

# SAP Data Intelligence 3 on SUSE CaaS Platform 4

## Installation Guide

SUSE CaaS Platform 4  
SAP Data Intelligence 3  
SUSE Linux Enterprise Server for SAP Applications 15 SP1

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## Installation Guide

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SAP\* Data Hub 2 is the toolset to govern big amounts of data. SUSE CaaS Platform 4 is the Kubernetes base that makes deploying SAP Data Hub 2 easy. This document describes the installation and configuration of SUSE CaaS Platform 4 and SAP Data Hub 2.

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# 1 Introduction

Today, business and industries create more and more data. As the amount of data grows, so does the need to manage and get the best out of the data. SAP Data Intelligence 3 is a tool to make it easier to deal with such amounts of data, and with SUSE CaaS Platform 4, SUSE delivers the foundation on top of which to run SAP Data Intelligence 3.

## 2 Requirements

To install SAP Data Intelligence 3 on SUSE CaaS Platform 4, we need to meet certain requirements. Consult the relevant documentation:

- SUSE
  - SUSE CaaS Platform 4 (<https://documentation.suse.com/suse-caasp/4/>) ↗
  - SUSE Enterprise Storage (<https://www.suse.com/documentation/suse-enterprise-storage-5>) ↗
- SAP
  - SAP Data Hub ([https://help.sap.com/viewer/product/SAP\\_DATA\\_HUB/2.7.latest/en-US](https://help.sap.com/viewer/product/SAP_DATA_HUB/2.7.latest/en-US)) ↗
  - SAP Note 2686169 (<https://launchpad.support.sap.com/#/notes/2686169>) ↗
  - SAP Note 2865345 (<https://launchpad.support.sap.com/#/notes/2865345>) ↗


## 2.1 Hardware and software requirements

### 2.1.1 SUSE CaaS Platform 4 cluster

Hardware requirements:

- see [SAP Data Hub Install Guide \(https://help.sap.com/viewer/product/SAP\\_DATA\\_HUB/\)](https://help.sap.com/viewer/product/SAP_DATA_HUB/) 

See SAP's sizing recommendations:

- [SAP Data Hub 2.7 \(https://help.sap.com/viewer/e66c399612e84a83a8abe97c0ee-b443a/2.7.latest/en-US/79724de552db4b2b81c4a893f2c7ed18.html\)](https://help.sap.com/viewer/e66c399612e84a83a8abe97c0ee-b443a/2.7.latest/en-US/79724de552db4b2b81c4a893f2c7ed18.html) 

The minimum hardware requirements for installing SAP Data Intelligence 3 for on-premises production use are:

- 7 Kubernetes cluster nodes (three master nodes and four worker nodes)
  - All machines should have at least four CPU cores
  - The master nodes should have > 32 GiB RAM
  - The worker nodes should have > 64 GiB RAM
- Load-balancer
- Management host

Environments for non-production use may run with one master, three workers, and a management node.



#### Note

Having only one master node is not recommended for production environments. For production use, three master nodes are recommended.

- Access to a SUSE Enterprise Storage 5 or SUSE Enterprise Storage 6 system (see SAP Note [Pre-requisites for installing SAP Data Hub \(https://launchpad.support.sap.com/#/notes/2686169\)](https://launchpad.support.sap.com/#/notes/2686169))

### 2.1.2 Management host

- Two cores
- 16 GiB RAM
- Disk space:
  - 80 GiB for `/`, including the space for the SAP Data Intelligence 3 software
  - At least 100 GiB for `/var/lib/docker` (needed for the SAP Data Intelligence 3 installation)
- Network connectivity to the SUSE CaaS Platform cluster (1 GBit/s)

## 2.2 Software requirements

The following software is needed:

- SUSE CaaS Platform 4.0.3



### Note

For SAP Data Hub, it is required to stay on SUSE CaaS Platform 4.0.0—4.0.3, because of the Kubernetes version delivered with our CaaS product. SAP Data Intelligence 3 needs a Kubernetes version not higher than 1.15.

- SAP Data Hub 2.7.1 or higher
- SAP Hostagent
- Access to SAP Maintenance Planner
- Connection to a secure private Docker registry
- Optional Hadoop/Spark, see Vora's Spark extensions

## 3 Installing SUSE CaaS Platform 4

### 3.1 Getting the installation media

All installation media can be found at: [SUSE CaaS Platform ISO images \(https://download.suse.com/\)](https://download.suse.com/)

### 3.2 Getting a subscription for SUSE CaaS Platform 4

To be able to get all maintenance updates for your SUSE products, you need a valid subscription for the particular product: \* [Order subscription for SUSE CaaS Platform \(https://www.suse.com/support/?id=SUSE\\_CaaS\\_Platform\)](https://www.suse.com/support/?id=SUSE_CaaS_Platform)

### 3.3 Reading the Deployment Guide for SUSE CaaS Platform 4

SUSE CaaS Platform is designed to make the installation of Kubernetes easy. To get a deeper understanding you should read the Deployment Guide for SUSE CaaS Platform 4, available at <https://www.suse.com/documentation/> For further reference, there are also a Quick Start Guide and an Administrator's Guide.

### 3.4 Installing SUSE CaaS Platform 4 on SUSE Linux Enterprise

In this guide, we describe the installation of SUSE CaaS Platform 4 on top of SUSE Linux Enterprise 15 SP1 on your premises. We will use the SUSE Linux Enterprise 15 SP1 installer ISO image for starting the installation.

Make sure that the host names you will use for the installation can be resolved via DNS. It is preferred to have a static network setup.

You will need to have the FQDN or IP address of your time server. A reliable system time is required.

Connect the media to your hardware and boot from the media.

Select **Installation** from the GRUB menu.

### 3.4.1 Preparation

Install SUSE Linux Enterprise 15 SP1 or higher (as released for CaaS Platform 4.x) on all nodes.

The following Modules/Products are required on the respective hosts:

- Management host:
  - SUSE Linux Enterprise 15 SP1
  - SUSE Linux Enterprise 15 SP1 Containers Modules
  - SUSE Linux Enterprise 15 SP1 Public Cloud
  - SUSE CaaSP 4
- Kubernetes master nodes:
  - SUSE Linux Enterprise 15 SP1
  - SUSE Linux Enterprise 15 SP1 Public Cloud
  - SUSE CaaSP 4
- Kubernetes worker nodes:
  - SUSE Linux Enterprise 15 SP1
  - SUSE Linux Enterprise 15 SP1 Public Cloud
  - SUSE CaaSP 4
- Load balancer host:
  - SUSE Linux Enterprise Server for SAP Applications 15 SP1  
or
  - SUSE Linux Enterprise 15 SP1 plus High Availability Extension



### 3.4.2 Installing the management node

- Install SUSE Linux Enterprise 15 SP1
- Add the following software:
  - Install software pattern "CaaS management"
  - Install Python2 and PyYaml-python2 (needed for installing DH2.7)
  - Install Docker (needed for installing DH2.7)

### 3.4.3 Installing the load balancer

This is only necessary if no other load-balancing device is available. In our setup, we describe the installation of a haproxy instance. haproxy is available in the SUSE Linux Enterprise High Availability Extension or SUSE Linux Enterprise Server for SAP Applications.

- Install SUSE Linux Enterprise 15 SP1
- Add the "SLE 15 SP1 HA" repository  
(in case of SUSE Linux Enterprise Server for SAP Applications, this is added automatically)
- Create the haproxy configuration
- Enable and start haproxy

### 3.4.4 Installing the master nodes

- Install SUSE Linux Enterprise 15 SP1
  - Set up static IP addresses
  - Use the "Expert Partitioner" to disable any swap partition

- Disable `firewalld`
- Enable `ssh`
- Add the necessary software repositories:
  - SUSEConnect -p caasp/4.0/x86\_64
  - SUSEConnect -p ...
- Create the directory `/var/lib/docker/containers`

### 3.4.5 Installing the worker nodes

- Install SUSE Linux Enterprise 15 SP1
  - Set up static IP addresses
  - Use the "Expert Partitioner" to disable any swap partition
  - Disable `firewalld`
  - Enable `ssh`
- Add the necessary software repositories:
  - SUSEConnect -p caasp/4.0/x86\_64
  - SUSEConnect -p ...

### 3.4.6 Creating the Kubernetes cluster on SUSE CaaS Platform 4

- Log in to the management host
  - Ensure that `ssh-agent` is working as expected  
(for example `ssh -A root@managementhost.example.com`)

- Initialize the Kubernetes cluster

```
skuba cluster init --control-plane <LB_IP/FQDN> my-cluster
```

- Create the first master node of the Kubernetes Cluster

```
cd my-cluster
skuba node bootstrap --user sles --sudo --target <IP/FQDN> <NODE_NAME>
```

- Add additional master nodes

```
skuba node join --role master --user sles --sudo --target <IP/FQDN> <NODE_NAME>
```

- Add worker nodes to the Kubernetes cluster

```
skuba node join --role worker --user sles --sudo --target <IP/FQDN> <NODE_NAME>
```

- verify your Kubernetes cluster

```
skuba cluster status
```

- Modifications needed to install SAP Data Haub 2 on a CaaSP 4 cluster
  - Change the `pid` parameter in `/etc/crio/crio.conf` from 1024 to 8192
  - Edit `/etc/containers/registry.conf` to reflect your private registry

## 4 Installing SAP Data Intelligence 3

The following sections describe the preparation and installation of SAP Data Intelligence 3 on a SUSE CaaS Platform 4 cluster.

