed on this node. In turn, we will be running our Sidero services with `hostNetwork: true`, so the Docker host will forward these to the Docker container, which will in turn be running in the same namespace as the Sidero Kubernetes components. A full separate management cluster will likely approach this differently, with a load balancer or a means of sharing an IP address across multiple nodes (such as with MetalLB).

Finally, the `--config-patch` is optional, but since we are running a single-node cluster in this Tutorial, adding this will allow Sidero to run on the controlplane. Otherwise, you would need to add worker nodes to this management plane cluster to be able to run the Sidero components on it.

## Access the cluster

Once the cluster create command is complete, you can retrieve the kubeconfig for it using the Talos API:

```
talosctl kubeconfig
```

Note: by default, Talos will merge the kubeconfig for this cluster into your standard kubeconfig under the context name matching the cluster name you created above. If this name conflicts, it will be given a `-1`, a `-2` or so on, so it is generally safe to run. However, if you would prefer to not modify your standard kubeconfig, you can supply a directory name as the third parameter, which will cause a new kubeconfig to be created there instead. Remember that if you choose to not use the standard location, you should set your `KUBECONFIG` environment variable or pass the `--kubeconfig` option to tell the `kubectl` client the name of the kubeconfig file.

## 3 - Prerequisite: DHCP service

Prerequisite: DHCP Service

### Automatic DHCP Proxy

Sidero v0.6 comes with DHCP proxy which augments the DHCP service provided by the network environment with PXE boot instructions automatically. There is no configuration required besides configuring the network environment DHCP server to assign IPs to the machines.

If the Sidero Metal DHCP proxy server is not enabled, follow the next section to set up the DHCP server.

### Manual DHCP Server Configuration

**Note:** This section is only required if you are not using the automatic DHCP proxy.

In order to network boot Talos, we need to set up our DHCP server to supply the network boot parameters to our servers. For maximum flexibility, Sidero makes use of iPXE to be able to reference artifacts via HTTP. Some modern servers support direct UEFI HTTP boot, but most servers still rely on the old TFTP-based PXE boot first. Therefore, we need to tell our DHCP server to find the iPXE binary on a TFTP server.

Conveniently, Sidero comes with a TFTP server which will serve the appropriate files. We need only set up our DHCP server to point to it.

The tricky bit is that at different phases, we need to serve different assets, but they all use the same DHCP metadata key.

In fact, we have as many as six different client types:

- Legacy BIOS-based PXE boot (undionly.kpxe via TFTP)
- UEFI-based PXE boot (snp.efi/ipxe.efi via TFTP)
- UEFI HTTP boot (snp.efi/ipxe.efi via HTTP URL)
- iPXE (boot.ipxe via HTTP URL)
- UEFI-based PXE arm64 boot (ipxe-arm64.efi via TFTP)
- UEFI HTTP boot on arm64 (ipxe-arm64.efi via HTTP URL)

### UEFI iPXE modules

There are two iPXE modules available with Sidero Metal:

- `snp.efi` uses iPXE network drivers to configure networking.
- `ipxe.efi` uses the UEFI network drivers to configure networking.

It is recommended to use `snp.efi` for UEFI-based PXE boot, since it is more reliable. However, some UEFI implementations do not support `snp.efi` and require `ipxe.efi` instead.

### Common client types

If you are lucky and all of the machines in a given DHCP zone can use the same network boot client mechanism, your DHCP server only needs to provide two options:

- Server-Name (option 66) with the IP of the Sidero TFTP service
- Bootfile-Name (option 67) with the appropriate value for the boot client type:
  - Legacy BIOS PXE boot: `undionly.kpxe`
  - UEFI-based PXE boot: `snp.efi` (fallback to `ipxe.efi` if `snp.efi` doesn't work)
  - UEFI HTTP boot: `http://sidero-server-url/tftp/ipxe.efi` (fallback to `ipxe.efi` if `snp.efi` doesn't work)
  - iPXE boot: `http://sidero-server-url/boot.ipxe`
  - arm64 UEFI PXE boot: `snp-arm64.efi` (fallback to `ipxe-arm64.efi` if `snp-arm64.efi` doesn't work)
  - arm64 UEFI HTTP boot: `http://sidero-server-url/tftp/ipxe-arm64.efi` (fallback to `ipxe-arm64.efi` if `snp-arm64.efi` doesn't work)

In the ISC DHCP server, these options look like:

```
next-server 172.16.199.50;
filename "snp.efd";
```

## Multiple client types

If you have a mix of machines, you may need a way to provide different images for different machine types.