## 4.1 Preparing the SAP Data Intelligence 3 installation

The steps that are needed to successfully install SAP Data Hub on SUSE CaaS Platform are as follows:

### 4.1.1 Downloading the SAP Data Intelligence 3 software archive

To download and install SAP Data Intelligence 3:

1. Go to the SAP Software Download Center, log in with your SAP account, and search for "SAP DATA Intelligence 3".
2. Download the SAP Data Hub Foundation file, for example:
  - [DHFOUNDATION07\\_3-80004015.ZIP](#) (SAP DATA HUB - FOUNDATION 2.7)

3. Unzip the software archive on to your management host.

There are three ways to install SAP Data Intelligence 3:

- Use the SL Plugin. There are two variants of it:
  - SL Plugin with Maintenance Planner ([mpsl](#))
  - SL Plugin only ([mpfree](#))
- Use the command line [install.sh](#) script.

This document will focus on the Maintenance Planner and SL Plugin installation methods.

## 4.1.2 Prerequisites on the SUSE CaaS Platform 4 cluster

The following steps are done on the jump host if not stated otherwise:

1. Create a new namespace in the Kubernetes cluster, into which to install SAP Data Intelligence 3:

```
$ kubectl create namespace datahub
```

2. Create the storage class to provide volumes for SAP Data Intelligence 3 on SUSE Enterprise Storage:

Make sure you have the connection data for your SUSE Enterprise Storage at hand:

- IP addresses and port number (default: 6789) of the monitor nodes of your SUSE Storage cluster
- Create a data pool (datahub in this example) on your SUSE Enterprise Storage for use with SAP Data Intelligence 3

3. Edit the example below to fit your environment.

```
$ cat > storageClass.yaml <<EOF
apiVersion: storage.kubernetes.io/v1
kind: StorageClass
metadata:
  annotations:
    storageclass.kubernetes.io/is-default-class: "true"
  name: datahub
  namespace: default
parameters:
  adminId: admin
  adminSecretName: ceph-admin-secret
  adminSecretNamespace: default
  imageFeatures: layering
  imageFormat: "2"
  monitors: <IP ADDRESS OF MONITOR 1>:6789, <IP ADDRESS OF MONITOR 2>:6789, <IP
ADDRESS OF MONITOR 3 >:6789
  pool: datahub
  userId: admin
  userSecretName: ceph-user-secret
provisioner: kubernetes.io/rbd
reclaimPolicy: Delete
volumeBindingMode: Immediate
EOF
```

```
$ kubectl create -f storageClass.yaml
```

#### 4. Create the secrets needed to access the storage:

Obtain the keys from your SUSE Enterprise Storage cluster. They are located in `ceph.admin.keyring` and `ceph.user.keyring`.

You must encode the keys using `base64`:

```
echo <YOUR KEY HERE> | base64
```

```
$ cat > ceph-admin-secret.yaml <<EOF
apiVersion: v1
kind: Secret
metadata:
  name: ceph-admin-secret
type: "kubernetes.io/rbd"
data:
  key: <YOUR BASE64 ENCODED KEY HERE>
EOF
image::002-SCT-CaaS.png
$ cat > ceph-user-secret.yaml <<EOF
apiVersion: v1
kind: Secret
metadata:
  name: ceph-user-secret
type: "kubernetes.io/rbd"
data:
  key: <YOUR BASE64 ENCODED KEY HERE>
EOF

$ kubectl create -f ceph-admin-secret.yaml
$ kubectl create -f ceph-user-secret.yaml
```

## 4.2 Installing SAP Data Intelligence 3 using the SAP Maintenance Planner with SL Plugin

SAP recommends the "SAP Maintenance Planner with SL Plugin" (`mpsl`) installation method as the best approach to install SAP Data Intelligence 3.

SAP recommends this Web-based installation method because it offers an option to send analytic data and feedback to SAP. All the necessary prerequisites have been satisfied by applying all the steps described above.



## Note

You need to install the latest SAP Host Agent on the management host. You can use the rpm package downloadable from the SAP Software Download center.

- Install the SAP Host Agent on the management host
  - Download the rpm package from the SAP Software Download Center
  - Install SAP Host Agent:

```
zypper in path to rpm
```
  - Start SAP Host agent

```
/etc/init.d/sapinit start
```
  - Configure SAP Host Agent to be used with SAP Maintenance Planner
    - Create certificates according to the documentation provided by SAP
    - Enable CORS Web service in SAP Host Agent
  - Navigate to apps.sap.com/mp with your browser
    - Create a new plan
    - Select "container based system"
    - Connect to your SAP Host Agent running on the management host
    - Follow the steps given by the wizard
    - Fill in values for the installer as needed.
    - Wait for successful deployment

## 4.3 Installing SAP Data Intelligence 3 using the SL Plugin (mpfree method)

This is an alternative command-line-based installation method. Refer to the SAP Data Hub documentation (2.7) for more information and the exact procedure.

## 4.4 Installing SAP Data Intelligence 3 using the command line (manual installation)

Unpack the SAP Data Hub software archive on the jump host — for example:

```
$ unzip DHFOUNDATION07_3-80004015.ZIP
```

Run the installation command as described in the SAP Data Intelligence 3 install guide:

- Installation of SAP Data Intelligence 3 (<https://help.sap.com/viewer/e66c399612e84a83a8abe97c0eeb443a/2.7.latest/en-US>) ↗

```
$ cd SAP-Datahub-2.7.155-Foundation
$ export DOCKER_REGISTRY=<URI of your registry>
$ export NAMESPACE=<YOUR NAME SPACE HERE>
// $ ./install.sh --enable-kaniko=yes --docker-log-path='/var/log/containers' -e vora-
vsystem.vRep.nfsv4MinorVersion=1 -e vora-diagnostic.fluentd.logDriverFormat=regex
$ ./install.sh --enable-kaniko=yes --docker-log-path='/var/log/containers' -e vora-
diagnostic.fluentd.logDriverFormat=regex
```

This interactive script configures the installation of SAP Data Intelligence 3. You should have the following information at hand:

- Name and credentials of your SAP S-User
- Your namespace
- Login credentials to your secure registry

## 4.5 Post-installation tasks

After successful installation, you can connect to the SAP Data Hub Web UI. You need to identify the service IP and port of the SAP Data Hub UI.

```
kubectl -n $NAMESPACE get services
kubectl -n $NAMESPACE describe service vsystem
```

Point your browser to the IP and port you obtained from the steps above.

Use the login data you defined during the installation.



## 4.5.1 Post-installation steps

Follow the documentation provided by SAP (<https://help.sap.com/viewer/e66c399612e84a83a8abe97c0eeb443a/2.7.latest/en-US/4c472c40595b450283a6ce039f71cfc6.html>) to the post-installation steps.

- Create the `vflow-secret` for the modeller app, as pointed out in the SAP documentation.
- Import any necessary certificate authority, for example the CA that signed the certificate of the secure registry.

# 5 Upgrading SAP Data Intelligence 3

This section describes the update of an existing SAP Data Hub 2 installation to a higher version (e.g. 2.3 to 2.4)

Execute the SAP Data Hub upgrade as described in the official instructions. One can choose between different upgrade methods:

- **Maintenance Planner:**  
Upgrade SAP Data Hub 2 using the Maintenance Planner / SL Plugin and SAP Host Agent (<https://help.sap.com/viewer/e66c399612e84a83a8abe97c0eeb443a/2.6.latest/en-US/31079833a65f4f379d5a76957ff8073c.html>)
- **SL Plugin method:**  
Upgrade SAP Data Hub 2 using the SL Plugin and SAP Host Agent (<https://help.sap.com/viewer/e66c399612e84a83a8abe97c0eeb443a/2.6.latest/en-US/ff37f3ccf6504bb38d7db53936fe8017.html>)
- **Command line method:**  
Upgrade SAP Data Hub 2 using the `install.sh` script (<https://help.sap.com/viewer/e66c399612e84a83a8abe97c0eeb443a/2.6.latest/en-US/aec679bc0209443ba4ae03a9018d4bd8.html>)

## 6 Appendix

### 6.1 Secure Private Registry

To satisfy the requirements of SAP Data Hub, you also need a Docker Registry. The easiest way to build and manage one is with the [Portus project \(http://port.us.org/\)](http://port.us.org/).

First, you need to create a dedicated server for your Docker registry and Portus stack.

```
# sudo virt-install --name portus-dr --ram 8192 --disk path=/var/lib/libvirt/VMS/portus-dr.qcow2,size=40 --vcpus 4 --os-type linux --os-variant generic --network bridge=common --graphics none --console pty,target_type=serial --location '/var/lib/libvirt/isos/SLE-12-SP4-Server-DVD-x86_64-GM-DVD1.iso' --extra-args 'console=ttyS0,115200n8 serial ifcfg=eth0=10.10.10.11/24,10.10.10.1,10.10.10.11,suse-sap.net hostname=portus-dr domain=suse-sap.net Textmode=1'
```

In our example, this server will be connected to another local bridge which provides common services (DNS, SMT, Docker-registry) for the Data Hub stack.

Our Portus deployment will be based on a container, and orchestrated locally with `docker-compose`.



#### Note

Portus deployments using `docker-compose` require an up-to-date release of the `docker-compose` tool.

```
sudo curl -L "https://github.com/docker/compose/releases/download/1.24.1/docker-compose-$(uname -s)-$(uname -m)" -o /usr/local/bin/docker-compose
sudo chmod +x /usr/local/bin/docker-compose
sudo ln -s /usr/local/bin/docker-compose /usr/bin/docker-compose
```

Now you can simply clone the Portus repository. Adapt the `.env` and the `nginx` configurations to your naming convention.

```
# git clone https://github.com/SUSE/Portus.git /tmp/Portus-DR
# mv /tmp/Portus-DR/examples/compose ./portus
# cd portus
```

You can edit both `.env` and `nginx/nginx.conf`. This is how our configuration looks:

```
# cat .env
```

```
MACHINE_FQDN=portus-dr.suse-sap.net
SECRET_KEY_BASE=b494a25faa8d22e430e843e220e424e10ac84d2ce0e64231f5b636d21251eb6d267adb042ad5884cbff0f38
PORTUS_PASSWORD=XXXXXXXXX
DATABASE_PASSWORD=YYYYYYYYY
```

In the `nginx/nginx.conf` file, you should adapt the following section:

```
server {
    listen 443 ssl http2;
    server_name portus-dr.suse-sap.net;
    root /srv/Portus/public;
```

Pull the latest `docker-compose.yml`:

```
# rm docker-compose.*
# wget https://gist.githubusercontent.com/Patazerty/d05652294d5874eddf192c9b633751ee/
raw/6bf4ac6ba14192a1fe5c337494ab213200dd076e/docker-compose.yml
```

To avoid dealing with Docker's insecure registry configuration, add SSL to your setup.

```
echo "subjectAltName = DNS:portus-dr.suse-sap.net" > extfile.cnf
openssl genrsa -out secrets/rootca.key 2048
openssl req -x509 -new -nodes -key secrets/rootca.key -subj "/C=FR/ST=FR/O=SUSE" -sha256
-days 1024 -out secrets/rootca.crt
openssl genrsa -out secrets/portus.key 2048
openssl req -new -key secrets/portus.key -out secrets/portus.csr -subj "/C=FR/ST=FR/
O=SUSE/CN
openssl req -new -key secrets/portus.key -out secrets/portus.csr -subj "/C=FR/ST=FR/
O=SUSE/CN=portus-dr.suse-sap.net"
openssl x509 -req -in secrets/portus.csr -CA secrets/rootca.crt -extfile extfile.cnf -
CAkey secrets/rootca.key -CAcreateserial -out secrets/portus.crt -days 500 -sha256
```

Next, all you need to do is to make the servers aware of this certificate:

```
cp -p secrets/rootca.crt /etc/pki/trust/anchors/.net-ca.crt
scp secrets/rootca.crt root@jumpbox.suse-sap.net:/etc/pki/trust/anchors/portus-dr.suse-
sap.net-ca.crt
```

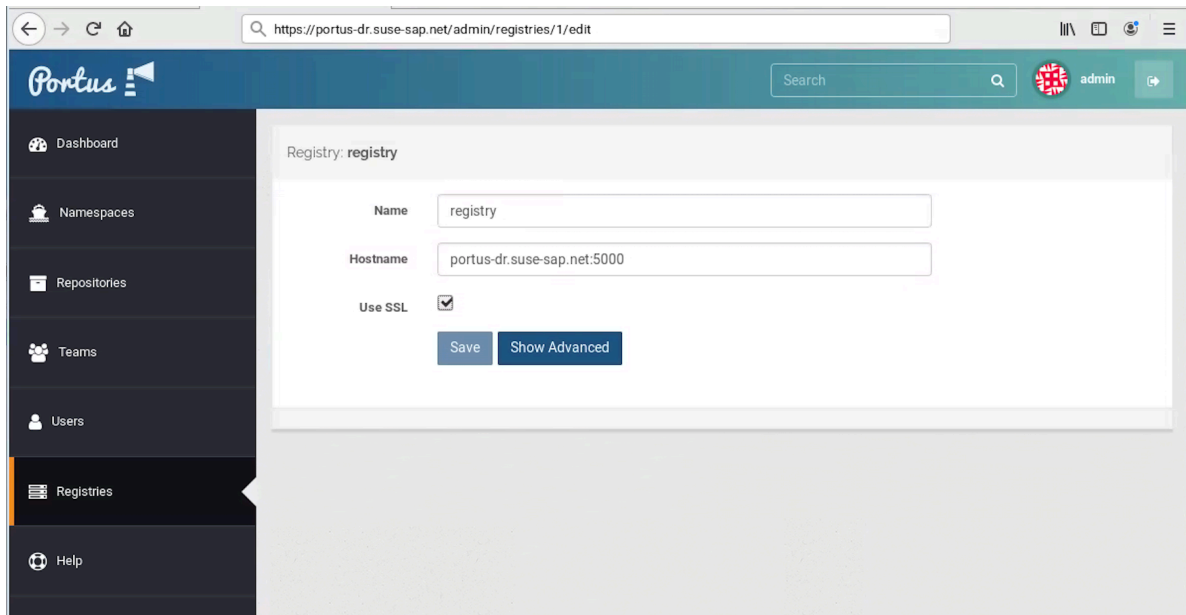
Then, on all servers that need to interact with the Docker registry, do the following:

```
sudo update-ca-certificates
sudo systemctl restart docker
```

Start your Portus setup:

```
docker-compose up -d
```

Finally, you can log in to Portus and configure the registry.



### 6.1.1 Installing and configuring a secure private registry using SUSE Linux Enterprise Server and the SLE-Container-Module

The needed components are Docker, a registry, and Portus. Create SSL certificates as needed. Distribute the CA certificates to all your Kubernetes nodes.

Run:

```
# update-ca-certificates
# systemctl restart docker
```

Create the namespaces on your registry that are needed for SAP Data Intelligence 3:

- com.sap.hana.container
- com.sap.datahub.linuxx86\_64
- com.sap.datahub.linuxx86\_64.gcc6
- consul
- elasticsearch
- fabric8

- [google\\_containers](#)
- [grafana](#)
- [kibana](#)
- [prom](#)
- [vora](#)
- [kaniko-project](#)
- [com.sap.bds.docker](#)

## 6.2 SUSE Enterprise Storage

An on-premises installation of SAP Data Intelligence requires SUSE Enterprise Storage 5 or higher.

If you plan to use SUSE Enterprise Storage not only for your Kubernetes dynamic storage class, but also for your Kubernetes Control plan (virtualized or not), you should reserve enough resources to address the [etcd hardware requirements \(https://github.com/etcd-io/etcd/blob/master/Documentation/op-guide/hardware.md\)](https://github.com/etcd-io/etcd/blob/master/Documentation/op-guide/hardware.md) ↗

The following steps will deploy a minimalist, virtualized, test-oriented instance of SUSE Enterprise Storage 5.5. In the our example, we will build a four-node (1 admin + 3 OSD) Ceph cluster.

Before you start:

- Obtain registration codes for SUSE Linux Enterprise Server 12 SP3 and SUSE Enterprise Storage from <https://scc.suse.com> ↗, or have an SMT/RMT properly set up and already mirroring these products:

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### Products > SUSE Linux Enterprise Server 15 SP1 x86\_64 released

Available Architectures	aarch64	ppc64le	s390x	x86_64
Release schedule	beta	Dec 14 2018	released	Jun 21 2019

Type: **Base** | Module | Extension

Product Class: 7261

Requires Regcode: Yes

EULA: [https://updates.suse.com/SUSE/Products/SLE-Product-SLES/15-SP1/x86\\_64/product.license/](https://updates.suse.com/SUSE/Products/SLE-Product-SLES/15-SP1/x86_64/product.license/)

Description: SUSE Linux Enterprise offers a comprehensive suite of products built on a single code base. The platform addresses business needs from the smallest thin-client devices to the world's most powerful high-performance computing and mainframe servers. SUSE Linux Enterprise offers common management tools and technology certifications across the platform, and each product is enterprise-class.