Most DHCP servers provide ways to supply such conditional responses: the examples below are for ISC DHCP.

In our example below, 172.16.199.50 is the IP address of our Sidero service.

`ipxe-metal.conf`:

```
allow bootp;
allow booting;

# IP address for PXE-based TFTP methods
next-server 172.16.199.50;

# Configuration for iPXE clients
class "ipxeclient" {
    match if exists user-class and (option user-class = "iPXE");
    filename "http://172.16.199.50/boot.ipxe";
}

# Configuration for legacy BIOS-based PXE boot
class "biosclients" {
    match if not exists user-class and substring (option vendor-class-identifier, 15, 5) = "00000";
    filename "undionly.kpxe";
}

# Configuration for UEFI-based PXE boot
class "pxeclients" {
    match if not exists user-class and substring (option vendor-class-identifier, 0, 9) = "PXEClient";
    filename "snp.efd";
}

# Configuration for UEFI-based HTTP boot
class "httpclients" {
    match if not exists user-class and substring (option vendor-class-identifier, 0, 10) = "HTTPClient";
    option vendor-class-identifier "HTTPClient";
    filename "http://172.16.199.50/tftp/snp.efd";
}
```

Once this file is created, we can include it from our main `dhcpd.conf` inside a `subnet` section.

```
shared-network sidero {
    subnet 172.16.199.0 netmask 255.255.255.0 {
        option domain-name-servers 8.8.8.8, 1.1.1.1;
        option routers 172.16.199.1;
        include "/config/ipxe-metal.conf";
    }
}
```

Since we use a number of Ubiquiti EdgeRouter devices in our home test networks, it is worth mentioning the syntax gymnastics we must go through there. Essentially, the quotes around the path need to be entered as HTML entities: &quot; .

Ubiquiti EdgeRouter configuration statement:

```
set service dhcp-server shared-network-name sidero \
subnet 172.16.199.1 \
subnet-parameters "include "/config/ipxe-metal.conf";"
```

Also note the fact that there are two semicolons at the end of the line. The first is part of the HTML-encoded "( &quot; ) and the second is the actual terminating semicolon.

## Troubleshooting

Getting the netboot environment correct is tricky and debugging it is difficult: the problem is nearly always one of a missing or incorrect configuration, since the process involves several different components.

See the Sidero [Troubleshooting](#) guide for more assistance.

## 4 - Install Sidero

### Install Sidero

Sidero is included as a default infrastructure provider in `clusterctl`, so the installation of both Sidero and the Cluster API (CAPI) components is as simple as using the `clusterctl` tool.

**Note:** Because Cluster API upgrades are *stateless*, it is important to keep all Sidero configuration for reuse during upgrades.

Sidero has a number of configuration options which should be supplied at install time, kept, and reused for upgrades. These can also be specified in the `clusterctl` configuration file (`$HOME/.cluster-api/clusterctl.yaml`). You can reference the `clusterctl` [docs](#) for more information on this.

For our purposes, we will use environment variables for our configuration options.

```
export SIDERO_CONTROLLER_MANAGER_HOST_NETWORK=true
export SIDERO_CONTROLLER_MANAGER_DEPLOYMENT_STRATEGY=Recreate
export SIDERO_CONTROLLER_MANAGER_API_ENDPOINT=192.168.1.150
export SIDERO_CONTROLLER_MANAGER_SIDEROLINK_ENDPOINT=192.168.1.150

clusterctl init -b talos -c talos -i sidero
```

First, we are telling Sidero to use `hostNetwork: true` so that it binds its ports directly to the host, rather than being available only from inside the cluster. There are many ways of exposing the services, but this is the simplest path for the single-node management cluster. When you scale the management cluster, you will need to use an alternative method, such as an external load balancer or something like [MetalLB](#).