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- [SUSE Linux Enterprise Server LTSS 15 SP1](#)
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Modules:

- [Basesystem Module 15 SP1](#) recommended
- [Containers Module 15 SP1](#)
- [Desktop Applications Module 15 SP1](#) added in migration
- [Development Tools Module 15 SP1](#) added in migration
- [Legacy Module 15 SP1](#) added in migration
- [Public Cloud Module 15 SP1](#)
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- [Server Applications Module 15 SP1](#) recommended
- [Transactional Server Module 15 SP1](#)
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Migratable from:

- [openSUSE Leap 15.1](#) online
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- SMT (<https://documentation.suse.com/sles/12-SP4/html/SLES-all/book-smt.html>) ↗

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### Products > SUSE Linux Enterprise Server 15 SP1 x86\_64 released

Available Architectures	aarch64	ppc64le	s390x	x86_64
Release schedule	beta released	Dec 14 2018	Jun 21 2019	

Type: **Base** | Module | Extension  
 Product Class: 7261  
 Requires Regcode: Yes  
 EULA: [https://updates.suse.com/SUSE/Products/SLE-Product-SLES/15-SP1/x86\\_64/product.license/](https://updates.suse.com/SUSE/Products/SLE-Product-SLES/15-SP1/x86_64/product.license/)  
 Description: SUSE Linux Enterprise offers a comprehensive suite of products built on a single code base. The platform addresses business needs from the smallest thin-client devices to the world's most powerful high-performance computing and mainframe servers. SUSE Linux Enterprise offers common management tools and technology certifications across the platform, and each product is enterprise-class.  
[Show technical details](#)  
 Still supported? Yes  
 Trial product code: No trial offered  
 Download information: [Show download information](#)  
 Installation media: [Show installation media](#)

Extensions:

- SUSE CaaS Platform 4.0
- SUSE Enterprise Storage 6
- SUSE Linux Enterprise High Availability Extension 15 SP1
- SUSE Linux Enterprise Live Patching 15 SP1
- SUSE Linux Enterprise Server LTSS 15 SP1
- SUSE Linux Enterprise Workstation Extension 15 SP1
- SUSE Package Hub 15 SP1

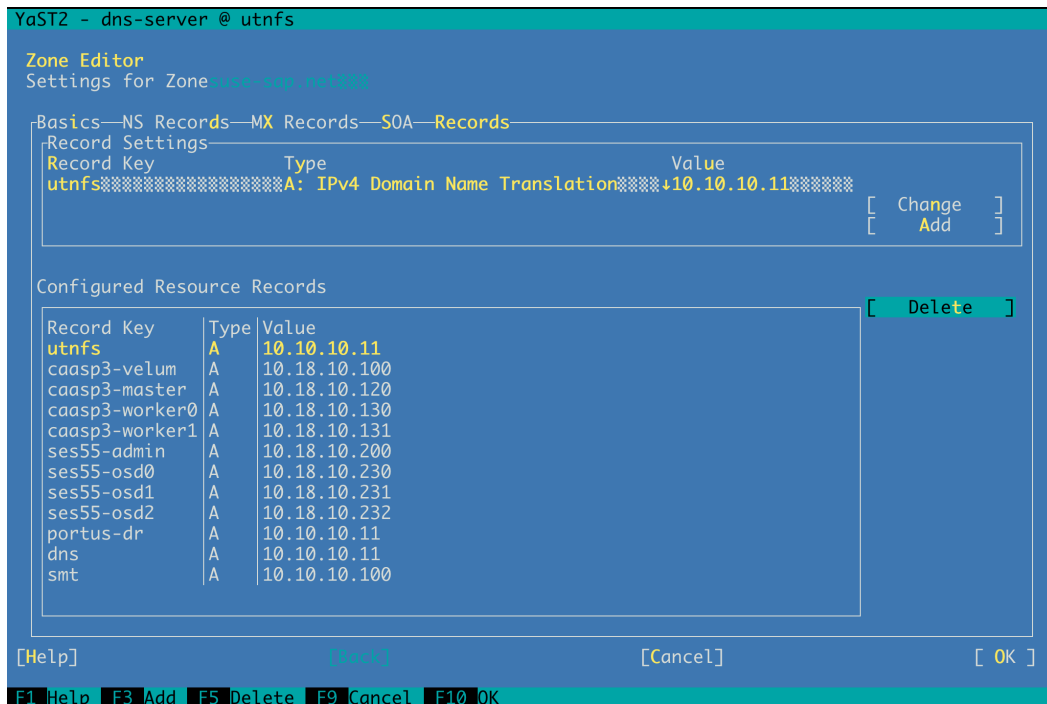
Modules:

- Basesystem Module 15 SP1 recommended
- Containers Module 15 SP1
- Desktop Applications Module 15 SP1 added in migration
- Development Tools Module 15 SP1 added in migration
- Legacy Module 15 SP1 added in migration
- Public Cloud Module 15 SP1
- Python 2 Module 15 SP1 added in migration
- SUSE Cloud Application Platform Tools Module 15 SP1
- Server Applications Module 15 SP1 recommended
- Transactional Server Module 15 SP1
- Web and Scripting Module 15 SP1 added in migration

Migratable from:

- openSUSE Leap 15.1 online
- SUSE Linux Enterprise Server 15 online

- You should already have set up a DNS zone. In our example, where all Data Hub components are in the same DNS zone and the same subnet, it should look like:



- To be as efficient as possible when using interactive shell-scripted infrastructure deployment, we advise to use an advanced terminal client or multiplexer which will allow you to address multiple shells at once:



Now you can create the virtual machines.



- Create

- First the Admin Node:

```
# sudo virt-install --name ses55-admin --ram 16384 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-admin.qcow2,size=40 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-admin-osd0.qcow2,size=20 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-admin-osd1.qcow2,size=20 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-admin-osd2.qcow2,size=20 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-admin-osd3.qcow2,size=20 --vcpus 4 --os-type linux --os-variant generic --network bridge=caasp3 --graphics none --console pty,target_type=serial --location '/var/lib/libvirt/ISOS/SLE-12-SP3-Server-DVD-x86_64-GM-DVD1.iso' --extra-args 'console=ttyS0,115200n8 serial autoyast-ses5=http://10.10.101/autoyast-ses5 ifcfg=eth0=10.18.10.200/24,10.18.10.1,10.10.10.11,suse-sap.net domain=suse-sap.net Textmode=1'
```

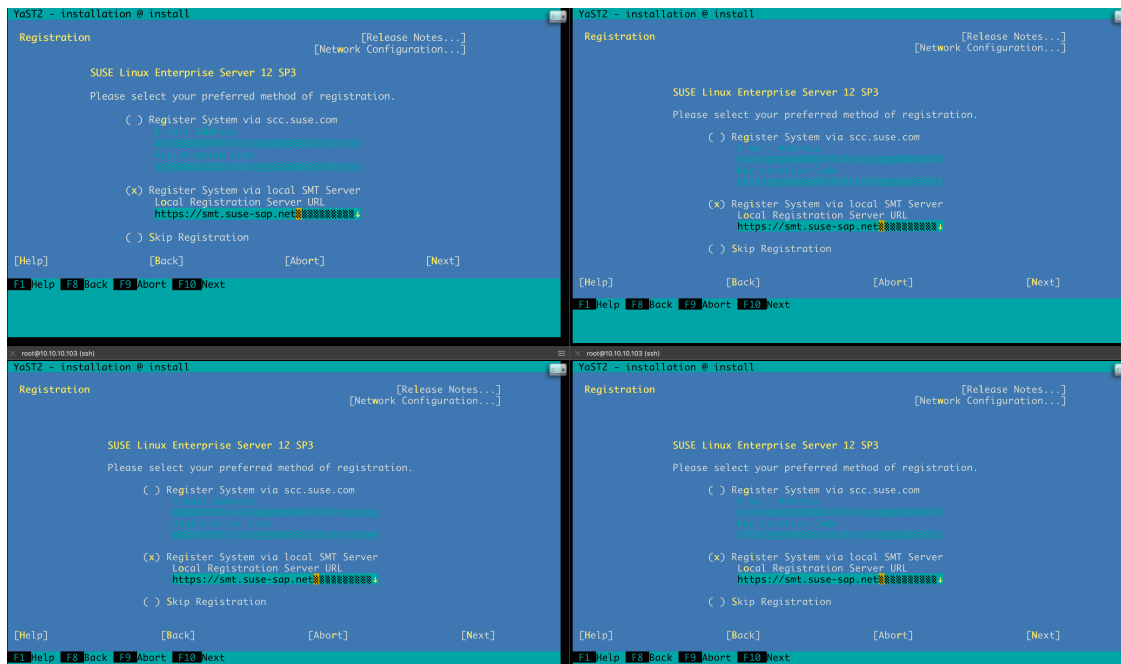
- Then the OSD Nodes:

```
# sudo virt-install --name ses55-osd0 --ram 16384 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-osd0.qcow2,size=40 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-osd0-osd0.qcow2,size=20 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-osd0-osd1.qcow2,size=20 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-osd0-osd2.qcow2,size=20 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-osd0-osd3.qcow2,size=20 --vcpus 4 --os-type linux --os-variant generic --network bridge=caasp3 --graphics none --console pty,target_type=serial --location '/var/lib/libvirt/ISOS/SLE-12-SP3-Server-DVD-x86_64-GM-DVD1.iso' --extra-args 'console=ttyS0,115200n8 serial autoyast-ses5=http://10.10.101/autoyast-ses5 ifcfg=eth0=10.18.10.230/24,10.18.10.1,10.10.10.11,suse-sap.net domain=suse-sap.net Textmode=1'
```

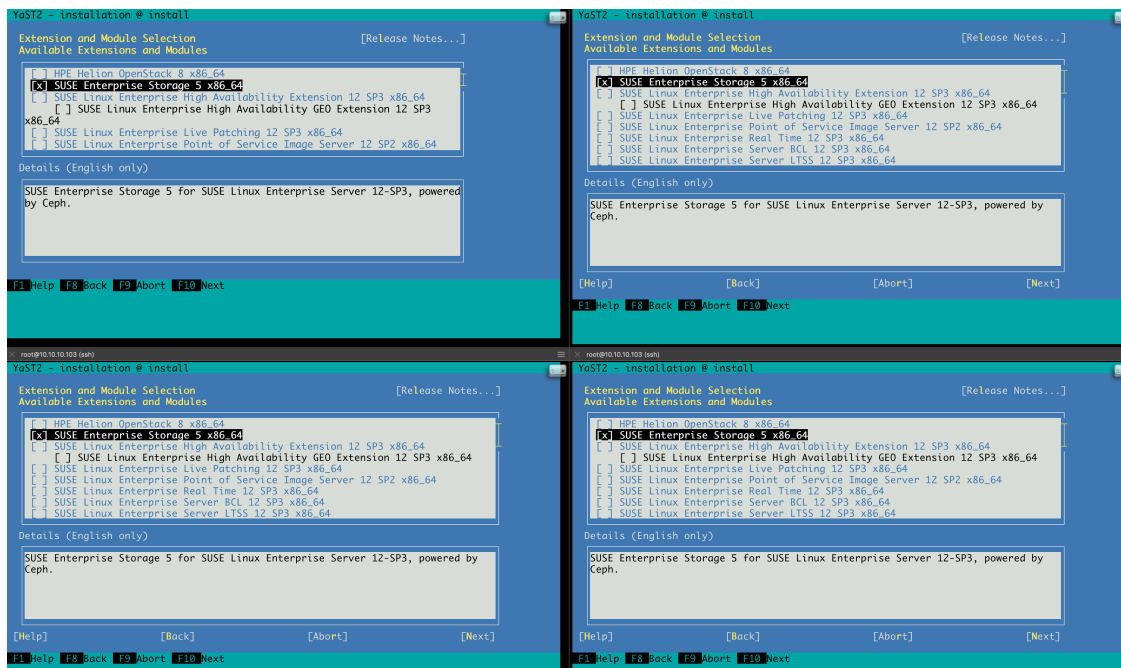
```
# sudo virt-install --name ses55-osd1 --ram 16384 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-osd1.qcow2,size=40 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-osd1-osd0.qcow2,size=20 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-osd1-osd1.qcow2,size=20 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-osd1-osd2.qcow2,size=20 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-osd1-osd3.qcow2,size=20 --vcpus 4 --os-type linux --os-variant generic --network bridge=caasp3 --graphics none --console pty,target_type=serial --location '/var/lib/libvirt/ISOS/SLE-12-SP3-Server-DVD-x86_64-GM-DVD1.iso' --extra-args 'console=ttyS0,115200n8 serial autoyast-ses5=http://10.10.101/autoyast-ses5 ifcfg=eth0=10.18.10.231/24,10.18.10.1,10.10.10.11,suse-sap.net domain=suse-sap.net Textmode=1'
```

```
# sudo virt-install --name ses55-osd2 --ram 16384 --disk bus=virtio,path=/var/lib/libvirt/VMS/ses55-osd2.qcow2,size=40 --disk bus=virtio,path=/var/
```

```
lib/libvirt/VMS/ses55-osd2-osd0.qcow2,size=20 --disk bus=virtio,path=/
var/lib/libvirt/VMS/ses55-osd2-osd1.qcow2,size=20 --disk bus=virtio,path=/
var/lib/libvirt/VMS/ses55-osd2-osd2.qcow2,size=20 --disk bus=virtio,path=/
var/lib/libvirt/VMS/ses55-osd2-osd3.qcow2,size=20 --vcpus 4 --os-
type linux --os-variant generic --network bridge=caasp3 --graphics
none --console pty,target_type=serial --location '/var/lib/
libvirt/ISOS/SLE-12-SP3-Server-DVD-x86_64-GM-DVD1.iso' --extra-args
'console=ttyS0,115200n8 serial autoyast-ses5=http://10.10.10.101/autoyast-ses5
ifcfg=eth0=10.18.10.232/24,10.18.10.1,10.10.10.11,suse-sap.net domain=suse-
sap.net Textmode=1'
```

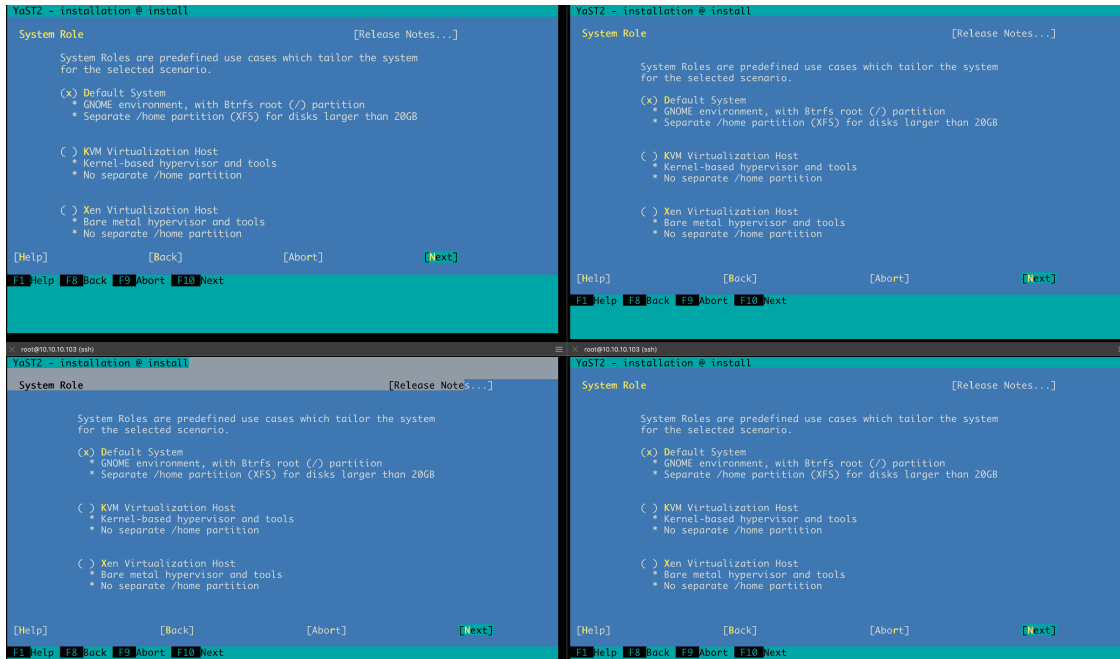


- Select the SUSE Enterprise Storage 5 extension:

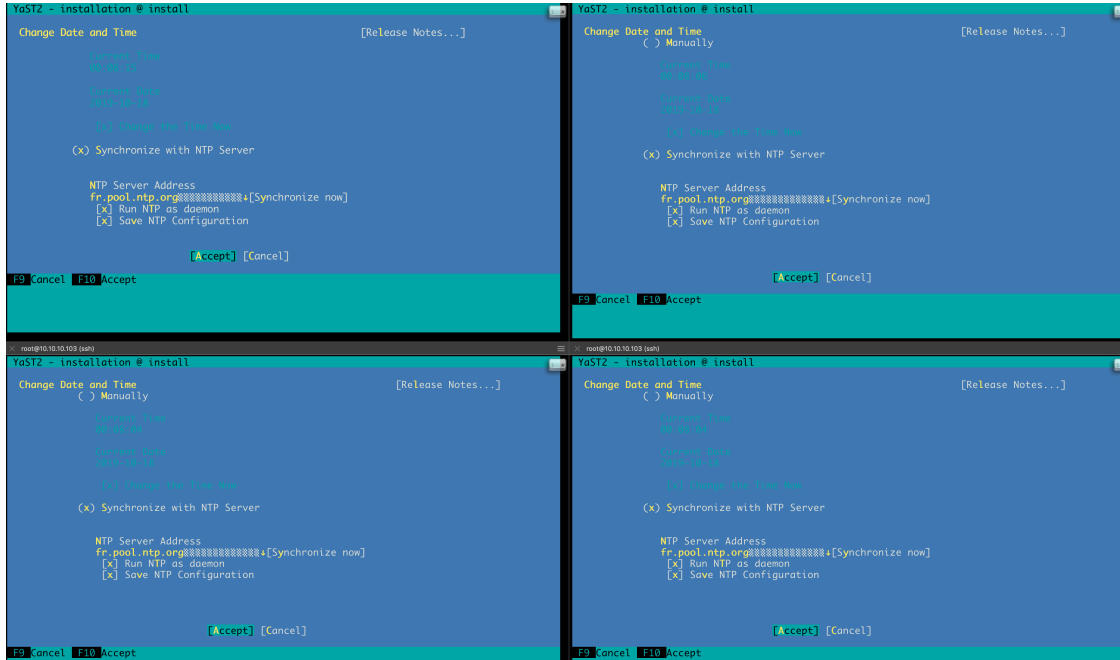


- On the hypervisor, you should also be able to route or bridge your upcoming SUSE Enterprise Storage 5.5 network segment. In our example, for simplicity, we are using the same bridge and network address as our CaaS cluster: `--network bridge=caasp3`