The `192.168.1.150` IP address is the IP address or DNS hostname as seen from the workload clusters. In our case, this should be the main IP address of your Docker workstation.

**Note:** If you encounter the following error, this is caused by a rename of our GitHub org from `talos-systems` to `siderolabs`.

```
$ clusterctl init -b talos -c talos -i sidero
Fetching providers
Error: failed to get provider components for the "talos" provider: target namespace can't be defaulted. Please specify
```

This can be worked around by adding the following to `~/.cluster-api/clusterctl.yaml` and rerunning the init command:

```
providers:
  - name: "talos"
    url: "https://github.com/siderolabs/cluster-api-bootstrap-provider-talos/releases/latest/bootstrap-components.yaml"
    type: "BootstrapProvider"
  - name: "talos"
    url: "https://github.com/siderolabs/cluster-api-control-plane-provider-talos/releases/latest/control-plane-components.yaml"
    type: "ControlPlaneProvider"
  - name: "sidero"
    url: "https://github.com/siderolabs/sidero/releases/latest/infrastructure-components.yaml"
    type: "InfrastructureProvider"
```

# 5 - Expose Sidero Services

A guide for bootstrapping Sidero management plane

If you built your cluster as specified in the [Prerequisite: Kubernetes] section in this tutorial, your services are already exposed and you can skip this section.

There are four external Services which Sidero serves and which must be made reachable by the servers which it will be driving.

DHCP Proxy (port 67/udp) is needed for all servers to provide PXE boot instructions. Most probably it can be only exposed via host network mode, as it requires receiving and sending packets targeted to the broadcast address. If DHCP Proxy is not exposed, follow [Prerequisite: DHCP service](#) section to set up the DHCP server in your environment.

For most servers, TFTP (port 69/udp) will be needed. This is used for PXE booting, both BIOS and UEFI. Being a primitive UDP protocol, many load balancers do not support TFTP. Instead, solutions such as [MetalLB](#) may be used to expose TFTP over a known IP address. For servers which support UEFI HTTP Network Boot, TFTP need not be used.

The kernel, initrd, and all configuration assets are served from the HTTP service (port 8081/tcp). It is needed for all servers, but since it is HTTP-based, it can be easily proxied, load balanced, or run through an ingress controller.

Overlay Wireguard SideroLink network requires UDP port 51821 to be open. Same as TFTP, many load balancers do not support Wireguard UDP protocol. Instead, use MetalLB.

The main thing to keep in mind is that the services **MUST** match the IP or hostname specified by the `SIDERO_CONTROLLER_MANAGER_API_ENDPOINT` and `SIDERO_CONTROLLER_MANAGER_SIDEROLINK_ENDPOINT` environment variables (or configuration parameters) when you installed Sidero.

It is a good idea to verify that the services are exposed as you think they should be.

```
$ curl -I http://192.168.1.150:8081/tftp/snp.efi
HTTP/1.1 200 OK
Accept-Ranges: bytes
Content-Length: 1020416
Content-Type: application/octet-stream
```

# 6 - Import Workload Machines

A guide for bootstrapping Sidero management plane

At this point, any servers on the same network as Sidero should network boot from Sidero. To register a server with Sidero, simply turn it on and Sidero will do the rest. Once the registration is complete, you should see the servers registered with `kubectl get servers` :

```
$ kubectl get servers -o wide
NAME          HOSTNAME   ACCEPTED   ALLOCATED   CLEAN
00000000-0000-0000-d05099d33360 192.168.1.201  false       false       false
```

## Accept the Servers

Note in the output above that the newly registered servers are not `accepted`. In order for a server to be eligible for consideration, it *must* be marked as `accepted`. Before a `Server` is accepted, no write action will be performed against it. This default is for safety (don't accidentally delete something just because it was plugged in) and security (make sure you know the machine before it is given credentials to communicate).

**Note:** if you are running in a safe environment, you can configure Sidero to automatically accept new machines.

For more information on server acceptance, see the [server docs](#).

## Create ServerClasses

By default, Sidero comes with a single `ServerClass any` which matches any (accepted) server. This is sufficient for this demo, but you may wish to have more flexibility by defining your own `ServerClasses`.