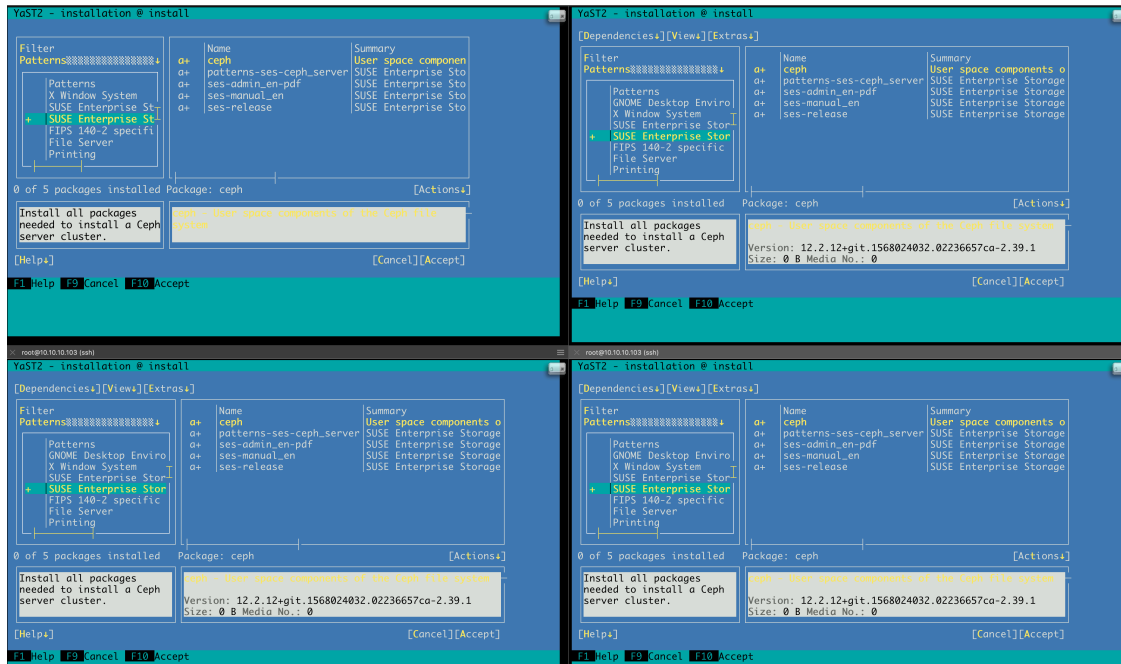
- In our example below, each node is powered by 16 GiB of RAM, 4 vCPUs, 40 GiB for the root disk, and 4 × 20 GiB OSDB disks:



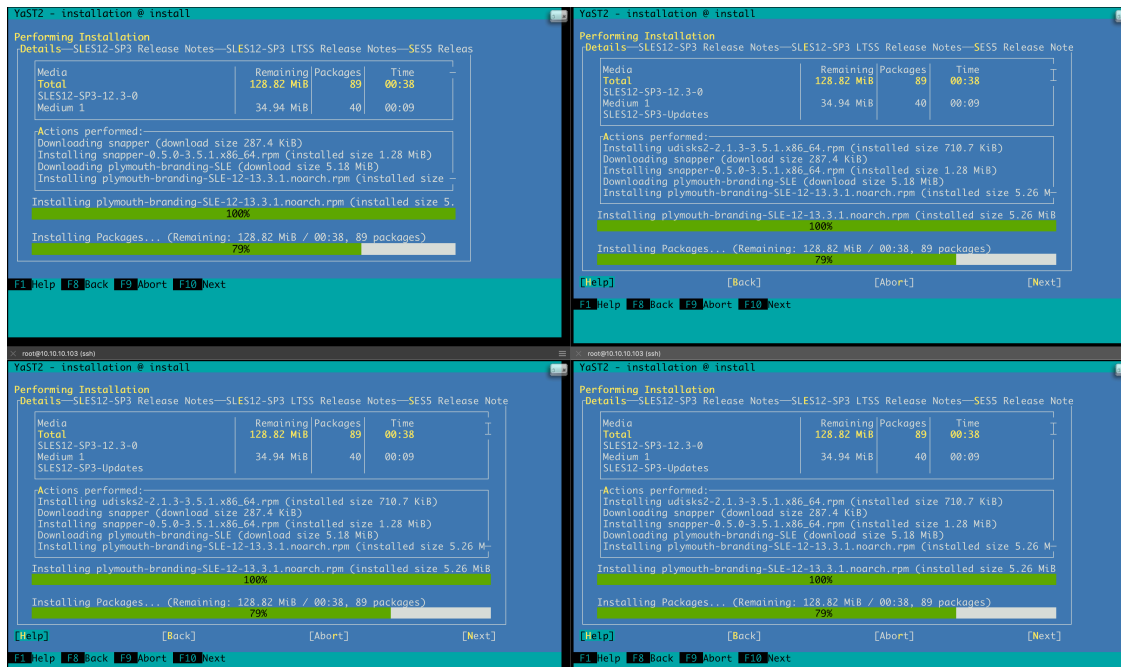
- NTP must be configured on each node:



- Deselect "AppArmor" and the unnecessary "X" and "GNOME" patterns, but select the "SUSE Enterprise Storage" pattern:



- De-activate the firewall on the nodes.
- Start the installation on all nodes:



- When the nodes have rebooted, log in and finish the network/host name and NTP configurations, so that `hostname -f` returns the FQDN of the nodes, and `ntpq -p` returns a stratum less than 16:

```

root@10.10.10.103 (ssh)
ses55-admin:~ # hostname -f
ses55-admin.suse-sap.net
ses55-admin:~ # ntpq -p
-----
remote      refid      st t when poll reach  delay  offset jitter
-----
*194.169.214.72 145.238.203.14 2 u 58 64 3 157.477 62.071 31.448
ses55-admin:~ #

root@10.10.10.103 (ssh)
ses55-osd0:~ # hostname -f
ses55-osd0.suse-sap.net
ses55-osd0:~ # ntpq -p
-----
remote      refid      st t when poll reach  delay  offset jitter
-----
*tor-exit-2.tuixl 188.165.236.162 3 u 21 64 377 159.973 0.114 1.569
ses55-osd0:~ #

root@10.10.10.103 (ssh)
ses55-osd1:~ # hostname -f
ses55-osd1.suse-sap.net
ses55-osd1:~ # ntpq -p
-----
remote      refid      st t when poll reach  delay  offset jitter
-----
*villiska.muku 85.199.214.98 2 u 19 64 377 170.462 0.034 1.475
ses55-osd1:~ #

root@10.10.10.103 (ssh)
ses55-osd2:~ # hostname -f
ses55-osd2.suse-sap.net
ses55-osd2:~ # ntpq -p
-----
remote      refid      st t when poll reach  delay  offset jitter
-----
*megaman.thican 91.121.7.182 3 u 26 64 37 178.548 -1.466 3.290
ses55-osd2:~ #

```

- Using `ssh-keygen` then `ssh-copy-id`, spread your SUSE Enterprise Storage Admin node `ssh` public key to all other nodes.
- Verify that the drives we will allocate for SUSE Enterprise Storage OSDs are clean by wiping them. Refer to 4.3.12 of the Deployment guide: [Wipe disk \(https://documentation.suse.com/ses/5.5/html/ses-all/ceph-install-saltstack.html#ceph-install-stack\)](https://documentation.suse.com/ses/5.5/html/ses-all/ceph-install-saltstack.html#ceph-install-stack)
- On all nodes, including the Admin Node, install `salt-minion`.
- On the Admin Node only (in our example, `ses55-admin.suse-sap.net`), also install `salt-master` and `deepsea`.
- Then, restart `salt-minion` on all nodes, and restart `salt-master` on the Admin Node:

```

root@10.10.10.103 (ssh)
Refreshing service 'SUSE_Enterprise_Storage_5_x86_64'.
Refreshing service 'SUSE_Linux_Enterprise_Server_12_SP3_x86_64'.
Loading repository data...
Reading installed packages...
Forcing installation of 'salt-master-2016.11.4-48.7.1.x86_64' from repository 'SUSE-Enterprise-Storage-5-Updates'.
Resolving package dependencies...

The following package is going to be reinstalled:
  salt-master

1 package to reinstall.
Overall download size: 1.7 MiB. Already cached: 0 B. No additional space will be used or freed after the operation.
Continue? [y/n/...? shows all options] (y): y
Retrieving package salt-master-2016.11.4-48.7.1.x86_64
(1/1), 1.7 MiB ( 1.6 MiB unpacked)
Retrieving: salt-master-2016.11.4-48.7.1.x86_64.rpm .....[done]

Checking for file conflicts: .....[done]
(1/1) Installing: salt-master-2016.11.4-48.7.1.x86_64 .....[done]
ses55-admin:~/SES-scripts # systemctl restart salt-minion.service
ses55-admin:~/SES-scripts # systemctl restart salt-master.service
ses55-admin:~/SES-scripts #

root@10.10.10.103 (ssh)
ses55-osd0:~ # systemctl restart salt-minion.service
ses55-osd0:~ #

root@10.10.10.103 (ssh)
ses55-osd1:~ # systemctl restart salt-minion.service
ses55-osd1:~ #

root@10.10.10.103 (ssh)
ses55-osd2:~ # systemctl restart salt-minion.service
ses55-osd2:~ #

```

- Accept the related pending Salt keys:

```
Admin:~ # salt-key -L
Accepted Keys:
admin.example.com
mon1.example.com
mon2.example.com
mon3.example.com
Denied Keys:
Unaccepted Keys:
Rejected Keys:
```

- Verify that `/srv/pillar/ceph/master_minion.sls` points to your Admin Node. In our example, it contains the FQDN of our `salt-master`:  
`master_minion: ses55-admin.suse-sap.net`
- Prepare the cluster:

```
# salt-run state.orch ceph.stage.0
```

```

Parsing orchestration ceph.stage.prep steps... []
Parsing ceph.stage.prep steps... ✓

[1/17]  ceph.salt.crc.master on
admin.example.com..... ✓ (0.5s)

[2/17]  ceph.sync on
admin.example.com..... ✓ (0.8s)

[3/17]  ceph.salt-api on
admin.example.com..... ✓ (18s)

[4/17]  ceph.repo on
admin.example.com..... ✓ (0.3s)

[5/17]  ceph.metapackage on
admin.example.com..... ✓ (0.5s)

[6/17]  ceph.updates on
admin.example.com..... ✓ (10s)

[7/17]  filequeue.remove(item=lock)..... ✓ (0.0s)

[8/17]  filequeue.enqueue(item=complete)..... ✓ (0.0s)

[9/17]  minions.ready(timeout=300)..... ✓ (0.3s)

[10/17] ceph.salt.crc.minion on
admin.example.com..... ✓ (1s)
mon1.example.com..... ✓ (1s)
mon3.example.com..... ✓ (1s)
mon2.example.com..... ✓ (2s)

[11/17] ceph.apparmor on
admin.example.com..... ✓ (14s)
mon1.example.com..... ✓ (12s)
mon3.example.com..... ✓ (13s)
mon2.example.com..... ✓ (13s)

[12/17] ceph.repo on
admin.example.com..... ✓ (0.4s)
mon1.example.com..... ✓ (0.5s)
mon3.example.com..... ✓ (0.4s)
mon2.example.com..... ✓ (0.4s)

[13/17] ceph.metapackage on
admin.example.com..... ✓ (0.5s)
mon1.example.com..... ✓ (0.6s)
mon3.example.com..... ✓ (0.6s)
mon2.example.com..... ✓ (0.6s)

[14/17] ceph.packages.common on
admin.example.com..... ✓ (28s)
mon1.example.com..... ✓ (65s)
mon3.example.com..... ✓ (69s)
mon2.example.com..... ✓ (69s)

[15/17] ceph.sync on
admin.example.com..... ✓ (2s)
mon1.example.com..... ✓ (3s)
mon3.example.com..... ✓ (2s)
mon2.example.com..... ✓ (2s)

[16/17] ceph.mines on
admin.example.com..... ✓ (0.7s)
mon1.example.com..... ✓ (0.8s)
mon3.example.com..... ✓ (0.8s)
mon2.example.com..... ✓ (0.7s)

[17/17] ceph.updates on
admin.example.com..... ✓ (10s)
mon1.example.com..... ✓ (13s)
mon3.example.com..... ✓ (13s)
mon2.example.com..... ✓ (13s)

Ended stage: ceph.stage.prep succeeded=17/17 time=199.7s

```



- Collect information about the nodes:

```
# salt-run state.orch ceph.stage.1
```

```
Parsing orchestration ceph.stage.discovery steps... []
Parsing ceph.stage.discovery steps... ✓

[1/3] minions.ready(timeout=300)..... ✓ (0.4s)
[2/3] ceph.refresh on
      admin.example.com..... ✓ (0.5s)
[3/3] populate.proposals..... ✓ (5s)

Ended stage: ceph.stage.discovery succeeded=3/3 time=12.7s
```

- Adapt the file `/srv/pillar/ceph/proposals/policy.cfg` to your needs. In our example, where the only deployed service is OpenAttic, it contains the following:

```
cluster-ceph/cluster/ses55-osd2.suse-sap.net.sls
config/stack/default/ceph/cluster.yml
config/stack/default/global.yml
profile-default/cluster/ses55-admin.suse-sap.net.sls
profile-default/cluster/ses55-osd0.suse-sap.net.sls
profile-default/cluster/ses55-osd1.suse-sap.net.sls
profile-default/cluster/ses55-osd2.suse-sap.net.sls
profile-default/stack/default/ceph/minions/ses55-admin.suse-sap.net.yml
profile-default/stack/default/ceph/minions/ses55-osd0.suse-sap.net.yml
profile-default/stack/default/ceph/minions/ses55-osd1.suse-sap.net.yml
profile-default/stack/default/ceph/minions/ses55-osd2.suse-sap.net.yml
role-admin/cluster/ses55-admin.suse-sap.net.sls
role-admin/cluster/ses55-osd0.suse-sap.net.sls
role-admin/cluster/ses55-osd1.suse-sap.net.sls
role-admin/cluster/ses55-osd2.suse-sap.net.sls
role-master/cluster/ses55-admin.suse-sap.net.sls
role-mgr/cluster/ses55-osd0.suse-sap.net.sls
role-mgr/cluster/ses55-osd1.suse-sap.net.sls
role-mgr/cluster/ses55-osd2.suse-sap.net.sls
role-mon/cluster/ses55-osd0.suse-sap.net.sls
role-mon/cluster/ses55-osd1.suse-sap.net.sls
role-mon/cluster/ses55-osd2.suse-sap.net.sls
role-openattic/cluster/ses55-admin.suse-sap.net.sls
```

- Prepare the final state of configuration files set:

```
# salt-run state.orch ceph.stage.2
```

```

Parsing orchestration ceph.stage.configure steps... [ ]
Parsing ceph.stage.configure steps... ✓

Stage initialization output:
deepsea_minions      : valid
yaml_syntax          : valid

[1/15]  push.proposal..... ✓ (0.0s)
[2/15]  ceph.refresh on
        mon1.example.com..... ✓ (2s)
        admin.example.com..... ✓ (1s)
        mon2.example.com..... ✓ (1s)
        mon3.example.com..... ✓ (2s)
[3/15]  advise.networks..... ✓ (0.6s)
[4/15]  ceph.packages on
        mon1.example.com..... ✓ (53s)
        admin.example.com..... ✓ (34s)
        mon2.example.com..... ✓ (58s)
        mon3.example.com..... ✓ (57s)
[5/15]  ceph.admin.key on
        admin.example.com..... ✓ (0.6s)
[6/15]  ceph.osd.key on
        admin.example.com..... ✓ (0.4s)
[7/15]  ceph.mon.key on
        admin.example.com..... ✓ (0.4s)
[8/15]  ceph.mgr.key on
        admin.example.com..... ✓ (2s)
[9/15]  ceph.igw.key on
        admin.example.com..... ✓ (0.9s)
[10/15] ceph.mds.key on
        admin.example.com..... ✓ (0.8s)
[11/15] ceph.rgw.key on
        admin.example.com..... ✓ (2s)
[12/15] ceph.ganesha.key on
        admin.example.com..... ✓ (0.8s)
[13/15] ceph.monitoring.prometheus.exporters.node_exporter on
        mon1.example.com..... ✓ (68s)
        admin.example.com..... ✓ (41s)
        mon2.example.com..... ✓ (69s)
        mon3.example.com..... ✓ (64s)
[14/15] ceph.ssl on
        admin.example.com..... ✓ (0.7s)
[15/15] ceph.ssl.distribute_ca on
        admin.example.com..... ✓ (1s)

Ended stage: ceph.stage.configure succeeded=15/15 time=146.0s

```

- You can now safely deploy your configuration:

```
# salt-run state.orch ceph.stage.3
```

```

Parsing orchestration ceph.stage.deploy steps... [ ]
Parsing ceph.stage.deploy steps... ✓

Stage initialization output:
firewall           : not installed
apparmor           : disabled
fsid               : valid
public_network     : valid
public_interface   : valid
cluster_network    : valid
cluster_interface  : valid
ip_version         : valid
monitors           : valid
subvolume          : valid
mgrs               : valid
storage            : valid
storage_role       : valid
rgw                : valid
ganesha            : valid
master_role        : valid
time_server        : valid
fqdn               : valid

[1/51] ceph.time on
mon3.example.com..... ✓ (43s)
admin.example.com..... ✓ (0.5s)
mon2.example.com..... ✓ (47s)
mon1.example.com..... ✓ (47s)

[2/51] ceph.configuration.check on
admin.example.com..... ✓ (0.3s)

[3/51] ceph.configuration.create on
admin.example.com..... ✓ (5s)

[4/51] ceph.configuration on
mon3.example.com..... ✓ (0.6s)
admin.example.com..... ✓ (0.5s)
mon2.example.com..... ✓ (0.5s)
mon1.example.com..... ✓ (0.6s)

[50/51] ceph.monitoring.prometheus.exporters.mgr_exporter on
admin.example.com..... ✓ (0.9s)

[51/51] ceph.monitoring.prometheus.exporters.rbd_exporter on
admin.example.com..... ✓ (18s)

Ended stage: ceph.stage.deploy succeeded=51/51 time=302.0s

```

- When Stage 3 has completed successfully, check the cluster’s health to ensure that everything is running properly:

```
# ceph -s
```

```
ses55-admin:~ # ceph -s
cluster:
  id:          520a906e-e6a3-324f-ba18-856c2e155395
  health: HEALTH_OK

services:
  mon: 3 daemons, quorum ses55-osd0,ses55-osd1,ses55-osd2
  mgr: ses55-osd0(active), standbys: ses55-osd1, ses55-osd2
  osd: 16 osds: 16 up, 16 in

data:
  pools:   0 pools, 0 pgs
  objects: 0 objects, 0B
  usage:   16.1GiB used, 302GiB / 318GiB avail
  pgs:     
```