`ServerClasses` allow you to group machines which are sufficiently similar to allow for unnamed allocation. This is analogous to cloud providers using such classes as `m3.large` or `c2.small`, but the names are free-form and only need to make sense to you.

For more information on `ServerClasses`, see the [ServerClass docs](#).

## Hardware differences

In baremetal systems, there are commonly certain small features and configurations which are unique to the hardware. In many cases, such small variations may not require special configurations, but others do.

If hardware-specific differences do mandate configuration changes, we need a way to keep those changes local to the hardware specification so that at the higher level, a `Server` is just a `Server` (or a server in a `ServerClass` is just a `Server` like all the others in that Class).

The most common variations seem to be the installation disk and the console serial port.

Some machines have NVMe drives, which show up as something like `/dev/nvme0n1`. Others may be SATA or SCSI, which show up as something like `/dev/sda`. Some machines use `/dev/ttyS0` for the serial console; others `/dev/ttyS1`.

Configuration patches can be applied to either `Servers` or `ServerClasses`, and those patches will be applied to the final machine configuration for those nodes without having to know anything about those nodes at the allocation level.

For examples of install disk patching, see the [Installation Disk doc](#).

For more information about patching in general, see the [Patching Guide](#).

## 7 - Create a Workload Cluster

### Create a Workload Cluster

Once created and accepted, you should see the servers that make up your ServerClasses appear as “available”:

```
$ kubectl get serverclass
NAME      AVAILABLE          IN USE
any      ["00000000-0000-0000-d05099d33360"]  []
```

## Generate Cluster Manifests

We are now ready to generate the configuration manifest templates for our first workload cluster.

There are several configuration parameters that should be set in order for the templating to work properly:

- **CONTROL\_PLANE\_ENDPOINT** : The endpoint used for the Kubernetes API server (e.g. `https://1.2.3.4:6443` ). This is the equivalent of the endpoint you would specify in `talosctl gen config`. There are a variety of ways to configure a control plane endpoint. Some common ways for an HA setup are to use DNS, a load balancer, or BGP. A simpler method is to use the IP of a single node. This has the disadvantage of being a single point of failure, but it can be a simple way to get running.
- **CONTROL\_PLANE\_SERVERCLASS** : The server class to use for control plane nodes.
- **WORKER\_SERVERCLASS** : The server class to use for worker nodes.
- **KUBERNETES\_VERSION** : The version of Kubernetes to deploy (e.g. `v1.21.1` ).
- **CONTROL\_PLANE\_PORT** : The port used for the Kubernetes API server (port 6443)

For instance:

```
export CONTROL_PLANE_SERVERCLASS=any
export WORKER_SERVERCLASS=any
export TALOS_VERSION=v1.5.1
export KUBERNETES_VERSION=v1.28.1
export CONTROL_PLANE_PORT=6443
export CONTROL_PLANE_ENDPOINT=1.2.3.4

clusterctl generate cluster cluster-0 -i sidero > cluster-0.yaml
```

Take a look at this new `cluster-0.yaml` manifest and make any changes as you see fit. Feel free to adjust the `replicas` field of the `TalosControlPlane` and `MachineDeployment` objects to match the number of machines you want in your controlplane and worker sets, respectively. `MachineDeployment` (worker) count is allowed to be 0.

Of course, these may also be scaled up or down *after* they have been created, as well.

## Create the Cluster

When you are satisfied with your configuration, go ahead and apply it to Sidero:

```
kubectl apply -f cluster-0.yaml
```

At this point, Sidero will allocate Servers according to the requests in the cluster manifest. Once allocated, each of those machines will be installed with Talos, given their configuration, and form a cluster.

You can watch the progress of the Servers being selected:

```
watch kubectl --context=sidero-demo \
  get servers,machines,clusters
```

First, you should see the Cluster created in the Provisioning phase. Once the Cluster is Provisioned, a Machine will be created in the Provisioning phase.