- To get the benefits of the OpenAttic WebUI, you must now initiate `ceph.stage.4`, which will install the OpenAttic service:

```
# salt-run state.orch ceph.stage.4
```

```

Parsing orchestration ceph.stage.services steps... []
Parsing ceph.stage.services steps... ✓

Stage initialization output:
No minions matched the target. No command was sent, no jid was assigned.
kernel_module      : valid
openattic-disabled  : valid

[1/17]  ceph.rgw.auth on
admin.example.com..... ✓ (4s)

[2/17]  ceph.rgw.users on
admin.example.com..... ✓ (34s)

[3/17]  ceph.rgw.dashboard on
admin.example.com..... ✓ (5s)

[4/17]  ceph.rgw on
mon3.example.com..... ✓ (79s)
admin.example.com..... ✓ (23s)
mon2.example.com..... ✓ (78s)
mon1.example.com..... ✓ (69s)

[5/17]  ceph.monitoring.prometheus.exporters.ceph_rgw_exporter on
admin.example.com..... ✓ (31s)

[6/17]  ceph.wait on
admin.example.com..... ✓ (7s)

[7/17]  ceph.processes.rgw on
mon3.example.com..... ✓ (0.5s)
admin.example.com..... ✓ (0.5s)
mon2.example.com..... ✓ (0.5s)
mon1.example.com..... ✓ (0.4s)

[8/17]  ceph.rgw.restart on
admin.example.com..... ✓ (3s)

[9/17]  ceph.wait on
admin.example.com..... ✓ (6s)

[10/17] ceph.processes.rgw on
mon3.example.com..... ✓ (0.4s)
admin.example.com..... ✓ (0.4s)
mon2.example.com..... ✓ (0.5s)
mon1.example.com..... ✓ (0.4s)

[11/17] ceph.rgw.restart on
mon1.example.com..... ✓ (3s)

[12/17] ceph.wait on
admin.example.com..... ✓ (7s)

[13/17] ceph.processes.rgw on
mon3.example.com..... ✓ (0.4s)
admin.example.com..... ✓ (0.5s)
mon2.example.com..... ✓ (0.4s)
mon1.example.com..... ✓ (0.5s)

[14/17] ceph.rgw.restart on
mon2.example.com..... ✓ (3s)

[15/17] ceph.wait on
admin.example.com..... ✓ (7s)

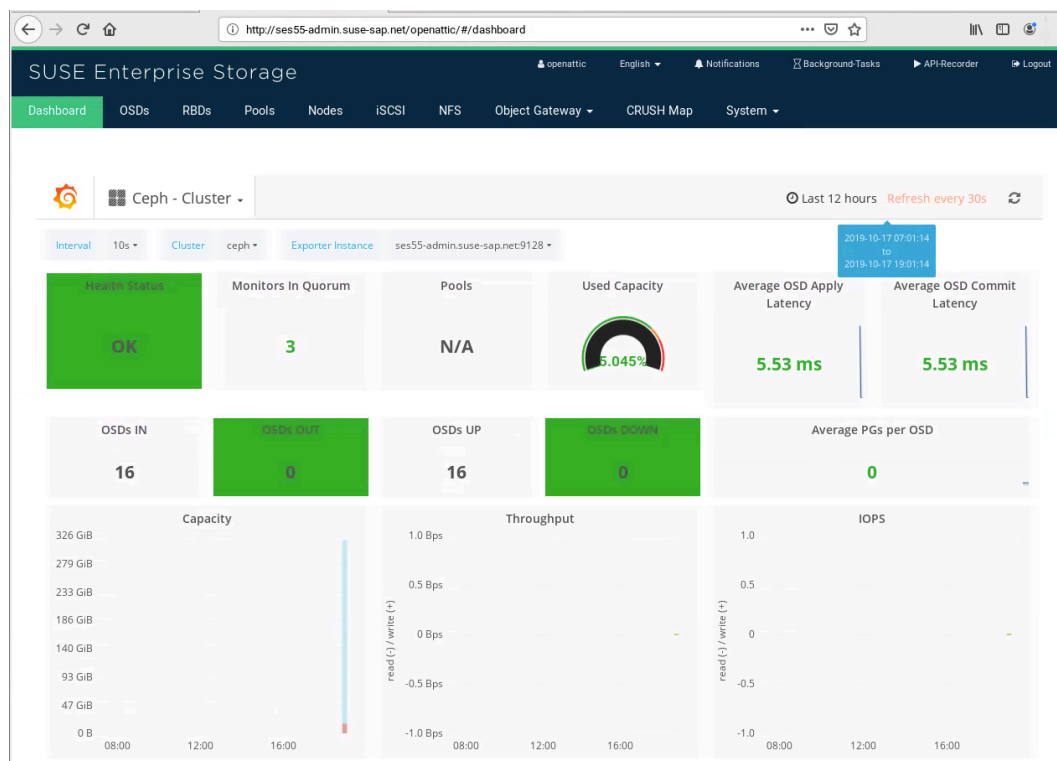
[16/17] ceph.processes.rgw on
mon3.example.com..... ✓ (0.8s)
admin.example.com..... ✓ (0.6s)
mon2.example.com..... ✓ (0.7s)
mon1.example.com..... ✓ (0.7s)

[17/17] ceph.rgw.restart on
mon3.example.com..... ✓ (3s)

Ended stage: ceph.stage.services succeeded=17/17 time=206.8s

```

- You can now manage your cluster through the WebUI:



- To provide a Data Hub RBD device, you first need to create a related pool:

← → ↻ 🏠 <http://ses55-admin.suse-sap.net/openattic/#/> ... 🛡️ ☆ 📄 📄 📄 ☰

SUSE Enterprise Storage openattic English Notifications Background-Tasks API-Recorder Logout

Dashboard OSDs RBDs Pools Nodes iSCSI NFS Object Gateway

CRUSH Map System

Ceph Pools » Add

### Create Ceph pool: sapdh26

**Name \***

**Pool type \***

**Crush ruleset \***   
[Size](#) [Steps](#)

**Replicated size \***     
 Minimum: 1 Maximum: 10

**Placement groups \***     
[Calculation help](#)

#### Compression

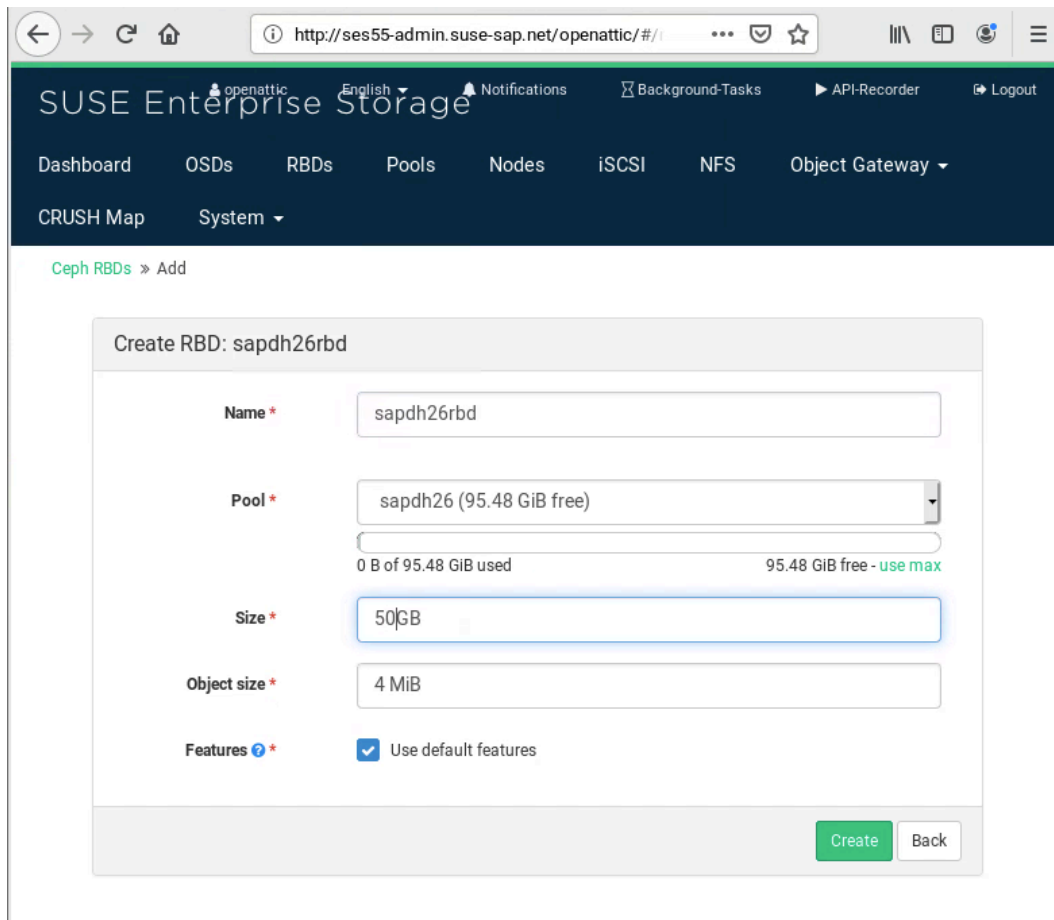
**Mode \***

#### Applications

**Add applications**

**Applications \***

- Then provide access to this pool through an RBD device:



You can now go to [Section 4.1.2, "Prerequisites on the SUSE CaaS Platform 4 cluster"](#) and follow the prerequisites for a SUSE CaaS Platform Cluster.

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