Every 2.0s: kubectl get servers,machines,clusters		scmlaptop: Sun Jun 6 10:45:06 2021				
NAME		HOSTNAME	ACCEPTED	ALLOCATED	CLEAN	POWER
server.metal.sidero.dev/15839a00-8f07-11e9-8000-ac1f6bf200c2		172.16.199.72	true	true	false	on
server.metal.sidero.dev/23282800-8ee5-11e9-8000-ac1f6b99bcb2		172.16.199.74	true	false	true	on
server.metal.sidero.dev/2f8c8200-8e0c-11e9-8000-ac1f6b9983b2		172.16.199.76	true		true	off
server.metal.sidero.dev/2fc17600-8f0f-11e9-8000-ac1f6b9aaca6		172.16.199.77	true		true	off
server.metal.sidero.dev/335afa00-8f1b-11e9-8000-ac1f6bf200aa		172.16.199.68	true	false	true	off
server.metal.sidero.dev/58f8de00-8e0b-11e9-8000-ac1f6b998742		172.16.199.75	true		true	off
server.metal.sidero.dev/80660000-87a6-11e9-8000-ac1f6b9987e6		172.16.199.67	true	false	true	off
server.metal.sidero.dev/c4fd4400-8ee8-11e9-8000-ac1f6b99bd12		172.16.199.73	true	false	true	off
server.metal.sidero.dev/fdaf6600-87e2-11e9-8000-ac1f6b998746		172.16.199.66	true	false	true	off
NAME	PROVIDERID	PHASE	VERSION			
machine.cluster.x-k8s.io/cluster-0-cp-g6w7l		Provisioning	v1.21.1			
NAME	PHASE					
cluster.cluster.x-k8s.io/cluster-0	Provisioned					

During the Provisioning phase, a Server will become allocated, the hardware will be powered up, Talos will be installed onto it, and it will be rebooted into Talos. Depending on the hardware involved, this may take several minutes.

Eventually, the Machine should reach the Running phase.

\$ kubectl get servers,machines,clusters		scmlaptop: Sun Jun 6 10:45:06 2021				
NAME		HOSTNAME	ACCEPTED	ALLOCATED	CLEAN	POWER
server.metal.sidero.dev/15839a00-8f07-11e9-8000-ac1f6bf200c2		172.16.199.72	true	true	false	on
server.metal.sidero.dev/23282800-8ee5-11e9-8000-ac1f6b99bcb2		172.16.199.74	true	false	true	off
server.metal.sidero.dev/2f8c8200-8e0c-11e9-8000-ac1f6b9983b2		172.16.199.76	true		true	off
server.metal.sidero.dev/2fc17600-8f0f-11e9-8000-ac1f6b9aaca6		172.16.199.77	true		true	off
server.metal.sidero.dev/335afa00-8f1b-11e9-8000-ac1f6bf200aa		172.16.199.68	true	false	true	off
server.metal.sidero.dev/58f8de00-8e0b-11e9-8000-ac1f6b998742		172.16.199.75	true		true	off
server.metal.sidero.dev/80660000-87a6-11e9-8000-ac1f6b9987e6		172.16.199.67	true	false	true	off
server.metal.sidero.dev/c4fd4400-8ee8-11e9-8000-ac1f6b99bd12		172.16.199.73	true	false	true	off
server.metal.sidero.dev/fdaf6600-87e2-11e9-8000-ac1f6b998746		172.16.199.66	true	false	true	off
NAME	PROVIDERID	PHASE	VERSION			
machine.cluster.x-k8s.io/cluster-0-cp-g6w7l	sidero://15839a00-8f07-11e9-8000-ac1f6bf200c2	Running	v1.21.1			
NAME	PHASE					
cluster.cluster.x-k8s.io/cluster-0	Provisioned					

The initial controlplane Machine will always be started first. Any additional nodes will be started after that and will join the cluster when they are ready.

## Retrieve the Talosconfig

In order to interact with the new machines (outside of Kubernetes), you will need to obtain the `talosctl` client configuration, or `talosconfig`. You can do this by retrieving the secret from the Sidero management cluster:

```
kubectl --context=sidero-demo \
  get secret \
  cluster-0-talosconfig \
  -o jsonpath='{.data.talosconfig}' \
  | base64 -d \
  > cluster-0-talosconfig
```

## Retrieve the Kubeconfig

With the `talosconfig` obtained, the workload cluster's `kubeconfig` can be retrieved in the normal Talos way:

```
talosctl --talosconfig cluster-0-talosconfig --nodes <CONTROL_PLANE_IP> kubeconfig
```

## Check access

Now, you should have two cluster available: your management cluster (`sidero-demo`) and your workload cluster (`cluster-0`).

```
kubectl --context=sidero-demo get nodes  
kubectl --context=cluster-0 get nodes
```

## 8 - Scale the Workload Cluster

A guide for bootstrapping Sidero management plane

If you have more machines available, you can scale both the controlplane ( `TalosControlPlane` ) and the workers ( `MachineDeployment` ) for any cluster after it has been deployed. This is done just like normal Kubernetes Deployments .

```
kubectl scale taloscontrolplane cluster-0-cp --replicas=3
```

## 9 - Optional: Management cluster

A guide for bootstrapping Sidero management plane

Having the Sidero cluster running inside a Docker container is not the most robust place for it, but it did make for an expedient start.

It might be a good idea to move it to a more robust setup, such as a dedicated bare-metal server, or a virtual machine. It also makes sense to establish regular backups of `etcd` in the management cluster to make sure the state of the cluster can be restored in case of a disaster.

# 10 - Troubleshooting

## Troubleshooting

The first thing to do in troubleshooting problems with the Sidero installation and operation is to figure out *where* in the process that failure is occurring.

Keep in mind the general flow of the pieces. For instance:

1. A server is configured by its BIOS/CMOS to attempt a network boot using the PXE firmware on its network card(s).
2. That firmware requests network and PXE boot configuration via DHCP.
3. DHCP points the firmware to the Sidero TFTP or HTTP server (depending on the firmware type).
4. The second stage boot, iPXE, is loaded and makes an HTTP request to the Sidero metadata server for its configuration, which contains the URLs for the kernel and initrd images.
5. The kernel and initrd images are downloaded by iPXE and boot into the Sidero agent software (if the machine is not yet known and assigned by Sidero).
6. The agent software reports to the Sidero metadata server via HTTP the hardware information of the machine.
7. A (usually human or external API) operator verifies and accepts the new machine into Sidero.
8. The agent software reboots and wipes the newly-accepted machine, then powers off the machine to wait for allocation into a cluster.
9. The machine is allocated by Sidero into a Kubernetes Cluster.
10. Sidero tells the machine, via IPMI, to boot into the OS installer (following all the same network boot steps above).
11. The machine downloads its configuration from the Sidero metadata server via HTTP.
12. The machine applies its configuration, installs a bootloader, and reboots.
13. The machine, upon reboot from its local disk, joins the Kubernetes cluster and continues until Sidero tells it to leave the cluster.
14. Sidero tells the machine to leave the cluster and reboots it into network boot mode, via IPMI.
15. The machine netboots into wipe mode, wherein its disks are again wiped to come back to the “clean” state.
16. The machine again shuts down and waits to be needed.

## Device firmware (PXE boot)

The worst place to fail is also, unfortunately, the most common. This is the firmware phase, where the network card’s built-in firmware attempts to initiate the PXE boot process. This is the worst place because the firmware is completely opaque, with very little logging, and what logging *does* appear frequently is wiped from the console faster than you can read it.

If you fail here, the problem will most likely be with your DHCP configuration, though it *could* also be in the Sidero TFTP service configuration.

## Validate Sidero TFTP service

The easiest to validate is to use a `tftp` client to validate that the Sidero TFTP service is available at the IP you are advertising via DHCP.

```
$ atftp 172.16.199.50
tftp> get.snp.efs
```

TFTP is an old, slow protocol with very little feedback or checking. Your only real way of telling if this fails is by timeout. Over a local network, this `get` command should take a few seconds. If it takes longer than 30 seconds, it is probably not working.

Success is also not usually indicated: you just get a prompt returned, and the file should show up in your current directory.

If you are failing to connect to TFTP, the problem is most likely with your Sidero Service exposure: how are you exposing the TFTP service in your management cluster to the outside world? This normally involves either setting host networking on the Deployment or installing and using something like MetalLB.